



**National
Institute for
Commodity
Promotion
Research &
Evaluation**

October 1996
NICPRE 96-06
R.B. 96-14

An Economic Analysis of Generic Egg Advertising in California, 1985-1995

by

**Todd M. Schmit
J. Carlos Reberte
and
Harry M. Kaiser**

Department of Agricultural, Resource, and Managerial Economics
College of Agriculture and Life Sciences
Cornell University, Ithaca, New York 14853

The National Institute For Commodity Promotion Research and Evaluation

The National Institute for Commodity Promotion Research and Evaluation was initially funded by a CSRS Special Grant in April 1994. The Institute is an offshoot of The Committee on Commodity Promotion Research (NEC-63). A component of the Land Grant committee structure to coordinate research in agriculture and related fields, NEC-63 was established in 1985 to foster quality research and dialogue on the economics of commodity promotion.

The Institute's mission is to enhance the overall understanding of economic and policy issues associated with commodity promotion programs. An understanding of these issues is crucial to ensuring continued authorization for domestic checkoff programs and to fund export promotion programs. The Institute supports specific research projects and facilitates collaboration among administrators and researchers in government, universities, and commodity promotion organizations. Through its sponsored research and compilations of related research reports, the Institute serves as a centralized source of knowledge and information about commodity promotion economics.

The Institute is housed in the Department of Agricultural, Resource, and Managerial Economics at Cornell University in Ithaca, New York as a component of the Cornell Commodity Promotion Research Program.

Institute Objectives

- Support, coordinate, and conduct studies to identify key economic relationships and assess the impact of domestic and export commodity promotion programs on farmers, consumers, and the food industry.
- Develop and maintain comprehensive databases relating to commodity promotion research and evaluation.
- Facilitate the coordination of multi-commodity and multi-country research and evaluation efforts.
- Enhance both public and private policy maker's understanding of the economics of commodity promotion programs.
- Facilitate the development of new theory and research methodology.

An Economic Analysis of Generic Egg Advertising in California, 1985-1995

Todd M. Schmit, J. Carlos Reberte, and Harry M. Kaiser*

Executive Summary

Since 1984, the California Egg Commission (CEC) has financed egg advertising, promotion, education, and research aimed at increasing egg and egg product consumption and enhancing returns for California egg producers. The CEC has an annual budget of about \$4 million, raised through assessing egg handlers \$.01 per dozen shell eggs sold within the state. Over \$3 million of this budget has been spent on generic egg advertising. The purpose of this study was to measure the impact of generic egg advertising in California on producer prices and net revenue from 1985 through 1995.

To measure the impact of advertising, an econometric model describing supply and demand for California eggs was estimated. Changes in various factors over time effect both the supply and demand for eggs. For instance, the following variables were hypothesized to impact quarterly egg production in the state from 1985-95: producer price of eggs, size of laying flock, feed price, layer productivity, seasonality variables, and a general trend variable to account for changes in the structure of the California egg industry since 1985. Likewise, the following variables were hypothesized to impact quarterly egg prices in California over this period: egg consumption, price of egg substitutes, consumer income, proportion of women in the labor force, seasonality variables, a general trend term, and generic egg advertising expenditures. To estimate the net impact of each of the variables on egg supply and price, an econometric supply and demand model was estimated with quarterly data for these variable from 1985-95. Econometric models are advantageous because they are able to measure the impact of how changes in supply and/or demand factors cause supply or demand to change. That is, the estimated model measures the percentage change in egg production and price due to a 1 percent change in each of the supply and demand determinants listed above. The key demand variable of interest in this study is generic advertising in the state, which is measured by monthly advertising expenditure levels.

The econometric model was then used to simulate the impact on producer prices and returns of two advertising scenarios. The first scenario simulated quarterly egg production, prices, and net revenue from 1985-95 with generic egg advertising

* The authors are, respectively, research support specialist, research associate, and associate professor in the Department of Agricultural, Resource, and Managerial Economics at Cornell University. Funding for this study was provided by the California Egg Commission, the American Egg Board, and the National Institute for Commodity Promotion Research and Evaluation. The authors thank Jennifer Ferrero for technical editing and layout for this paper.

expenditures set to historical levels. The second scenario was the same as the first, except generic egg advertising expenditures were increased in each quarter by 1 percent. A comparison of these two scenarios provides a measure of the marginal impacts of generic egg advertising, e.g., how does producer net revenue change given a 1 percent increase in egg advertising expenditure. From the simulations, a rate of return, which gives the ratio of the benefits to costs of generic egg advertising, can be computed. In this case, the benefit of egg advertising is the increase in net revenue to producers due to the 1 percent increase in advertising expenditure, while the cost is the 1 percent increase in advertising.

