Iran Agricultural Research 12:99-114 (1993)

THE PRICE ELASTICITY OF SUPPLY FOR RED MEAT IN IRAN, 1959-1986

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(Received January 31, 1993)

ABSTRACT

This study is an attempt to estimate the price elasticity of the red meat supply in Iran. For this purpose, a two-stage least squares linear regression model and time series data for years 1959-1986 are used. Based on the estimated results price elasticity for red meat supply is calculated at 0.864. The estimated coefficient for the dummy variable — with the value of one for the years of 1973 to 1978, the years of high oil revenue and rapid inflation, and of zero for other years — is positive and significant.

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تحقیقات کشاورزی ایران
۱۲:۹۹-۱٤٤ (۱۳۷۲)

کشش قیمتی عرضه گوشت قرمز در ایران ۱۳۳۸-۱۳٦۵

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چکیــده

در این مطالعه سعی می شود که کشش قیمتی عرضه گوشت قرمز در ایران تخمین زده شود. برای این منظور از مدل رگرسیون خطی کمترین مربعات دو مرحله ای و اطلاعات سری زمانی برای سالهای ۱۳۳۸ تا ۱۳٦۵ استفاده می شود. نتایج تخمین زده شده کشش قیمتی عرضه گوشت قرمز را ۰/۸٦٤ نشان می دهد. ضریب تخمین زده شده برای متغیر مجازی ــ با ارزش ۱ برای سالهای ۱۳۵۲ تا ۱۳۵۷ یعنی سالهای با درآمد زیاد نفت و تورم شدید و صفر برای سالهای دیگر ــ مثبت و معنی دار است.

INTRODUCTION

Compared to studies on price elasticities for crops, little research has been done on the price elasticities for meat supply, particularly red meat, in Iran. Red meat in this paper includes sheep, goat, cattle, buffalo and camel meat. The number of each species in 1982 were 34605, 18663, 5106, 188 and 114 thousands heads, respectively (6). One of the reasons for little research work has been the difficulty in reaching some significant statistical estimate for supply coefficients.

This in turn is due to the effect of other structural changes, that have critical effects on the amount of red meat production. The effects of environmental factors on the supply of sheep and goat meat in Iran are more serious than for cattle and buffalo meat. A considerable amount of sheep and goat meat in the country is produced by tribes who have little control on the conditions of production. Environmental factors such as weather, are difficult to specify properly. Weather variables have been excluded in some crop supply studies. Instead, acreage rather than the quantity of output has been used as the dependent variable in the supply function (2). This kind of exclusion is less feasible in livestock supply studies.

Another problem is the lack of reliable published data on quantities of red meat produced over a sufficient period of time to calculate a significant estimated supply coefficient. Data on the quantities of red meat produced by tribes compared to those produced on farms in Iran, with the exception of the last few years, are not available. Tribes produce a significant percentage of the red meat in Iran. In 1989, for example, some 60 to 80% of livestock was from tribe sources delivering to slaughter-house in the city of Isfahan (6). The tribe's production function for red meat includes somewhat different variable, than in farm production function. Red meat produced by tribes is also subjected to structural changes, due to factors such as considerable changes in the year-to-year amounts of grazing pastures, credit, and livestock supplemental food available.

The relative price index for red meat has risen rapidly in Iran. The relative price indices for red meat and a few other agricultural commodities for the years 1959 and 1986 are shown in Table 1.

Table 1. Price index for several agricultural products in Iran, 1974=100.

Commodity	Price index 1959	Price index 1986	Price index Growth (fold)	Relative price index[a] 1959	Relative price index[a] 1986
Red meat[b]	39.5	909.3	23.0	0.72	1.81
Chicken meat[c]	25.6	300.0	5.7	0.95	0.60
Dairy[b]	51.2	735.8	14.4	0.93	1.47
Rice[c]	50.9	646.0	12.7	0.92	1.29
Barley[b]	47.2	480.8	10.2	0.86	0.96
Bread[c]	61.0	326.0	5.3	1.11	0.65
Commodity price index[b]	55.2	501.6	9.1	1.00	1.00

Source: different issues of Annual Statistical Report, Plan and Budget Organization, Iran; and interviews with the statistical experts of the same organization.

a price index divided by commodity wholesale price index.

b wholesale price index.

c retail price index.

