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FARM SUPPLY RESPONSE FOR MEAT UNDER THE CONTROLLED PRICE SYSTEM IN KOREA

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Although there have been many attempts to estimate demand for livestock, statistical estimates of supply for practical purposes are almost completely lacking in Korea. To devise price policies which will make a sound contribution toward the development of the livestock industry, economists and policy decision makers are concerned with how the quantity of meat supplied to the market varies with changes in its price and those of related products and inputs, with some other minor variables held constant.

It appears to be difficult to derive supply functions at the retail level because there has existed a controlled price system in the meat market for several years.[1] Therefore, it may be wise to investigate the possibility of second best alternatives in approaching supply functions, which directs attention to the farm supply for major types of meat in Korea.

The objectives of this paper are first to examine how the demand and marketing margins affect prices received by farmers, second to identify factors affecting the quantity of major types of meat supplied at the farm level, and finally to estimate farm supply relations using time-series data for 1959–78.

FARM SUPPLY AND PRICE CHANGES UNDER THE CONTROLLED PRICE SYSTEM

The prices set by the government mainly for beef and pork are not allowed to fluctuate weekly or even monthly.[1] This creates serious difficulties in obtaining the variations in price movements needed for supply estimates. The question which arises is who are the suppliers

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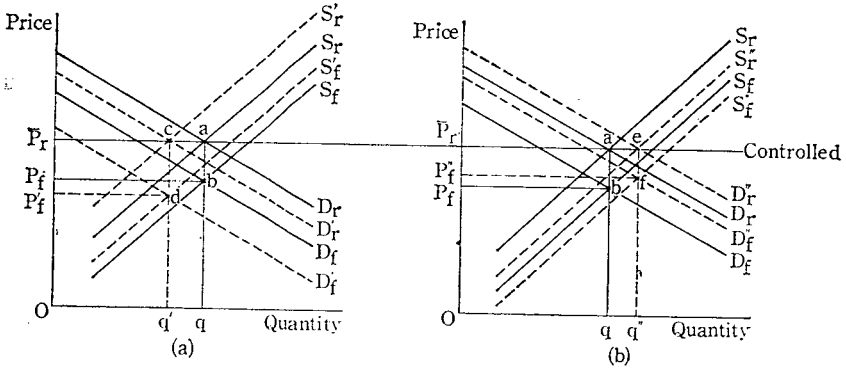
[1] The government has directly controlled the retail prices of beef and pork for more than two decades and indirectly intervenes in the chicken market by purchasing when there exists a surplus in supply in an effort to maintain prices within the set range.

of meat and what prices do they respond to? The real suppliers of meat into the market are not shippers or wholesalers, but livestock farmers. Such merchants as shippers and wholesalers can be regarded as simply charging for their labor, facilities utilized, and other cost items incurred. The marketing margin including profits taken by the merchants differ depending upon the retail demand and farm supply.

To a certain extent, the merchant in the meat market has a tendency to try to obtain a fixed marketing margin under any circumstances, which may be a minimum level for their continued operation in business. Assuming that the minimum margin equals $\square \bar{P}_r abp_f$ in Figure 1 (a), it diminishes as the retail demand for meat declines from D_r to D_r' shown in the Figure. To avoid a reduction of their margin they may have to offer livestock farmers price P_f' that is below P_f, in such a way that $\square \bar{P}_r cdP_f' \geq \square \bar{P}_r abP_f$ since at the retail level they can not raise their selling price which is subject to government regulation. As a result, the supply of meat by farmers would be cut by qq' $(= oq - oq')$.

FIGURE 1

CHANGES IN FARM PRICES UNDER THE CONTROLLED PRICE SYSTEM



Imagine that the consumer income shifts up the demand curve for meat from D_r to D_r'' shown in Figure 1 (b). The marketing margin available to merchants will be greater than the minimum $\square \bar{P}_r abP_f$. This stimulates competition between merchants in buying more meat by bidding up a higher price to farmers, up to the point P_f'' (at which $\square \bar{P}_r abP_f = \square \bar{P}_r efP_f''$) in the figure. As a result, the farm supply increases from oq to oq''.