The results of the econometric model indicate that the supply and demand variable explained over 90 percent and 86 percent of the variation in egg production and egg prices, respectively, from 1985-95, which is reasonable for econometric models. Furthermore, based on a dynamic, in-sample simulation, the model had relatively low errors in predicting producer prices (2.1 percent error), production (0.5 percent error), and consumption (2.0 percent error). Thus, the accuracy of the model was deemed sufficient for simulation purposes. As expected, a positive relationship was found between producer prices and production, layer productivity and production, and layer numbers and production. A negative relationship was found between feed prices and production and the general trend term and production. The two most important factors affecting production were productivity and layer numbers. With regards to the demand model, positive relationships were found between egg prices and the price of meat, consumer income, percent of women in the labor force, and generic egg advertising. The price of meat was included as a measure for the effect of egg substitutes on egg price, while the percent of women in the labor force was included because prior studies have shown us this percentage increase causes the demand and price of eggs to increase. A negative relationship was found between egg consumption and egg price, and the general trend farm and egg prices.

Money spent on generic egg advertising had a positive and statistically significant impact on egg prices over the ten year period. The model indicated that a 1 percent increase in advertising expenditure resulted in an average increase of 0.13 percent in the producer egg price, holding all other demand factors constant. Furthermore, a 1 percent increase in real advertising expenditures, which is equivalent to \$304,000, resulted in a \$2.1 million increase in producer net revenue over the period, 1985-95. This translates into a marginal rate of return of 7.0 (\$2.1 million divided by \$304,000), i.e., an additional dollar added to existing advertising expenditure levels generated \$7.00 in producer profits. An alternative profitability measure, the internal rate of return (IRR) to advertising, was also computed, and a monthly IRR of 59.3 percent was determined. A program is considered profitable if its IRR exceeds the opportunity cost of the funds invested. In this case, it appears that investing in generic egg advertising provides a relatively high return on investment to California egg producers.

An Economic Analysis of Generic Egg Advertising in California, 1985-1995

Todd M. Schmit, J. Carlos Reberte, and Harry M. Kaiser

Since 1984, the California Egg Commission (CEC) has financed egg advertising, promotion, education, and research aimed at increasing egg consumption and enhancing returns for California egg producers. California is the largest egg producing state in the nation, with over 25 million laying hens producing more than six billion eggs per year -- approximately 10 percent of the national total. The CEC generates revenues for operation of their programs by assessing egg handlers 1¢ per dozen shell eggs sold within the state.¹ The CEC assessment and marketing program operates completely independent of the national program operated by the American Egg Board (AEB). As such, any assessments levied on California producers or handlers are in addition to assessments at the national level.² Eggs sold outside of the state, exported, consumed by the military, or transported to breaking plants within the state for further processing are exempt from assessments under the CEC.

The CEC has an annual budget of about \$4 million. Approximately 90 percent of this budget is directed towards advertising, public relations, promotion, and education and research purposes, with media advertising comprising the largest share. Annual expenditures for advertising have consistently been over \$3 million, with approximately 80 percent in the form of media advertising and the remaining 20 percent corresponding to the production

¹Producers handling less than 26,000 cases of eggs (or liquid equivalent) per year are exempt from the assessment. There are currently nineteen exempt handlers, but their combined marketings constitute less than 2 percent of the total volume handled. Starting in 1993, separate assessments were also levied on distributors of eggs and egg products produced outside of the state and imported within California. Assessments on egg products are based on a thirty-eight pound liquid equivalent weight of 30-dozen eggs (one case) and is currently at 7¢ per case, with a mandatory limit of 30¢. The CEC producer assessment currently averages approximately 2 percent of farm prices.

²Since February 1995, producers with more than 75,000 laying hens pay a mandatory national assessment of 10¢ per 30 dozen case. Prior to this, the assessment was 5¢ and applied to producers with more than 30,000 laying hens.

costs of advertising. Since 1985, CEC advertising expenditures have totaled more than \$37 million.

Figure 1 displays per capita egg consumption in California from 1985 to 1995. Between 1985 and mid-1995, quarterly consumption of eggs and egg products dropped from 66 eggs to 48 eggs, but has increased since then to its current level of nearly 54 eggs. This represents an 18 percent decrease in consumption and compares to a decrease at the national level of approximately 10 percent. The downward trend in the demand for eggs has been attributed to the abundance of information surrounding heart disease and cholesterol intake. For this reason, much of the past generic advertising has been developed under a defensive strategy to counter negative publicity. Relative to consumption, producer prices have been much more variable. As Figure 2 indicates, real producer prices for eggs have generally trended downward over this period, even though prices reversed the trend in late 1988, and actually increased in 1990. After 1990, prices have trended downward, with a slight increase in both prices and consumption since late 1994.

Given the slow, yet steady decline in per capita egg consumption and producer prices, an evaluation of the effectiveness of generic egg promotion in California is both timely and important. Accordingly, the purpose of this study was to measure the impact of generic egg advertising in California on producer prices and net revenue over the period 1985 to 1995. To measure these impacts, an econometric model describing the supply and demand for California eggs was estimated. The estimated model was then used to simulate the impact of two advertising scenarios on producer prices, production, and net revenues for the 1985 through 1995 period. In the first scenario generic egg advertising expenditures were set equal to historical levels, while in the second scenario expenditures were increased by 1 percent. Based on the simulation results, the marginal rate of return to advertising expenditures (i.e., benefits to costs of additional generic advertising) was computed.