Among the six products shown in Table 1, relative price index for red meat was the lowest in 1959, at 0.72, and the highest in 1986, at 1.81. That is, the relative price index for red meat had risen by 3.4% per year during 28 years. This price rise has been more serious during several years of the period under study (Fig. 1).

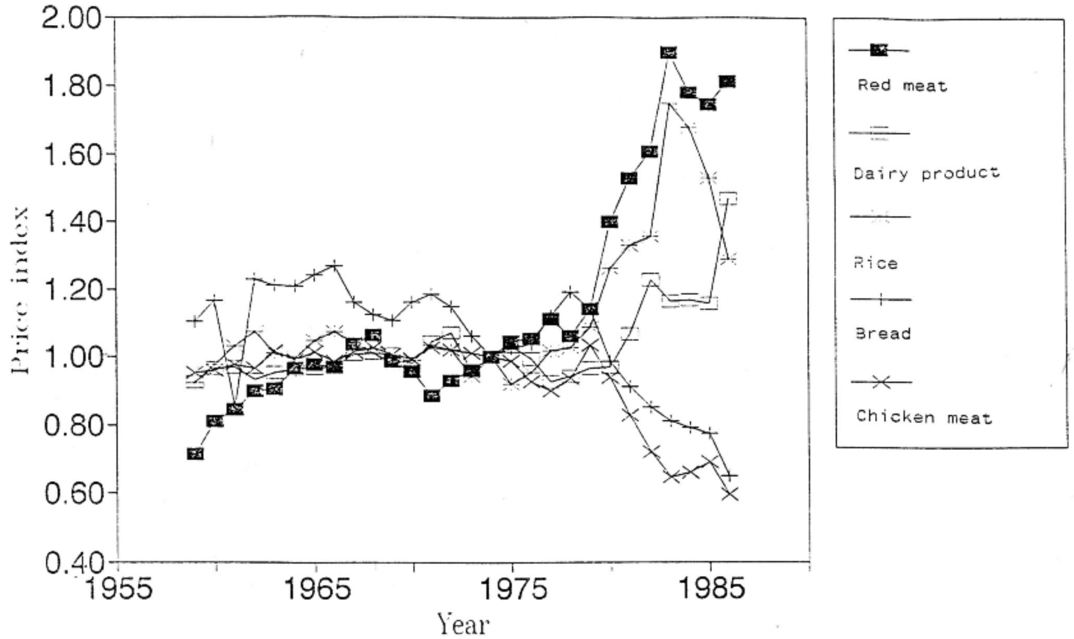

Fig. 1. Real price indices for red meat, dairy products, rice, bread and chicken in Iran, 1959–1986

The rapid price rise of red meat, in these years, has been due to persisting excess demand. Excess demand for red meat has increased mainly because of a rapid population growth of more than 3%, in spite of a considrable increase in the quantities of domestic production. The amount of red meat production has risen from 233175 tons in 1959 to 594639 tons in 1986. To cope with the excess demand, the amount of red meat imported has risen from 125 tons (0.05% of consumption) in 1959 to 178145 tons (23.05% of consumption) in 1986. In short, in spite of the growth in both domestic production and importation of this commodity, the relative price index for red meat rose in Iran during the 28 years under study.

The impact of price rise for red meat on the domestic production of this commodity is important for price policymakers. The puropose of this study is to estimate the price elasticities of the red meat supply in Iran.

