RESEARCH NOTE: DEMAND ANALYSIS OF EGGS IN SOUTH AFRICA

RCG Cleasby
BSc Agric Student, Department of Agricultural Economics, University of Natal, Pietermaritzburg

GF Ortmann
Associate Professor, Department of Agricultural Economics, University of Natal, Pietermaritzburg

Abstract

This research note summarizes empirical estimates of price and income elasticities of demand for eggs in South Africa. Multicollinearity and autocorrelation posed problems for the analysis. The price elasticity for eggs was estimated as -0,55 and the income elasticity as 0,41.

Uittreksel

Vraaganalise van eiers in Suid-Afrika

Hierdie navorsingsnota is 'n samevatting van die empiriese beramings van die prys- en inkomste-elastisiteite van eiers in Suid-Afrika. Multikollinеariteit en autokorrelasie het die analise bemoeilik. Die pryselastisiteit vir eiers is beraam as -0,55 en die inkomste-elastisiteit as 0,41.

1. Introduction

The Egg Industry has developed into one of the largest farming industries in South Africa. Advancement in technology has enabled the Industry to increase its efficiency substantially over the past two decades. However, this development, coupled with a floor price set above the free market level, led to the introduction of a permit scheme by the Egg Board to try and curb over-production. The structure of the Egg Industry and the functions of the Egg Board are discussed by Cleasby (1989).

In this research note the demand for eggs in South Africa is analyzed for the period 1950 to 1987 (38 years). Ordinary least squares (OLS) regression is used to estimate price and income elasticity of demand coefficients for eggs in South Africa. Results presented in this paper are compared with estimates obtained by Broom (1969) and researchers overseas.

2. Model specification

Both linear and log models were specified. In general, the demand function hypothesizes that *per capita* egg consumption (dependent variable EC) is linearly related to the following explanatory variables:

- real egg price in cents per dozen (PE)
- real beef price in cents per kg (PB)
- real per capita disposable income (I)

i.e. $EC_t = b_0 + b_1PE_t + b_2PB_t + b_3I_t + e_t$

where b_i = coefficients
e = error term
t = 1,...,38 years.

Egg consumption data were obtained from Egg Board Annual Reports (Egg Board, several years). Consumption was expressed in dozens by converting tons to dozen on the basis of 1,5 dozen per kg (EggBoard, 1989). Population data were obtained from the Directorate Agricultural Economic Trends (1989:1). TBVC States were also included in the population data. Estimates of personal disposable income were extracted from Reserve Bank Quarterly Bulletins (Reserve Bank, several years).

A time period of 38 years was used in the analysis (1950 to 1987). The consumer price index for food (Directorate Agricultural Economic Trends, 1989: 90) served as the deflator of price and income data (1985 = 100). Figure 1 shows real egg price per dozen versus consumption per capita and reflects the close correlation between the two variables.

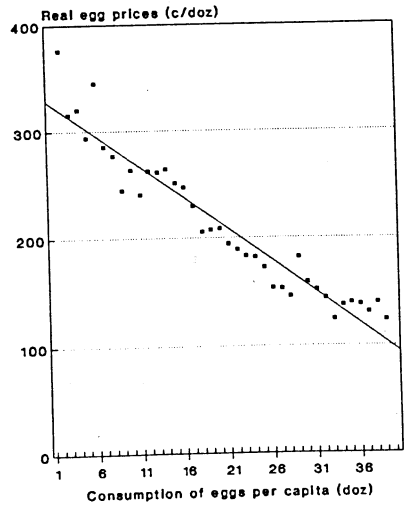

Figure 1: Real egg price per dozen versus consumption *per capita* (1950-1987)

A number of models were estimated in an attempt to find the best possible model as judged by the residual plot, the realisation versus forecast plot and the Durbin-Watson and adjusted R^2 statistics.

3. Research procedure

A correlation matrix was extracted to check on the simple correlations among the variables considered (Table 1).

Table 1: Correlation matrix

	EC	PE	PB	I
EC	1,000			
PE	-0,840	1,000		
PB	0,813	-0,922	1,000	
I	0,482	-0,620	0,618	1,000

As the correlation between PE and PB is high, the confidence intervals for the relevant population parameters are expected to be overstated, increasing the probability of accepting a false hypothesis (i.e. type II error). If multicollinearity is not perfect, estimation of the regression coefficients is possible but the estimates and their standard errors become very sensitive to even small changes in the data. That is, OLS estimators are no longer the best linear unbiased estimators (BLUE).

Tests for multicollinearity (Klein's Rule) among the independent variables showed that the price of beef (PB) was collinear with the price of eggs (PE) (Cleasby,1989:32-33).

Positive autocorrelation was also evident. The generalised difference method (Gujarati, 1978:239-244) was used in an attempt to remedy this situation (Cleasby, 1989:35-36).

4. Results

4.1 Linear model

In all cases the real income coefficient was not significantly different from zero and the variable was dropped from the model. Initially, both PE and PB were retained in the model despite high collinearity.

The following results were obtained:

$$EC_t = 5,1719 - 0,0115PE_t + 0,0027PB_t$$
$$(t=2,324)\ (t=-2,596)\ (t=1,105)$$

$R^2 = 0,70$ df = 35 d = 1,03

The coefficient of PE is significant at the 5 per cent level of probability and the sign conforms to expectations. The Durbin-Watson (d) statistic indicates that the test for autocorrelation is in the inconclusive range. The price elasticity of demand for eggs (Ed) was estimated as -0,582 at the mean values of price and consumption.