Previous Research

While various egg price forecasting models and egg industry models were common in the 1970s and 1980s (e.g., Miller and Masters, 1973; Roy and Johnson, 1973; Salathe, et. al., 1983; Chavas and Johnson, 1981; and Blaylock and Burbee, 1985), little research has focused on the impact of generic advertising on farm level prices and per capita consumption. Chavas and Johnson (1981) provide the most detailed model of the egg industry in the literature, encompassing estimation of production, consumption, and storage components. Brown and Schrader (1990) estimated an econometric model for the egg industry and found that information on the links between cholesterol and heart disease had a significant negative impact on consumer demand for eggs. However, the effectiveness of generic advertising to maintain consumption levels was not addressed in either of these studies.

Generic egg advertising has been studied more recently by McCutcheon and Goddard (1992) and Chyc and Goddard (1994); however these studies dealt with the Canadian supply-managed egg sector where imports and egg production are restricted to maintain producer prices. Although evaluation of advertising in light of government intervention is more problematic, both studies were able to determine that generic egg advertising had a positive impact on demand.

The only recent study to examine generic egg advertising impacts in the United States is Reberte, Schmit and Kaiser (1996), who estimated a comprehensive model of the U.S. egg sector, including production and consumption equations for both whole and processed egg products. Although similar in form to Chavas and Johnson, the model incorporated national AEB advertising expenditures since 1990. Advertising was shown to significantly influence farm prices, and ultimately producer net revenues.

The Conceptual Model

The production of eggs is a fairly straightforward process. Approximately five months after the initial placement of chicks into the hatchery supply flock, hens are released into the laying flock. The laying process lasts from twelve to fourteen months when the hens are either slaughtered or forced molted. In the later case, the hens receive a two month rest before resuming the laying cycle in the production flock. Therefore, the following variables are specified as determinants of California egg production:

$$(1) \quad PROD = f(PEGG_{-1}, FEED_{-1}, LAY, PTVTY, QTR1, QTR2, QTR3, TIME) \quad ,$$

where *PROD* is the production of eggs in California, *PEGG_t* is the real producer price for large eggs in Southern California lagged one quarter³, *FEED_t* is the real feed price in Southern California lagged one quarter, *LAY* is a four quarter moving average of the size of the California laying flock, *PTVTY* is the average layer productivity for the quarter, *QTR1*, *QTR2*, and *QTR3* are quarterly dummy variables to account for seasonal variation in supply, and *TIME* is a time trend as a proxy for structural change. Lagged producer prices reflect a delay in farmers' production response to a current change in price. Feed costs are for "typical" feed at delivered net prices in Southern California.⁴ Egg prices and production costs were obtained from the CEC for the time period evaluated (Bell, 1996).

The demand for California eggs is modeled in price dependent form, which means that changes in the demand for eggs is reflected through changes in the price of eggs since the market volume of eggs is fixed in the short run. The following variables are specified as

³All monetary measures (except advertising expenditures) in the supply and demand equations were deflated by the Consumer Price Index for the Western Region of the United States (1982-84=100). Generic advertising expenditures were deflated by the Media Cost Index provided by Leo Burnett Media.

⁴"Typical" refers to a feed mixture of corn and soybean meal in approximately a 85/15 blend ratio. Feed price is measured in real dollars per hundred-weight (\$/cwt.).

demand determinants: farm egg demand, income, price of substitutes, generic advertising, a time trend, three quarterly dummy variables, and the percentage of women in the labor force. The level of farm egg demand should be negatively related with egg prices, while consumer income, price of egg substitutes, and generic advertising should be positively related to egg prices. The price of egg substitutes is represented in the model by a composite retail price index for meat for the Western Region. The time trend is included to represent changes in consumers' tastes and preferences for eggs over the last ten years.⁵

Similar to Reberte, Schmit, and Kaiser (1996) and Brown and Schrader (1990), the percentage of women in the labor force was included in the demand equation. Conflicting views exist regarding the relationship of this variable with egg consumption. On one hand, Stillman (1987) suggests a negative relationship since as more women work outside the home, less time is available to prepare eggs for breakfast. On the other hand, Brown and Schrader (1990) assert that as the number of working women increase, so does the number of breakfasts eaten away from home, which may increase overall egg consumption.

Following virtually every previous empirical study on generic advertising evaluations, the advertising effort was measured in terms of advertising expenditures. As mentioned earlier, the AEB advertising and promotion program operates independently of CEC advertising efforts. AEB and CEC advertising expenditures were converted to a per capita basis and then added to account for all advertising in California. Although actual per capita advertising expenditures may be higher or lower in California than at the national level, the approach followed here should provide a reasonable approximation. Average quarterly advertising expenditures in California per 100 people from 1985 to 1995 were \$2.46. Of this

⁵Consumer demand is included as an identity in the model as farm production less net exports. This allows the use of producer price levels in both equations and production defined as farm-level demand.

amount, \$2.31 -- nearly 94 percent -- was obtained from CEC expenditures. Both total and per capita CEC advertising expenditures are detailed in Figure 3.

