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In This Issue

"One person's trash is another person's treasure" is an adage whose truth we regularly see verified at flea markets and garage sales. Its truth also prevails in economic research. Consider the economic historian. One of this researcher's tasks is to sort through the mass of historical economic data to discern which will explain the long-term trends—growth or decay—in an economy or in its institutions. And, consider the developer of short-term economic forecasting models. One of this researcher's tasks is to sort through the mass of current economic information to discern which could reasonably be expected to explain near-term developments. To the first researcher such occurrences as the seasonal timing of rainfall, the unexpected freeze, the strike, an advertising campaign, or an income windfall are "trash" through which the researcher must sort to identify the variables of longer term significance. Within this researcher's period of interest, these are likely to be stable. The builder of a forecasting model must "detrend" the data to identify the explanatory variables of near-term significance.

One researcher's trash is another's treasure.

In this issue we have articles reflecting both aspects of this time perspective. Westcott, Hull, and Green in the lead article present a version of a short-term corn price forecasting model. They show the important relationship between quarterly corn prices and both quarterly corn stocks and preharvest information about the new crop.

In the following article Lee and Culver examine the role of agriculture in the economic development of three Asian countries. They explore broader aggregates such as growth in agricultural output, urban-rural terms of trade, agriculture's share in total national output, and the timing of land reform in the development process. They conclude that, although Japan, Korea, and Taiwan fit a general stage-of-development process, the role of agriculture in the development process differed.

In the Research Review section, Orden and Gardner comment on Paarlberg's January 1984 AER article, "When Are Export Subsidies Rational?". Orden utilizes a two-good general equilibrium context to question the validity of Paarlberg's conclusion that export subsidies are rational if policymakers place higher weight on the welfare of producers than others. His critique draws on two important concepts from trade theory: the existence of a social welfare function when weights attached to different individuals are known and the nonoptimality of a trade intervention (such as an export subsidy) as opposed to other forms of intervention (such as domestic production taxes and subsidies) in cases where the objective is something other than exploiting monopoly power in trade. Gardner elaborates on the second point. He cites findings of the standard welfare economics of trade distortion that export subsidies are suboptimal to domestic support policies, and he supports his point with numerical and graphic illustrations. Paarlberg replies. . . no, I won't summarize his reply. I suggest the original article and this entire exchange be read as a unit. This is a rare opportunity for a "teaching moment" in a professional journal. Orden, Gardner, and Paarlberg provide logic from some of our profession's best minds in this effort to merge our theoretical models with the real world of the policymaker's arena. The illuminating, timely, and thoughtful exchange deserves to be read and pondered.

Moore reviews *Modeling Farm Decisions for Policy Analysis*, a compilation of papers presented at a November 1981 micromodeling conference and is encouraged by the nature of some of the work.

Ahalt draws on his personal association with Fred Waugh to give a review of Waugh's effect on the profession and his coworkers as well as his *Selected Writings on Agricultural Policy and Economic Analysis.*

Wunderlich reviews *Land Reform, American Style* and finds a book of fine readings, too diverse to sustain a central theme, but one which makes up in scope, energy, and content of individual chapters what it lacks in tractable theory.

Crom reviews *Livestock Response Functions*, a collection of articles describing interdisciplinary experiments at Iowa State University for estimating livestock and poultry production functions, and finds it an excellent technical reference.

Gerald Schluter

Contents

Relationships between Quarterly Corn Prices and Stocks

By Paul C. Westcott, David B. Hull, and Robert C. Green*

Abstract

This article estimates a model relating quarterly corn prices to quarterly corn stocks for 1971-81. Results are consistent with expectations that higher stocks in any specific quarter yield lower corn prices and that any given level of stocks later in the marketing year yields lower prices than does the same level earlier in the marketing year. Preharvest information on the new crop affects prices in the June-September quarter. The relationships estimated here enable analysts to forecast corn prices and to respond to other situation and outlook questions.

Keywords

Corn, prices, stocks, free stocks, forecasts, quarterly econometric model

Van Meir (*3*) recently investigated the effects of yearend stocks on annual season-average corn prices.[1] Because stocks summarize the effects of both supply and demand factors, annual prices are highly correlated with stocks.