In both cases, one finds that as the retail demand curve shifts, both farm prices and supplies, move along with it. This enables one to employ the quantity of meat supplied at the farm level as a function of prices received by livestock farmers.

A MODEL OF FARM SUPPLY

It is well known that the aggregate supply of meat for the nation at the farm level is a horizontal summuation of the individual farmers' supply relations. The majority of livestock farmers raise animals in small numbers. The national average number of animals being raised per farm was 1.3 head for cattle, 2.2 head for hogs, and 26 head for chickens in 1977. These traditional farms with small scale livestock activities are not sophisticated in decision making for production. In this study it is hypothesized that farmers base their current production plans upon the current prices as well as the previous year's average prices of animals and the current price or availability of feed inputs.

It follows that the aggregate output of an individual livestock product is affected by either or both of current and previous average farm prices of animals, prices of available inputs, and adopted technology. The aggregate output equals the actual production, which may or may not be the planned production, because there exists a time lag between the decision to produce and the actual realization of production. It is reasonable to assume that farmers base their decisions on current or recent past prices, so that the expected quantity (Q_t^*) supplied at the farm level can be

$$Q_t^* = \alpha + \beta_1 P_{t-i} + \beta_2 T \tag{1}$$

where P_{t-i} is considered as a vector of prices which may be current or lagged ones, and T denotes an adopted technology variable.

Production adjustments to price changes are expected to be different between the long-run and the short-run. Most of the cattle raising farms utilize by-products from crop production for their animal feed. The off-farm opportunity cost of this by-product would be almost zero if it were not used for animals. In addition, the farmers are faced with fixed assets and few good alternative uses for them. It is also true that at least a couple of years is required to raise calves and supply them for slaughter. These facts imply that the short-run supply elasticity for cattle may be quite low in Korea. As the time period under consideration becomes longer, the farmers may have better information and knowledge concerning adjustments to price changes, resulting in cattle supply response becoming elastic.[2] To test the hypothesis that the

[2] Wipf and Houck estimated the short-run and the long-run supply elasticities of U.S. milk with respect to milk prices, grain prices, and slaughter prices. The elasticities turned out to be very inelastic due to high fixed costs and few good alternative uses for land, buildings, and equipment. In addition, a long time period is required to raise calves and bring them into full production. Some of their indications should be brought to the attention of the Korean livestock industry (Wipf and Houck, 1967).

short-run supply elasticity for cattle is more inelastic than the long-run elasticity, the distributed lag model developed by Nerlove will be used (Nerlove 1958). Nerlove's supply adjustment model is

$$Q_t - Q_{t-1} = \gamma(Q_t^* - Q_{t-1}) \tag{2}$$

where Q_t is the realized output, Q_t^* represents the long-run equilibrium quantity which is assumed to be equal to the expected supply, and γ represents the coefficient of adjustment.[3] Substituting (2) into (1) an estimable short-run farm supply relation can be obtained

$$Q_t = \gamma\alpha + \gamma\beta_1 P_{t-1} + \gamma\beta_2 T + (1 - \gamma)\, Q_{t-1} \tag{3}$$

The variables can be in linear or logarithmic form.