Two cholesterol indexes were separately included in preliminary estimations, however neither was incorporated into the final specification due to poor performance and unexpected signs. The first index was constructed by Ward (1992) based on national survey data, and measures the percentage of consumers expressing strong or moderate concern about cholesterol in their diets. The second index was constructed similar to the one in McGuirk, et. al. (1995), and measures the number of articles dealing with dietary cholesterol issues in national publications.⁶ Both Brown and Schrader (1990) and McGuirk, et al. (1995) found a negative and significant relationship between cholesterol “concern” and consumption of eggs and meat, respectively. However, both studies were evaluated from the late 1960s to the late 1980s, a time period which demonstrated a definitive increase in dietary cholesterol concern, and ended prior to the decline in concern as distinguished in both the Ward survey index and publication index developed for this study. Both indexes suggest relatively low awareness in the mid-1980s, peaking in the late-1980s and early-1990s, and decreasing steadily since. To the extent that dietary cholesterol concern can be viewed as a structural change in the demand for eggs, its impact should be captured by the time trend.

Based on the above discussion, the demand for eggs in California was modeled as the following equation:

$$(2) \quad PEGG = g(\text{PROD}, \text{PMEAT}, \text{INC}, \text{ADV}, \text{QTR1}, \text{QTR2}, \text{QTR3}, \text{TIME}, \text{WOMEN}) \quad ,$$

⁶The publication index was constructed by counting the number of articles each month regarding nutritional impacts of dietary cholesterol reported in the *Reader's Guide to Periodical Literature* from 1985 through 1995. The index was weighted by the circulation levels of the various magazines and converted to a quarterly basis for inclusion in the model.

where *PEGG* is the real producer price for large eggs in Southern California, *PROD* is farm-level production in California available for state consumption and net exports,⁷ *PMEAT* is the real retail price index for meat in the Western Region of the U.S., *INC* represents real disposable income per capita in California, *ADV* represents per capita generic egg advertising expenditures in California, *QTR1*, *QTR2*, and *QTR3* are quarterly dummy variables to account for seasonal variation, *TIME* is a time trend, and *WOMEN* is the proportion of women employed in the labor force.

Econometric Results

Both the supply and demand equations were specified on a per capita basis, using a double log functional form (Table 1). The model was estimated using quarterly data from 1985 through June 1995. Autocorrelation correction procedures were used to estimate these equations since autocorrelation was detected.

The variables in the egg supply equation explained over 90 percent of the variation in production and all variables had expected signs. As expected, there exists a positive relationship between producer prices and production; however, the magnitude of this relationship is rather small. To measure the magnitude, economists use a measure called an "elasticity," which gives the percentage change in production given a one percent change in each of the determinants of production. In this case, the elasticity of supply with respect to the producer price is only 0.009, which means that a one percent increase in producer prices leads to a 0.009 percent increase in per capita production. This finding may not be surprising given the biological and economic constraints that limit production adjustments (Salathe, et. al., 1983). Layer number and productivity are also found to have a positive effect on

⁷Consumer demand is represented by the civilian disappearance of eggs (production + imports - exports - military use) as calculated and provided by the CEC and is included as an identity in the model such that total supply equals total demand either through civilian consumption or net exports and military use.

production. Moreover, these two variables have the largest impact on production. The elasticity of supply with respect to layer numbers is 0.61, which means a one percent increase in layer numbers leads to a 0.61 percent increase in egg production, while the elasticity of supply with respect to productivity is 0.73, which means a one percent increase in productivity leads to a 0.73 percent increase in egg production. Lagged feed prices were negatively related to production and exhibited a fairly inelastic response (-0.04). The negative signs on the three seasonal dummy variables suggest production is highest in the fourth quarter. Finally, given the steady decline in per capita production over the time period evaluated, the negative trend variable is not unexpected.

Variables in the demand equation explained 86 percent of the variation in producer prices and all variables had expected signs. Unlike previous studies, however, the elasticity of demand with respect to the egg price is much larger. Our results indicate that a one percent increase in egg prices leads to a 1.7 percent decrease in farm-level egg demand. This result differs from the results of two earlier studies by Brown and Schrader (1990) and Chavas and Johnson (1981), who calculated price elasticities of -0.17 and -0.34, respectively. The more elastic results found here are likely due to two factors. First, demand for eggs may have become more price elastic in the past several years due to heightened concern over cholesterol. Second, retail prices for eggs in California were over 40 percent higher on average than the national average over the sample period, and hence it is reasonable to expect a higher elasticity in California.

The positive and statistically significant coefficient on the meat price index indicates red meats are substitute products for eggs. Similar to other studies (i.e. Chavas and Johnson, 1981; and Brown and Schrader, 1990) both cross-price and income parameters show inelastic responses to price. Specifically, we found that a one percent increase in the retail price of red meat leads to a 5.0 percent increase in egg prices holding all other demand factors constant.

Consumer income is also an important determinant of egg demand, with a one percent increase in real income resulting in a 13.1 percent increase in egg prices. Farm-level egg demand is higher in the fourth quarter which may be due in large part to the holiday season. Not surprisingly, given the steady decline in consumption since 1985, the trend variable displays a negative and statistically significant relationship.

Lagged, as well as current, generic advertising expenditures are included to account for delays in the demand response to advertising (see, for example, Forker and Ward, p. 169). Several lag lengths were considered for up to a full year (four quarters). Based on the significance of the lagged coefficients, three lags were included in the final specification. The estimated coefficients indicate that generic advertising had a positive and statistically significant (at the 10 percent significance level) impact on California per capita egg consumption. The long-run elasticity, obtained by summing the advertising elasticities over all lags, is 0.13. This means that a one percent increase in generic advertising expenditures results in an average increase in the producer egg price of 0.13 percent.