Our article investigates the relationship between quarterly corn stocks and prices. As in an annual framework, higher ending stocks in any specific quarter result in lower farm-level prices. The effect of stocks on prices, however, differs throughout the marketing year, largely reflecting the annual nature of corn production. Early in the marketing year, large levels of stocks are necessary to meet demand until the next harvest. As the market year progresses and the next harvest approaches, lower stocks are sufficient to meet demand. A given level of stocks later in a marketing year, consequently, results in lower prices than does the same level of stocks earlier in the marketing year.

The Model

The general framework used here relating quarterly prices to ending stocks derives from a disequilibrium model where ending stocks clear the market as a residual. In a quarterly framework, a disequilibrium model is more appropriate than an equilibrium model because, with shorter time periods, the market is more likely to be observed in adjustment than as approximating equilibrium.

The functional form used here derives from the general hyperbolic function $(P - a)(S - d) = c$, where P is the quarterly corn price; S denotes quarterly ending stocks of corn; and a, c, and d are parameters (*1*). To avoid nonlinearities in estimation, we assume the parameter, d, equals 0. When one solves for price, $P = a + cS^{-1}$. To represent the different effects of stocks throughout the year, we assume a separate c parameter for each quarter. S is measured relative to the scale of activity in the corn industry, represented here by use (U). This procedure is necessary because of industry growth in the past 15 years. Furthermore, we include lagged price to reflect stickiness of prices in a quarterly framework, largely due to the lag structures in underlying supply and demand functions. Including lagged price also allows us to conduct the analysis using nominal prices, thereby circumventing the

*The authors are agricultural economists with the National Economics Division, ERS. They thank an anonymous reviewer for many helpful comments. The model discussed here is part of a quarterly situation and outlook forecasting model of the agricultural sector now being developed in ERS.

[1]Italicized numbers in parentheses refer to items in the References at the end of this article.

issue of choosing an appropriate price deflator. These adjustments result in the following equation:

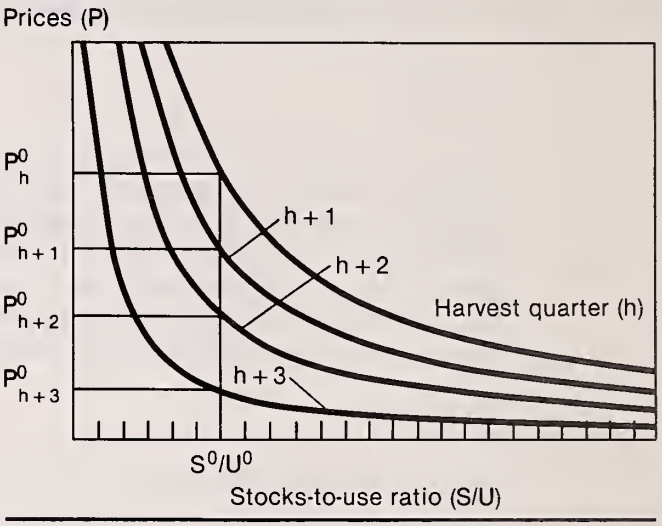
$$P = a + b\ lag(P) + \sum_{i=1}^{4} c_i D_i (S/U)^{-1} \qquad (1)$$

D_i represents four quarterly dummy variables (equal to 1 in the i^{th} quarter and to 0 elsewhere); lag(P) is the 1-quarter lag of P; and a, b, and c_i are parameters to be estimated. The subscript, i, denotes quarters, where i = 1 is the January-March quarter, i = 2 is the April-May quarter, i = 3 is the June-September quarter, and i = 4 is the October-December quarter. All other variables are as defined before.

The inclusion of four $c_i D_i (S/U)^{-1}$ terms allows stocks to affect prices differently in each quarter. Each c_i is expected to be positive, with the largest coefficient occurring in the harvest quarter and successively smaller coefficients occurring in the three following quarters. Thus, equation (1) is expected to yield a family of four hyperbolic curves such as in figure 1, which shows prices related to the stocks-to-use ratio.[2] As the stocks-to-use ratio increases in any given quarter, price falls, indicated by a move along that quarter's curve. For any given stocks-to-use ratio (such as S^0/U^0), the resulting prices (P^0_h, P^0_{h+1}, P^0_{h+2}, P^0_{h+3}) are smaller later in the marketing year, indicated by a move from one curve to the next.