ESTIMATES OF FARM SUPPLY

Numerous approaches were attempted in finding the best suitable relationship between the quantity supplied at the farm level and its affecting factors. The estimation results are as follows:

Beef supply function:

$$\ln QB_t = 3.940 + \underset{(0.250)}{0.440}\ln PB_{t-4} - \underset{(0.260)}{0.165}\ln PH_{t-4} - \underset{(0.279)}{0.561}\ln PF_{t-4} + \underset{(0.102)}{0.683}\ln QB_{t-1} \qquad R^2 = .912$$

Pork supply function:

$$\ln QP_t = 8.758 + \underset{(0.240)}{0.607}\ln PH_{t-2} - \underset{(0.240)}{0.850}\ln PB_{t-2} - \underset{(0.247)}{0.361}\ln PI_{t-2} + \underset{(0.037)}{0.126}\ln T \qquad R^2 = .911$$

Chicken supply function:

$$\ln QC_t = -0.785 + \underset{(0.174)}{0.351}\ln PC_{t-2} + \underset{(0.226)}{0.330}\ln PE_{t-2} - \underset{(0.233)}{0.034}\ln PI_{t-2} + \underset{(0.114)}{0.718}\ln QC_{t-1} \qquad R^2 = .970$$

where

QB = the total quantity of beef from domestic production[4] (total

[3] γ is referred to as the coefficient of adjustment if the equation is linear in natural numbers and is the elasticity of adjustment if the equation is in log form (Nerlove and Addison 1958, p. 864).

[4] The aggregate market supply of meats (Q^S) for the nation for a certain time period may equal domestic production (Q^P) in the current period, stocks carried over from the previous period (Q^C), imports (Q^I), less exports (Q^X); $Q^S = Q^P + Q^C + Q^I - Q^X$. Many economists are in agreement that most of domestic meat production is in hands of consumers within a few days from slaughtering because most retail stores are small

equilibrium quantity and export less import), in metric tons (MAF data),

QH = the total quantity of pork from domestic production[4] (total equilibrium quantity and export less import), in metric tons (MAF data),

QC = the total quantity of chicken from domestic production[4] (total equilibrium quantity and export less import), in metric tons (MAF data),

PB = the average cattle price received by farmers (national average between male and female prices per head alive), deflated by the index of prices received by farmers (1975 = 100), in Won (Monthly Review, NACF),

PH = the average hog price received by farmers, deflated, in Won per head of 75kg alive (Monthly Review, NACF),

PC = the average chicken price received by farmers, deflated, in Won per head alive (Monthly Review, NACF),

PE = the arerage egg price received by farmers, deflated, in Won per 10 eggs(Monthly Review, NACF),

PF = the average feed price paid by farmers, (weighted components: rice bran 57.2%, wheat bran 27.3%, barley bran 15.5%), deflated by the index of prices paid by farmers (1975 = 100), Won per 100 l (Monthly Review, NACF),

PI = index of livestock feed mixture prices (1975=100), (NACF),

Q_{t-1}=lagged dependent variable,

T = technology or a trend variable.

Standard errors are in parentheses. Estimates of the parameters of these equations have signs consistent with the theoretical expectations. There appear to be a few coefficients having little ground for statistical significance. However, Houck stated any strict interpretation of the usual tests of statistical significance is not appropriate for distributed lag models (Wipf 1967).

In relation to the beef supply, the time to make decisions to produce is much longer. This is what one should expect. Traditionally, more than 90 percent of total cattle for beef have been raised for draft purposes. The national average number of draft cattle was 1.3 head per farm in 1977. Most farms are known to raise cattle for more than three years. This leads one to believe that many Korean farmers routinely sell their draft cattle after a longer period of time (four years), at which time the decision is made.

in respect of sales and storage facilities. This implies that the carryover of meat to next year by private retailers would be negligible or at least almost the same as the amount from the previous year. It is reasonable to assume $Q^C = 0$. Then, $Q^P = Q^S + Q^X - Q^I$.

In relation to the pork and chicken supply, the time lag showed two years between the based price for production plans and the realization of actual production. Many of hog and chicken farms grow fast in size with increasing fixed costs. It takes time to expand buildings and labor, and for capital formation. These might be the reasons why there appeared to be a two year lag instead one. As more commercial farms settle down in their operation, the time lag is expected to be shorten.