Producer Returns to Advertising

A dynamic, in-sample simulation was conducted to measure how well the model replicated historical values of the three endogenous variables: farm price, production, and consumption. Root Mean Square percentage errors (%RMSE) were computed to measure how predicted values deviated from actual values. The %RMSE's for price, production, and consumption were 2.1 percent, 0.5 percent, and 2.0 percent, respectively. In addition, acceptable MSE decomposition proportions existed for all endogenous variables, with small proportions corresponding to the bias (U^m) and regression (U^r) components and proportions close to one corresponding to the disturbance component (U^d). Thus the model was deemed acceptable for simulation purposes.

While the econometric results indicated that generic egg advertising had a positive impact on price, the bottom-line to California egg producers is the impact on net revenue. In order to ascertain the impact of advertising on producer revenue, the model was simulated under two alternative scenarios: (1) with actual, inflation-adjusted advertising expenditures, and (2) with a 1 percent increase in expenditures. The change in net economic benefits to producers was then computed for each quarter in the sample as the difference in producer revenue, i.e.:

$$(3) \quad \Delta PS_t = \Delta GR_t - \Delta C_t,$$

where ΔPS is the change in producer net revenue for each time period t , ΔGR is the change in gross revenues, and ΔC is the change in production costs. The simulation procedure not only accounts for the production response due to changes in producer prices from advertising, but also accounts for the impact of checkoff assessments on producer costs.⁸ This was accomplished by subtracting the per unit checkoff from producer prices generated through the simulation procedure, and therefore the simulated gross revenues are net of checkoff payments.⁹

The results of this simulation indicated that generic egg advertising had a substantial impact on egg producers' net revenue. A one percent change in real advertising expenditures resulted in a 0.13 percent increase in producer prices.¹⁰ Furthermore, a one percent change

⁸Since the generic advertising programs must also cover overhead costs, they should also be included in the return calculation; however data on these costs are not available. In addition, some assessment revenues are directed towards education, public relations, and research programs but due to data limitations, cannot be directly modeled here.

⁹See Reberte, Schmit, and Kaiser (1996) for a further explanation of this procedure. The model was simulated in SAS using the simulation procedure in PROC MODEL.

¹⁰Similar simulations were run at advertising changes of 10 percent and 50 percent; resulting in percentage increases in average producer prices of 1.2 percent and 5.3 percent, respectively.

in real advertising expenditures, which is equivalent to \$304,000, resulted in a change in producer net revenue of approximately \$2.1 million over the entire sample period. This translates into a marginal rate of return 7.0, i.e. an additional dollar added to existing advertising expenditure levels generated \$7.00 in producer profits. As a means of comparison, Liu et al. (1990) computed a marginal rate of return for the national dairy advertising campaign of 4.8 and Ward (1992) estimated a marginal rate of return for the beef checkoff program of 6.7. This result has two important implications. First, California egg producers are benefiting from generic egg advertising because the benefits exceed the cost of the program. Second, since the marginal benefits of advertising exceed its marginal costs, more money should be spent on advertising California eggs.

Finally, the Internal Rate of Return (IRR) to advertising expenditures was calculated. The IRR method is common in *ex post* evaluation of research projects and it allows ranking of alternative programs in terms of their relative profitability (Alston, Norton, and Pardey, 1995). The procedure is similar to the rate of return method previously discussed; however, here the returns to advertising are calculated by discounting the stream of benefits and costs over time. The IRR to generic advertising is the solution to:

$$(4) \quad 0 = \sum_{t=0}^n \frac{\Delta PS_t - \Delta AE_t}{(1 + IRR)^t}$$

where AE denotes advertising expenditures. Based on the above equation, a monthly IRR of 59.3 percent was generated. A program is considered profitable if its IRR exceeds the opportunity cost of the funds invested.

Summary

A supply and demand econometric model of the California egg industry was estimated to evaluate the impact of generic egg advertising in the state on producer prices and returns over the past ten years. Econometric estimation indicated advertising efforts have had a positive impact on producer prices and net profits. The model was simulated with existing advertising expenditure levels, and with expenditures one percent higher than actual levels. A one percent change in advertising expenditures resulted in an average 0.13 percent increase in producer prices and a marginal rate of return to advertising of 7.0. In other words, each additional dollar spent on advertising generated \$7.00 in producers' profits. The estimated returns to generic egg advertising in California indicate that advertising efforts in the state have been quite profitable.