Figure 1

Hyperbolic Family of Curves Relating Quarterly Prices to the Stocks-to-Use Ratio



Data: Definitions and Sources

The farm price of corn, which we used to estimate equation 1, is a monthly series published by the U.S. Department of Agriculture in *Agricultural Prices.* We derived quarterly prices by averaging the monthly prices from each quarter. Use and total stocks data are from supply and disappearance tables for corn published in the *Feed Outlook and Situation* (based on data from the Statistical Reporting Service).[3] Data for the categories that comprise total stocks are from the Agricultural Stabilization and Conservation Service.

We used three alternative definitions of stocks to estimate equation (1): total stocks and two alternative definitions of free stocks. Total stocks include stocks that are privately held, owned by the Commodity Credit Corporation (CCC), under outstanding CCC loans, and in the farmer-owned reserve (FOR). The first free-stock definition is total stocks less CCC-owned stocks less FOR stocks. The second free-stock definition further subtracts outstanding CCC loans from total stocks. The latter free-stock definition represents removal of all Government program stocks, whereas the former free-stock definition includes outstanding CCC loans which can be redeemed at any time without penalty. Units for stocks and use categories are million bushels, whereas units for prices are dollars per bushel.

[2]Although the hyperbolae being estimated can be expressed to show a direct relationship between prices and the stocks-to-use ratio (S/U) (fig. 1), the inverse of that ratio, $(S/U)^{-1}$, is the appropriate explanatory variable to use in estimating equation (1). Therefore, we refer to the inverse of the stocks-to-use ratio in discussing estimation results, but to the stocks-to-use ratio in discussing implications drawn from these parameter estimates.

[3]The use data have been adjusted because the corn marketing year has uneven quarters—two 3-month quarters, one 2-month quarter, and one 4-month quarter. We multiplied use in the April-May quarter by 1.5 and use in the June-September quarter by 0.75. Thus, all four quarters of adjusted use data are on a prorated, 3-month equivalent basis, thereby allowing the scale-of-activity deflation of stocks to be comparable.

Model Estimation

Equation (1) was estimated over 1971-81 (44 observations) with each of the three stock definitions; the first free-stock definition proved superior. The estimated equation is:

$$\begin{aligned} P = & -0.358 + 0.718\,\text{lag(P)} + 1.978\,D_1(S/U)^{-1} \\ & (1.8) \quad (10.1) \quad (3.8) \\ & + 1.462\,D_2(S/U)^{-1} + 0.551\,D_3(S/U)^{-1} \\ & (3.6) \quad (4.1) \\ & + 2.351\,D_4(S/U)^{-1} \\ & (3.3) \end{aligned}$$

$$\bar{R}^2 = 0.873 \qquad \text{MAE} = 0.162$$
$$\text{TPE1} = 12 \qquad \text{TPE4} = 4 \qquad (2)$$

Numbers shown in parentheses are t-statistics. Over 87 percent of quarterly corn price variation is explained by equation (2). The mean absolute error (MAE) of 16.2 cents per bushel over the estimation period represents a 7.3-percent error relative to the average price of $2.22 per bushel over the estimation period. TPE1 and TPE4 are the number of 1-quarter and 4-quarter turning point errors (TPE's)[4] over the 44-quarter estimation period. The TPE's for equation (2) indicate reasonably good performance.

All coefficients are significant at the 5-percent level. As expected, all coefficients of the inverse stocks-to-use ratios are positive. The largest coefficient occurs in the harvest quarter (subscript = 4) and coefficients for successive quarters diminish in size. Lagged price also plays an important role.

The Effects of New Crop Information

We estimated another equation to assess the effects on prices of preharvest information about the crop being grown. As new information becomes available—such as planted acres and weather developments—expectations about harvest size influence prices in the months prior to harvest. Large acres planted and weather favorable to crop development lead to expectations of a large harvest, pushing corn prices down in the third quarter. Factors leading to expectations of a small harvest are expected to push prices up.