CONCLUSIONS

The estimation results indicate that farm supply relations for meat under the controlled price system in Korea can be obtained by utilizing lagged models. Having attempted various methods, it was found that Nerlove's distributed lag model using a much longer time period provided the closest estimated values of the actual farm supply of major types of meat and might represent the best expression of the farm supply relations for beef, pork, and chicken in Korea. The variables affecting production plans include four year lagged prices for the beef supply function, and two year lagged prices for pock and chicken.

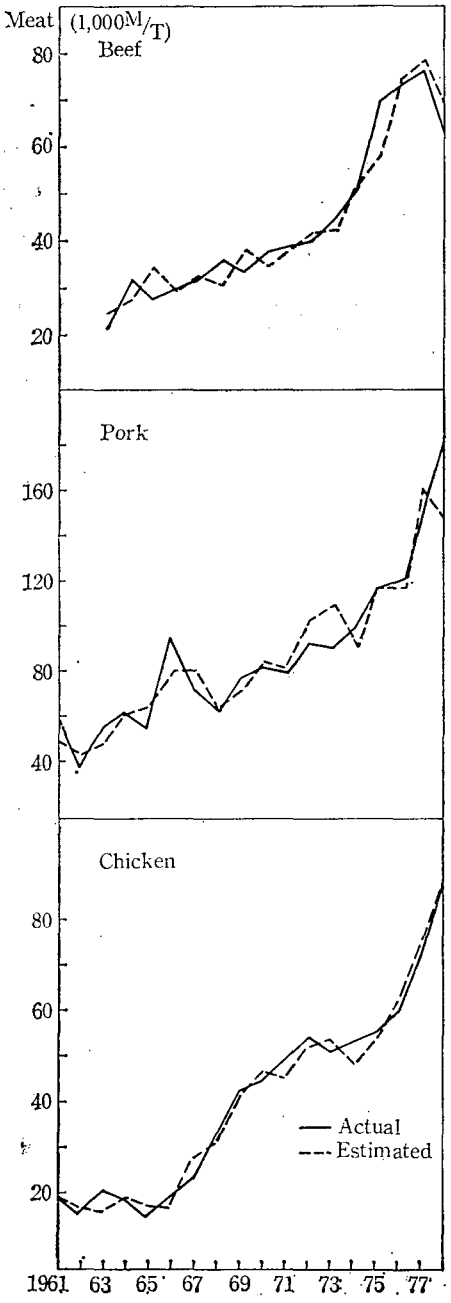
The short-run farm supply elasticities of beef, pork, and chicken with respect to the prices received by farmers appeared to be 0.44, 0.61, and 0.35 respectively. The long-run elasticities obtained were 1.39 for beef, and 1.24 for chicken.[5]

It was not possible to obtain the long-run supply elasticity of pork because the lagged dependent variable included in the function provided a worse relation on the whole. Instead, a time trend variable (which may represent adopted technology) was chosen to improve the functional relation. The estimated long-run supply elasticities of beef and chicken are fairly high allowing one to imagine that pork would be high as well. These are not surprising results when one takes account of the rapid economic growth achieved in Korea during the last decade. As income rose, the demand for livestock products increased dramatically so that the livestock industry turned out to be a very attractive sector to farmers in recent years. However, the controlled price system becomes an obstacle not allowing enough incentive for farmers to expand their production.

The short-run cross elasticities of beef farm supply with respect to hog prices and feed prices were -0.17 and -0.56 respectively. Those of pork supply with respect to cattle prices and feed prices were -0.85 and -0.36 respectively, and those of chicken with respect to egg prices and feed prices $+0.33$ and -0.03 respectively.

[5] Long-run coefficients can be computed by dividing the short-run coefficients by γ which is obtained simply by solving $\beta = 1 - \gamma$.

FIGURE 2
ESTIMATED VS. ACTUAL MEAT SUPPLY, KOREA



Both production adjustments of beef and chicken to a given price change require about nine years for completion. However, stable and favorable prices would contribute to a quicker adjustment.

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