References

- Alston, J. M., G. W. Norton, and P. G. Pardey. Science Under Scarcity: Principles and Practice for Agricultural Research Evaluation and Priority Setting. Ithaca and London: Cornell University Press, 1995.
- Bell, D. "Southern California Egg Production Costs and Income: 1979-1995." California Egg Commission, Upland, CA. February 1996.
- Blaylock, J., and C. Burbee. "Consumer Demand for Eggs and Market Implications." Economic Research Service, United States Department of Agriculture, Washington, DC. ERS Staff Report No. AGES850924, November 1985.
- Brown, D. J., and L. F. Schrader. "Cholesterol Information and Shell Egg Consumption." *American Journal of Agricultural Economics*, 72(1990): 548-555.
- Chavas, J-P., and S. R. Johnson. "An Economic Model of the US Egg Industry." *Applied Economics*, 13(1981): 321-335.
- Chyc, K. M., and E. W. Goddard. "Optimal Investment in Generic Advertising and Research: The Case of the Canadian Supply-Managed Egg Market." *Agribusiness*, 10(1994): 145-166.
- Forker, O. D., and R. W. Ward. Commodity Advertising: The Economics and Measurement of Generic Programs. New York: Lexington Books, 1993.
- Godfrey, L. G. Misspecification Tests in Econometrics: The Lagrange Multiplier Principle and Other Approaches. New York: Lexington Books, 1993.

- Huang, K. S. and R. C. Haidacer. "Estimation of a Composite Food Demand System for the United States." *Journal of Business and Economic Statistics*, 1(1983): 285-291.
- Liu, D. J., H. M. Kaiser, O. D. Forker, and T. D. Mount. "An Economic Analysis of the US Generic Dairy Advertising Program Using an Industry Model." *Northeastern Journal of Agricultural and Resource Economics*, 19(1990): 37-48.
- McCutcheon, M. L., and E. Goddard. "Optimal Producer and Social Payoff from Generic Advertising: The Case of the Canadian Supply-managed Egg Sector." *Canadian Journal of Agricultural Economics*, 40(1992): 1-24.
- McGuirk, A., P. Driscoll, J. Alwang, and H. Huang. "System Misspecification Testing and Structural Change in the Demand for Meats." *Journal of Agricultural and Resource Economics*, 20(1995): 1-21.
- Miller, B. R., and G. C. Masters. "A Short-Run Price Prediction Model for Eggs." *American Journal of Agricultural Economics*, 55(1973): 484-489.
- Reader's Guide to Periodical Literature*. Bronx NY: H. W. Wilson Company. Various Issues 1985-1995.
- Reberte, J. C., T. M. Schmit, and H. M. Kaiser. "An Ex Post Evaluation of Generic Egg Advertising in the US." (R.B. 96-15), National Institute for Commodity Promotion Research and Evaluation, Cornell University, Ithaca, NY, June 1996.
- Roy, S. K. and P.N. Johnson. "Econometric Models for Quarterly Shell Egg Prices." *American Journal of Agricultural Economics*, 55(1973): 209-213.

Salathe, L. E., J. M. Price, and K. E. Gadson. "The Food and Agricultural Policy Simulator: The Poultry- and Egg-Sector Submodel." *Agricultural Economics Research*, 35(1983): 23-34.

Schrader, L. F., H. E. Lanzelere, G. B. Rogers, and O. D. Forker. "The Egg Subsector of US Agriculture: A Review of Organization and Performance." North Central Region Research Publication No. 258, NC-117 Monograph No. 6, June 1978.

Ward, R. W. "The Beef Checkoff: Its Economic Impact and Producer Benefits." University of Florida, Gainesville, FL., January 1992.

Table 1. California Supply and Demand Specification Results.

Supply Equation:

$$\begin{aligned} \ln(\text{PROD/POP}) = & -9.174 + 0.009 \ln(\text{PEGG})_{.1} - 0.035 \ln(\text{FEED})_{.1} + 0.610 \ln(\text{LAY}) \\ & (-1.76) \quad (0.28) \quad (-0.54) \quad (2.12) \\ & + 0.729 \ln(\text{PTVTY}) - 0.017 \text{QTR1} - 0.035 \text{QTR2} - 0.025 \text{QTR3} - 0.008 \text{TIME} \\ & (6.78) \quad (-2.63) \quad (-4.80) \quad (-3.71) \quad (-3.01) \end{aligned}$$

$$R^2 = 0.94 \quad \rho_1 = -0.617 \quad (-4.22)$$

Demand Equation:

$$\begin{aligned} \ln(\text{PEGG}) = & -170.678 - 0.579 \ln(\text{PROD/POP}) + 5.019 \ln(\text{PMEAT}) + 14.149 \ln(\text{INC}) \\ & (-4.78) \quad (-1.23) \quad (4.67) \quad (4.97) \\ & - 0.007 \text{QTR1} - 0.201 \text{QTR2} - 0.118 \text{QTR3} - 1.246 \ln(\text{TIME}) + 1.387 \ln(\text{WOMEN}) \\ & (-0.23) \quad (-4.37) \quad (-3.56) \quad (-5.17) \quad (2.27) \\ & + 0.026 \ln(\text{ADV/POP}) + 0.038 \ln(\text{ADV/POP})_{.1} + 0.038 \ln(\text{ADV/POP})_{.2} + 0.026 \ln(\text{ADV/POP})_{.3} \\ & (1.76) \quad (1.76) \quad (1.76) \quad (1.76) \end{aligned}$$

$$R^2 = 0.86 \quad \rho_1 = 0.416 \quad (1.95)$$

Consumption Identity:

$$\text{CON} = \text{PROD} + \text{IMPORT} + \text{INTRA} + \text{GENERIC} - \text{TOTEXEGG} - \text{EGGBREAK}$$

Note: POP is the average quarterly state population, t-ratios are in parentheses, and ρ represents the autoregressive parameters.