MATERIALS AND METHODS

A two-stage least squares (2SLS) linear regression model is used to estimate the elasticity of Iran's red meat supply (1, pp. 603-605; 9, pp. 211-212). The structural equations, a demand-supply model, used for the analysis are as follows:

Demand function $Q_t = a_o + a_1P_{rt} + a_2I_t + U_{1t} \qquad a_1 < 0,\ a_2 > 0$ (1)

Supply function $Q_t = \beta_o + \beta_1P_{rt} + \beta_2D_1 + \beta_3D_2 + \beta_4T + \beta_5Q_{t-1} + \beta_6P_{rt-1} + \beta_7P_{ct} + \beta_8P_{bt} + \beta_9W_t + U_{2t}$

$\beta_1 > 0,\ \beta_6 > 0,\ \beta_7 < 0$ (2)

where:

Q_t = per capita consumption of red meat in year t in kilograms.

P_{rt} = wholesale price index for red meat divided by commodity wholesale price index in year t; 1974=100.

I_t = per capita income deflated by commodity wholesale price index in year t in 1000 rials[1].

D_1 = dummy variable, with a value of one for the years of 1973 to 1978 and of zero for the other years.

D_2 = dummy variable, with a value of one for the years of 1979 to 1986 and of zero for the other years.

T = time trend with values of 1 to 27 for the years of 1960 to 1986, respectively.

Q_{t-1} = Q_t with a one year lag.

P_{rt-1} = P_{rt} with a one year lag.

P_{ct} = retail price index for chicken meat divided by commodity wholesale price index in year t; 1974=100.

P_{bt} =wholesale price index for barley divided by wholesale price index of red meat; 1974=100.

W_t = mean amount of spring rainfall of the country in year t in millimeters.

a_0 and β_0 = intercepts for equation (1) and (2), respectively.

a_1 and a_2 and β_1 to β_9 = regression coefficient for equations (1) and (2), respectively.

U_{1t} and U_{2t} = regression residuals for year t for equations (1) and (2), respectively.

Q_t used in both equations (1) and (2), represents the demanded and

1. Official exchange rate: 79 Rials = 1 U.S. Dollar in 1986.

supplied quantities of red meat at the equilibrium price in year t. D_1 and D_2 are introduced into the model to pick up the possible structural changes for the two periods. D_1 represents the years of high oil revenue and inflation. D_2 represents the years following the revolution and war with Iraq. T represents the possible structural and technological changes over time (4, p. 222). P_{rt-1} is included in the model to see the effects of the preceding year price on the quantities supplied and Q_{t-1} is included in the model for the partial adjustment. P_{ct} is the price of the possible substituting product for red meat supply. P_{bt} is included in the model to see whether it will improve the estimated results. Barley is one of the variable inputs in red meat production and for its profit maximization, it is required to reach the point of marginal physical product equal to input-output price ratio (3). Spring rainfall, W_t, is expected to improve pasture that would encourage farmers and especially tribes to keep more animals in their herds. W_t excludes the four cities of Bandar-anzali, Rasht, Ramsar and Babolsar all of which have heavy rainfall. This exclusion is done in order to pick up the effects of the variations in the amounts of rainfall in other low-rainfall cities. Other specifications for rainfall variable were tried as well which included the total amount of rainfall for current or previous years. None of their estimated coefficients, however, were statistically significant.

In equations (1) and (2), Q_t and P_{rt} are endogenous and I_t, D_1, D_2, T, Q_{t-1}, P_{rt-1}, P_{ct}, P_{bt} and W_t are exogenous variables. In the first stage of our 2SLS, P_{rt} is regressed on all exogenous variables of the model as follows:

$$P_{rt} = \Pi_o + \Pi_1 I_t + \Pi_2 D_1 + \Pi_3 D_2 + \Pi_4 T + \Pi_5 Qt-1 + \Pi_6 P_{rt-1} + \Pi_7 P_{ct} + \Pi_8 P_{bt} + \Pi_9 W_t + e_t \qquad (3)$$

where e_t is the usual OLS residual. From equation (3) we obtain:

$$\hat{P}_{rt} = \Pi_o + \Pi_1 I_t + \Pi_2 D_1 + \Pi_3 D_2 + \Pi_4 T + \Pi_5 Qt\text{-}1 + \Pi_6 P_{rt-1} + \Pi_7 P_{ct} + \Pi_8 P_{bt} + \Pi_9 W_t \tag{4}$$