The variable PB was subsequently excluded from the model. Specification error may result when a relevant variable is excluded from the model. While multicollinearity may prevent effective estimation of the parameters of the model, omitting a variable may mislead the investigator as to the true values of the parameters.

Regressing EC on PE resulted in a model with a d statistic of 0,22. Attempts to remedy the autocorrelation problem with the generalised difference method, even by lagging the model more than one time period, did not eliminate autocorrelation.

The following estimates were obtained:

$$EC_t^* = 7,3176 - 0,0145PE_t^*$$
$$(t=-7,547)$$

$R^2 = 0,60$ df = 36 d = 0,71

* denotes transformed variables

Under these conditions the price elasticity of demand for eggs was estimated as -0,697.

4.2 Log model

The log model is linear in the parameters and in the logarithms of its variables. An attractive feature of the model is that the slope coefficients measure the (constant) elasticities of the dependent variable in relation to the respective independent variables.

The log model is specified as follows:

$$LEC_t = Lb_0 + b_1LPE_t + b_2LPB_t + b_3LI_t + u_t$$

Where:

LEC = log of egg consumption per capita
LPE = log of real price of eggs
LPB = log of real price of beef
LI = log of real disposable income per capita
u = error term
t = time (1,...,38 years).

Klein's Rule indicated that multicollinearity was present between LPE and LPB. The estimated price coefficients should, therefore, be interpreted with caution. Estimates of the lagged log model were as follows:

$$LEC_t^* = -0,1459 - 0,5150LPE_t^* + 0,2422LPB_t^* + 0,3625LI_t^*$$
$$(t=-5,766)\quad (t=1,705)\quad (t=2,416)$$

$R^2 = 0,60$ df = 34 d = 0,90

* denotes transformed variables

The LPE, LI and LPB coefficients are significant at the 1 per cent, 5 per cent and 10 per cent levels of probability respectively. The price and income elasticities of demand are estimated as -0,515 and 0,363 respectively and the cross-price elasticity of eggs with respect to beef (Eeb) as 0,242. When LPB was excluded from the model because its coefficient is not significant at the 5 per cent level of probability, the following estimates were obtained. Note that the d statistic has improved.

$$LEC_t^* = 0,1444 - 0,4157LPE_t^* + 0,4587LI_t^*$$
$$(t=-4,089)\quad (t=5,538)$$

$R^2 = 0,67$ df = 35 d = 1,09

* denotes transformed variables

In this case, the price elasticity of demand for eggs (Ed) is estimated as -0,416 and the income elasticity of demand (Ey) as 0,459. These coefficients, and the ones estimated before, suggest that the demand for eggs is both price and income inelastic. The Ed estimates compare favourably with the coefficients estimated with the linear models (-0,582 and -0,697).

The mean of all the price elasticity of demand estimates is -0,55. This compares favourably with other estimates, for example -0,32 for Western Australia (Beck, 1974:244), -0,494 for Canada (Andrikopoulos *et al*, 1984:147), -0,58 for the USA

[Wetmore *et al* (1959), as reported by Tomek and Robinson (1981:7)] and Broom's (1969) earlier estimate of -0,60 for South Africa.

According to the homogeneity condition, the sum of the own-price, cross-price and income elasticities for a particular commodity is zero (taking account of signs). This implies that the substitution and income effects of an own-price change must be consistent with the cross and income elasticities for the commodity (Tomek and Robinson, 1981:53). Under this condition, and assuming mean price and income elasticities of -0,55 and 0,41 respectively, the sum of all cross-price elasticities is estimated as 0,14, implying that substitutes (e.g. beef) dominate the cross-effects.

5. Conclusion

Multicollinearity and autocorrelation problems were encountered in estimating relevant models of egg consumption. The price and income elasticity coefficients that were estimated (-0,55 and 0,41 respectively) should thus be treated with caution. Nevertheless,the estimated price elasticity is similar to estimates obtained elsewhere.

Acknowledgments

The authors express their thanks to Dr MC Lyne and an anonymous referee for comments on an earlier draft.

References

ANDRIKOPOULOS, A, BROX, J and CARVALHO, E. (1984). Substitution in demand for protein commodities: The Canadian experience 1958 to 1981. Canadian Journal of Agricultural Economics, Vol 32:141-149.

BECK, AC. (1974). The social cost of production control in the Australian Egg Industry. Review of Marketing and Agricultural Economics, Vol 42, No 4:240-256.

BROOM, DN. (1969). Demand and price analysis for meat and eggs in South Africa. Unpublished MSc Agric thesis, University of Natal, Pietermaritzburg.

CLEASBY, RCG. (1989). Demand analysis of eggs in South Africa. Unpublished BSc Agric thesis, University of Natal, Pietermaritzburg.

DIRECTORATE AGRICULTURAL ECONOMIC TRENDS. (1989). Abstract of agricultural statistics. Department of Agriculture, Pretoria.

EGG BOARD. (1989). Personal communication. Pretoria.

EGG BOARD. (several years). Egg Board annual reports. Pretoria.

GUJARATI, D. (1978). Basic econometrics. International student ed, Tokyo, McGraw-Hill Kogakusha.

RESERVE BANK. (several years). Reserve Bank quarterly bulletin. Pretoria.

TOMEK, WG and ROBINSON, KL. (1981). Agricultural product prices. London, Cornell University Press.