IMPORT = imported eggs, INTRA = intra-state breakers, GENERIC = generic egg product imports, TOTEXEGG = total exempt exported eggs, and EGGBREAK = eggs to breakers.

Production, consumption, egg price, production cost, disposable income, and advertising expenditure data were provided by the CEC. PMEAT and WOMEN were obtained from the US Dept. of Labor, Bureau of Labor Statistics, On-line Computer File WWW, Washington, DC, 1985-1995.

Figure 1. Quarterly California Egg Consumption Per Capita

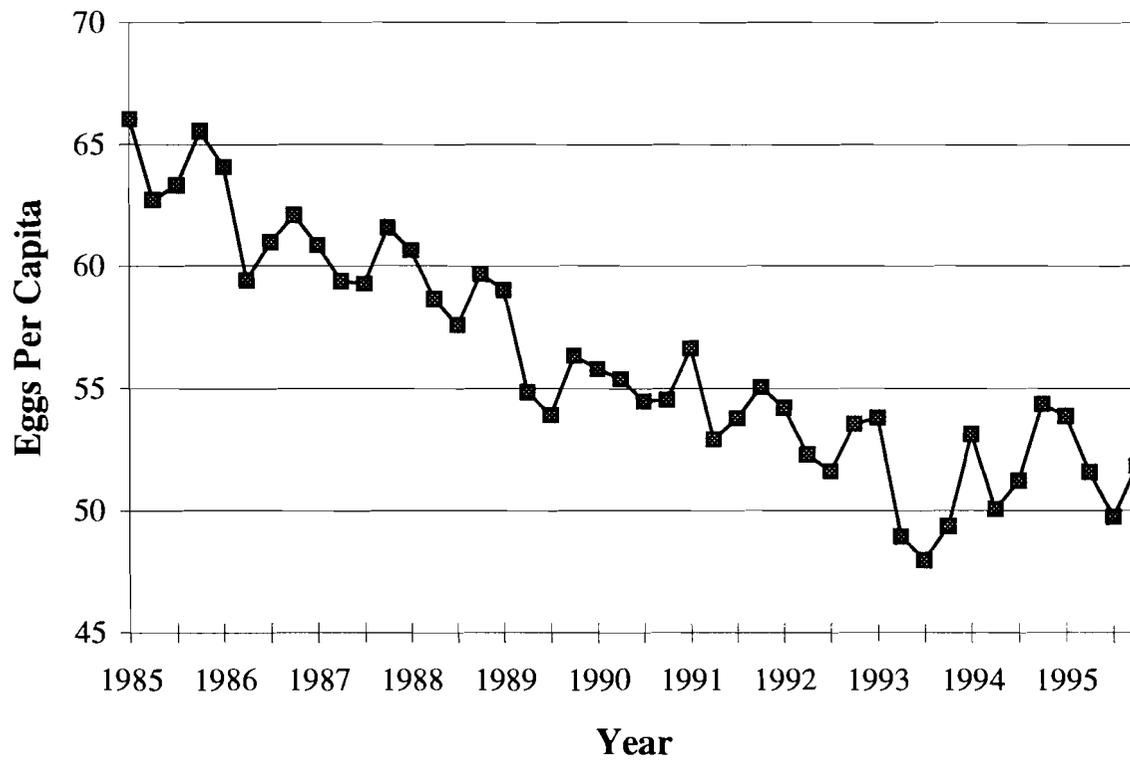


Figure 2. California Producer Egg Prices, 1985 -1995

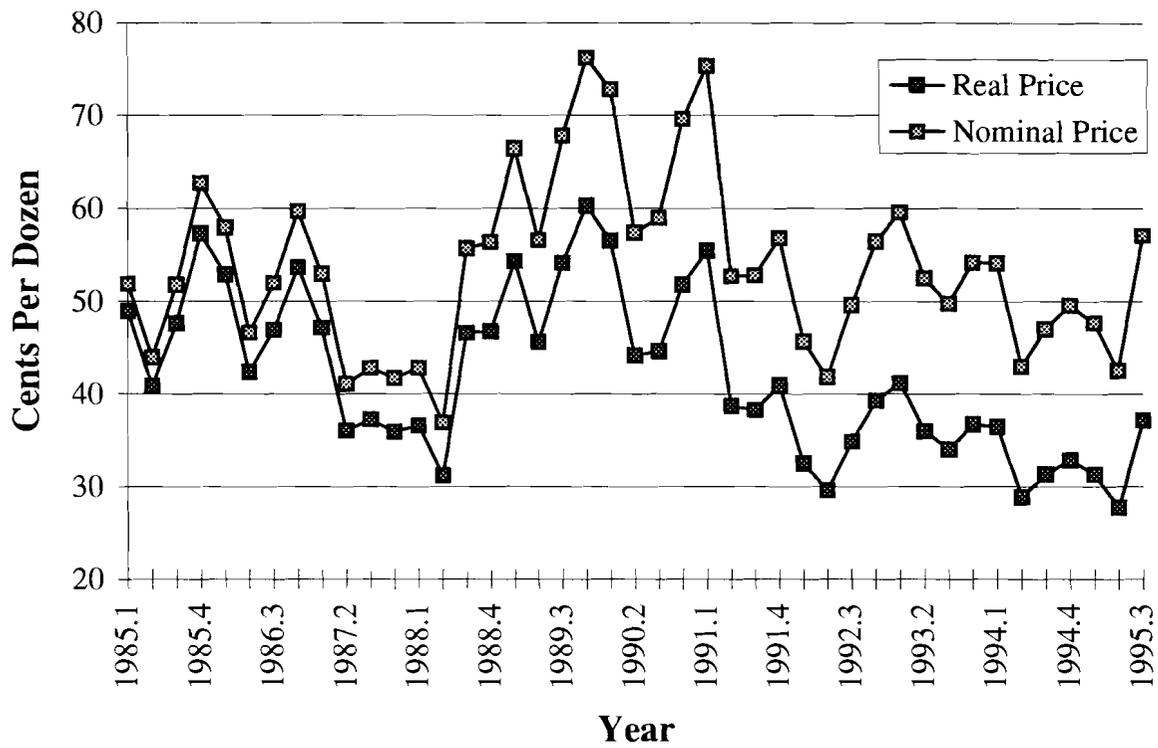
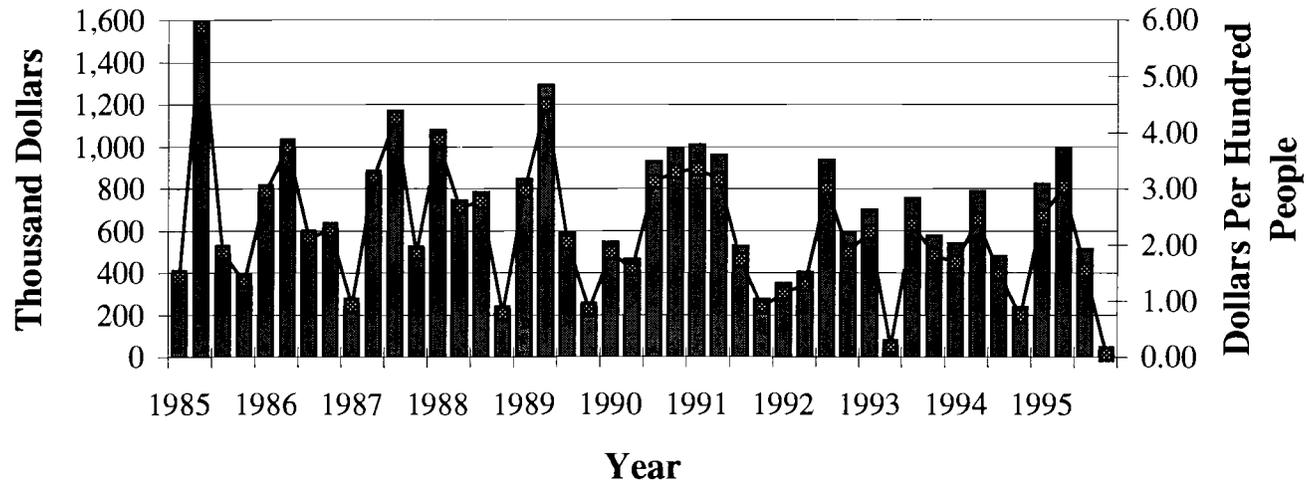


Figure 3. Real CEC Advertising Expenditures, by Quarter 1985 - 1995



Total CEC Advertising
 CEC Advertising Per Hundred People

OTHER A.R.M.E. RESEARCH BULLETINS

- | | | |
|-----------|---|--|
| No. 96-06 | Dairy Department Procurement
Dynamics The Role of the
Supermarket Buyer | Edward W. McLaughlin
Debra J. Perosio |
| No. 96-07 | Integrating Knowledge to Improve