Where $\hat{P}_{rt}$ is an estimated value of P_r conditional upon fixed values of I_t, D_1, D_2, T, Q_{t-1}, P_{rt-1}, P_{ct}, P_{bt} and W_t for related years.

Equation (3) can now be expressed as:

$$P_{rt} = \hat{P}_{rt} + e_t \tag{5}$$

In the second stage, we replace P_{rt} in equation (2) by its estimated values, $\hat{P}_{rt}$, from equation (4), and run the OLS regression as follows:

$$Q_t = \beta_0 + \beta_1 P_{rt} + \beta_2 D_1 + \beta_3 D_2 + \beta_4 T + \beta_5 Q_{t-1} + \beta_6 P_{rt-1} + \beta_7 P_{ct} + \beta_8 P_{bt} + \beta_9 W_t + u^*_{2t} \tag{6}$$

where $u^*_{2t} = u_{2t} + \beta_1 e_t$.

Regression results were compared according to their F ratios, R^2, and Dublin-Watson statistics for the whole regression as well as the sign and the t statistics for the estimated partial regression coefficients.

Time series data for the period of 1959 to 1986 are taken or calculated from published annual reports, other publications, and unpublished data of the Plan and Budget Organization, Islamic Republic of Iran. The data are also taken from reports of the Central Bank of Iran.

RESULTS AND DISCUSSION

The estimated results for equations 3 and 6, which are for stages 1 and 2 of the 2SLS, are presented in Tables 2 and 3, respectively. Regressions 1 to 13 of Table 3 correspond to regressions 1 to 13 of Table 2, respectively.

Table 2. Estimated regression coefficients for the first stage of the 2SLS using equation (3) for Iran's red meat supply from 1959 to 1986, the dependent variable being the price of red meat, P_{rt}.

	Regression number						
Explanatory variables†	1	2	3	4	5	6	7
I_t	0.012 (7.12)§	0.002 (1.37)	0.001 (0.31)	0.003 (2.54)	0.003 (3.08)	0.002 (1.73)	0.003 (3.16)
D_1	-0.692 (-5.95)		0.040 (0.20)	-0.173 (-2.45)	-0.187 (-2.98)	-0.178 (-2.75)	-0.20 (-3.08)
D_2		0.602 (8.83	0.630 (4.07)				
T							
Q_{t-1}						0.006 (0.72)	
P_{rt-1}				0.847 (10.39)	0.537 (3.95)	0.526 (3.80)	0.497 (3.44)
P_{ct}					-0.759 (-2.70)	-0.773 (-2.71)	-0.748 (-2.64)
P_{bt}							-0.126 (-0.87)
W_t							
R^2 R^2(adj.)	0.69 0.67	0.82 0.81	0.82 0.80	0.95 0.94	0.96 0.95	0.96 0.95	0.96 0.95
F_{ratio} n_1, n_2	26.9 2.24	54.8 2.24	35.1 3.23	133.8 3.23	129.6 4.22	101.5 5.21	102.6 5.21
D-WΠ k, n	1.32^{**} 2.27	0.99 2.27	0.96^{**} 3.27	2.07 3.27	1.89 4.27	1.84^{*} 5.27	1.93 5.27
SEE	0.192	0.147	0.150	0.082	0.073	0.074	0.073
Intercept	0.614 (6.67)	0.897 (13.92)	0.913 (8.90)	0.081 (1.26)	1.119 (2.87)	1.098 (2.79)	1.252 (2.98)

Table 2. Continued ...