To account for these effects, we added Corn Belt temperature for July and national corn acres planted to equation (2).[5] Units for Corn Belt temperature in July (JT7) are degrees (F), and units for acres planted (COAPLD3) are million acres. To estimate the preharvest price impacts of these variables, we allowed them to occur only in the third quarter and set them equal to zero in the other quarters.[6] Separate intercepts and separate lag price parameters were also assumed, allowing an unrestricted estimate of a different process for price determination in each quarter.[7]

The additional estimated equation is:

$$\begin{aligned} P = & -1.697 + 1.974\,D_1 + 1.807\,D_2 \\ & (3.0) \quad (2.6) \quad (2.7) \\ & - 4.828\,D_3 + 0.849\,D_1\,\text{lag(P)} \\ & (1.8) \quad (5.2) \\ & + 0.852\,D_2\,\text{lag(P)} + 0.744\,D_3\,\text{lag(P)} \\ & (4.5) \quad (3.7) \\ & + 0.804\,D_4\,\text{lag(P)} + 0.243\,D_1(S/U)^{-1} \\ & (7.9) \quad (0.2) \\ & + 0.331\,D_2(S/U)^{-1} + 0.757\,D_3(S/U)^{-1} \\ & (0.3) \quad (4.8) \\ & + 5.224\,D_4(S/U)^{-1} - 0.0418\,\text{COAPLD3} \\ & (3.4) \quad (2.0) \\ & + 0.119\,\text{JT7} \\ & (3.2) \end{aligned}$$

$$\bar{R}^2 = 0.908 \qquad \text{MAE} = 0.121$$
$$\text{TPE1} = 7 \qquad \text{TPE4} = 3 \qquad (3)$$

[4] An i-quarter TPE (for i equal to 1 or 4) is defined to occur when $(p_t - a_{t-1})(a_t - a_{t-1}) < 0$, where p and a are the predicted and actual prices, respectively, in the quarter indicated by the subscript.

[5] Corn Belt precipitation for July was also included, but did not provide a statistically significant effect.

[6] These variables will also influence prices in the following marketing year because the size of the harvest affects supply, use, and stocks throughout the next year. However, those effects are already accounted for by the inverse stocks-to-use variables through the next marketing year, whereas these additional variables are intended to measure the price impacts of preharvest information before that information is realized in production, use, and stocks.

[7] The resulting equation is equivalent to estimating a separate equation for each quarter. However, because the summary statistics of most interest for this study are for the full price series, we present the combined equation. The appendix gives the four equivalent quarterly equations.

The relative performance of this equation has improved; the $\bar{R}^2$ has increased while the MAE (representing a 5.4-percent error) and the TPE's have decreased. Both COAPLD3 and JT7 have the expected signs, and both are statistically significant. However, other coefficients are not all statistically significant.

Equation (3) implies that a 1-million-acre difference in planted acres causes a 4.2-cent-per-bushel difference in third-quarter corn price, giving a price flexibility (evaluated at the means) of 1.5. A 1-degree difference in Corn Belt temperature in July causes an 11.9-cent-per-bushel difference in third-quarter corn price, implying a price flexibility of 4.0.

Plots

Figures 2 and 3 show plots of the quarterly hyperbolic curves that result from the estimated equations. The figures illustrate the relative positions of the estimated hyperbolae relating price to the stocks-to-use ratio, other things being constant. Therefore, mean values for other variables over the estimation period ($2.22 per bushel corn price, 79.1 million acres planted, and 75.4 degrees) were assumed for the plots.

Higher stocks relative to use give lower prices within each quarter, and any specific level of stocks relative to use later in a marketing year gives lower prices than does the same level earlier in the marketing year. Because equation (2) was restricted to have the same intercept and the same lag price parameter across quarters, the resulting quarterly plots in figure 2 show four hyperbolae from the same family of curves. With those parameter restrictions relaxed for equation (3), each of the resulting quarterly plots is from a different family of curves, as shown by the four quarterly hyperbolae in figure 3. Nonetheless, the general properties about the slope of each curve and the relative positions of the four quarters' plots are preserved.

In figure 3, the plots for the first and second quarters are from the flatter parts of their hyperbolae, whereas the plots for the third and fourth quarters are from the steeper parts of their hyperbolae. This difference indicates that prices adjust most near harvest; as the size of the new crop becomes known, prices adjust during the transition from one marketing year to the next. Price adjustments in the other quarters are smaller because relatively little new information regarding crop supplies becomes known then. The estimation period data

Figure 2

Plot of Equation (2)