Dairy Farm Sustainability | Caroline N.
Rasmussen, ed. |
| No. 96-08 | A Descriptive Analysis of the
Characteristics and Financial
Performance of Dairy Farms in
Michigan, New York, Ontario,
Pennsylvania and Wisconsin | S. Ford
R. Gardner
S. Gripp
S. Harsh
W. Knoblauch
A. Novakovic
L. Putnam
M. Stephenson
A. Weersink
R. Yonkers |
| No. 96-09 | The Feasibility of a Mid-Hudson
Valley Wholesale Fresh Product
Facility: A Buyer Assessment | Craig Robert Kreider
Edward W. McLaughlin |
| No. 96-10 | Impact of National Dairy
Advertising on Dairy Markets, 1984-
95 | Harry M. Kaiser |
| No. 96-11 | Dairy Farm Management Business
Summary New York State 1995 | Stuart F. Smith
Wayne A. Knoblauch
Linda D. Putnam |
| No. 96-12 | A Spatial Equilibrium Model for
Imperfectly Competitive Milk
Markets | Tsunemasa Kawaguchi
Nobuhiro Suzuki
Harry Kaiser |
| No. 96-13 | Developing a Farm Plan to Address
Water Quality and Farm Business
Objectives: A Framework for
Planning | John J. Hanchar
Robert A. Milligan
Wayne A. Knoblauch |