Explanatory variables†	Regression number 8	9	10	11	12	13
I_t	0.003 (3.01)	0.001 (0.61)	-0.002 (-1.57)	-0.003 (-3.14)	-0.003 (-3.08)	0.003 (3.01)
D_1	-0.190 (-2.95)	-0.150 (-2.29)				-0.190 (-2.95)
D_2						
T		0.011 (1.57)	0.017 (2.37)	0.027 (5.56)	0.027 (5.40)	
Q_{t-1}						
P_{rt-1}	0.529 (3.79)	0.335 (1.83)	0.354 (1.77)			0.529 (3.79)
P_{ct}	-0.780 (-2.69)	-0.915 (-3.16)	-0.948 (-3.00)	-1.403 (-7.29)	-1.393 (-6.90)	-0.780 (-2.69)
P_{bt}						
W_t	-0.000 (-0.45)				0.000 (0.21)	-0.000 (-0.45)
R^2	0.96	0.96	0.95	0.95	0.95	0.96
R^2(ajd.)	0.95	0.96	0.95	0.94	0.94	0.95
F_{ratio}	99.9	111.1	115.3	139.8	100.5	99.9
n_1, n_2	5.21	5.21	4.22	2.23	4.22	5.21
D-W	1.90	1.62**	1.47**	1.21**	1,20**	1.90
k, n	5.27	5.27	4.27	3.27	4.27	5.27
SEE	0.074	0.071	0.077	0.081	0.082	0.074
Intercept	1.167 (2.84)	1.445 (3.36)	1.504 (3.21)	2.254 (10.90)	2.233 (9.57)	1.167 (2.84)

* Significant at 5% level.

** Significant at 1% level.

† Definitions of the variables are given under equations (1) to (4).

§ Figures in parentheses are t values for the estimated coefficients.

Π Dublin-Watson

Table 3. Estimated regression coefficients for the second stage of the 2SLS using equation (6) for Iran's red meat supply from 1959 to 1986, the dependent variable being the quantity of red meat, Q_t.

Explanatory variables†	Regression number						
	1	2	3	4	5	6	7
$\hat{P}_{rt}$	11.019 (12.22)§	56.749 (12.12)	141.339 (5.57)	50.089 (9.00)	50.841 (9.46)	57.171 (6.00)	51.238 (9.21)
D_1	6.253 (10.74)		-7.619 (-2.89)	6.280 (11.00)	6.980 (12.27)	8.145 (6.71)	7.618 (12.53)
D_2		-33.324 (-10.72)	-89.552 (-5.23)				
T							
Q_{t-1}						-0.026 (-0.17)	
P_{rt-1}				-44.077 (-7.76)	-32.002 (-7.38)	-35.379 (-6.10)	-30.476 (-6.93)
P_{ct}					31.135 (5.40)	35.990 (4.36)	30.955 (5.24)
P_{bt}							5.483 (2.38)
W_t							
R^2	0.90	0.89	0.90	0.91	0.92	0.94	0.92
R^2(adj.)	0.89	0.88	0.89	0.89	0.90	0.93	0.90
F_{ratio}	105.5	99.6	67.9	73.8	60.5	66.8	46.6
n_1, n_2	2.24	2.24	3.23	3.23	4.22	5.21	5.21
D-WΠ	1.13**	1.14*	1.14**	1.27**	1.44**	1.88	1.45
k, n	2.27	2.27	3.27	3.27	4.27	5.27	5.27
SEE	1.215	1.247	1.237	1.191	1.146	0.988	1.169
Intercept	0.613 (0.56)	-42.999 (-9.19)	-121.90 (-5.10)	4.360 (4.72)	-41.897 (-5.05)	-45.340 (-4.10)	-44.518 (-5.07)

Table 3. Continued ...

Explanatory variables†	Regression number 8	9	10	11	12	13
$\hat{P}_{rt}$	50.814 (9.27)	146.207 (5.24)	-49.623 (-5.00)	-39.082 (-7.19)	-39.093 (-7.03)	50.814 (9.27)
D_1	7.092 (11.95)	19.515 (5.68)				7.092 (11.95)
D_2						
T		-1.575 (-3.85)	0.974 (11.18)	1.046 (10.88)	1.045 (10.58)	
Q_{t-1}						
P_{rt-1}	-31.693 (-7.22)	-45.277 (-6.22)	12.569 (2.06)			-13.693 (-7.22)
P_{ct}	31.886 (5.31)	125.864 (4.66)	-55.497 (-5.95)	-56.873 (-6.07)	-56.553 (-5.91)	31.886 (5.31)
P_{bt}						
W_t	-0.004 (-0.40)				-0.001 (0.08)	-0.004 (-0.40)
R^2	0.92	0.92	0.90	0.89	0.89	0.92
R^2(ajd.)	0.90	0.90	0.88	0.87	0.87	0.90
F_{ratio}	46.6	46.4	48.1	60.0	43.0	46.6
n_1, n_2	5.21	5.21	4.22	3.23	4.22	5.21
D-W	1.45**	1.42**	1.21**	1.12**	1.12**	1.45**
k, n	5.27	5.27	4.27	3.27	4.27	5.27
SEE	1.169	1.171	1.273	1.308	1.337	1.169
Intercept	-40.024 (-4.68)	-191.700 (-4.44)	95.168 (7.02)	98.038 (7.12)	97.363 (6.91)	-40.024 (-4.68)

* Significant at 5% level.

** Significant at 1% level.

† Definitions of the variables are given under equations (1) to (4).

§ Figures in parentheses are t values for the estimated coefficients.

Π Dublin-Watson

The regressions were run using different combinations of the exogenous variables to see their effects in the presence or absence of other variables. Out of 13 estimated regressions, only regressions 1 of Tables 2 and 3 have satisfactory results. That is, besides having high R^2s, significant F ratios, and significant values for the Dublin-Watson statistics, all of their partial estimated coefficients are significant and have right signs. Regressions 2 to 13 in one or both of the Tables 2 and 3, on the other hand, suffer from either insignificancy or wrong signs for one or more of their partial coefficient estimates. For example, regressions 2 and 3 of Table 3 have the wrong sign for the coefficient of P_{rt-1}, regressions 5 to 9 and 13 of Table 3 have wrong signs for the coefficients of P_{ct}, and regressions 10 to 12 have wrong signs for the coefficients of P_{rt}. Thus, regression 1 is considered to be the best regression for estimating the price elasticity of supply. The price elasticity of red meat from regression 1 is calculated at 0.864. It is calculated by multiplying 11.019, the coefficient of P_{rt}, by the ratio of the mean value of $\hat{P}_{rt}$ to the mean value of Q_t — that is, 1.1516 to 14.6919.

Compared to the results of the other studies, the long run supply elasticities in U.K. for sheep was 2.31 for the years 1907-1958 and for cattle was 0.46 for the years 1924-39 and 1945-58 (7, p. 111). The estimated coefficient for the dummy variable in regression 1 of Table 3 is positive and significant. This implies that the undefined structural changes during the years 1973 to 1978 - the years of high oil revenue and rapid inflation - have had positive effects on the quantity of red meat production in Iran.

CONCLUSIONS

The elasticity of supply for red meat in Iran with respect to its own relative price index, with the value of 0.864 is estimated to be positive and significant. Regarding the considerable rise in the relative price index of red meat in Iran, especially in recent years, (Fig. 1), the government might need to look for policy devices to regulate land use or to prevent or slow down the rise in the real price index of this commodity. Not taking such measures could result in overgrazing of pastures by red meat producers, as has been the case in recent years (5).

ACKNOWLEDGEMENT

The author appreciates the Plan and Budget Organization of Isfahan for preparing the main part of the data used in this paper. Appreciation is also extended to the anonymous reviewers for their valuable suggestions.

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