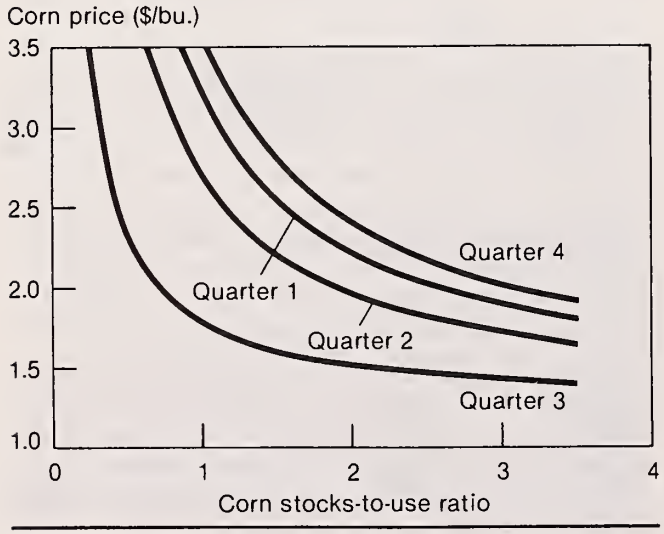
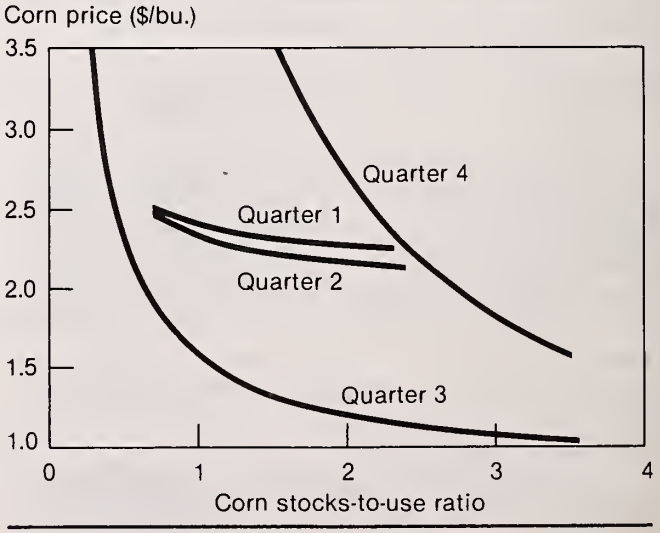


Figure 3

Plot of Equation (3)



confirm this relationship. The mean absolute price changes in the third and fourth quarters are larger than those in the first and second quarters.

Model Estimates for 1982 and 1983

To assess the performance of the estimated equations, we used each to estimate quarterly corn prices for 1982 and 1983, 2 years beyond the estimation period. In each quarter, actual exogenous and lagged endogenous data were used. For 1983, we made two data adjustments for the third and the fourth quarters to reflect the effects of the payment-in-kind (PIK) program.

First, we added to free stocks any unpaid PIK entitlement stocks in the farmer-owned reserve or in CCC inventories (stock positions not normally considered free) if the PIK participants' 5-month entitlement period had begun. In the third quarter, the entitlement period began for only a small amount of PIK payment corn (estimated at 70 million bushels representing participants in Florida, Louisiana, and much of Texas). However, for the fourth quarter of 1983, all PIK payment corn had begun the 5-month entitlement period, so all remaining PIK payment corn in the FOR or owned by CCC was assumed to be free (estimated at 1,418 million bushels). This adjustment affects both equations in the third and fourth quarters.

Second, we made an adjustment to represent effects on prices of anticipated PIK payments prior to those payments. Similar to the preharvest effects of planted acreage, anticipated PIK payments would hold prices lower than otherwise because many PIK payments came from "nonfree" stocks. We assumed that anticipated PIK payments affect prices as do preharvest expectations regarding the size of the new crop (represented in equation (3) by the planted acres variable). Therefore, we represented the effect of anticipated PIK payments by adjusting the planted acreage variable by an estimated amount of land that would have to be planted, on average, to give a harvest equal to the PIK entitlement.[8] This adjustment affects third-quarter 1983 price estimates from equation (3), but does not affect estimates from equation (2).

[8]We adjusted required conservation use acreage for corn under the PIK program (*2*) by the PIK payment rate and by an average-planted-to-harvested-acreage estimate to derive 22 million acres.

The table shows the actual 1982 and 1983 quarterly corn prices, the two equations' estimates, and summary statistics for each equation. Both equations perform reasonably well in 1982 with a similar pattern estimated by each. The MAE for equation (2) is 20.1 cents per bushel, which represents an 8.4-percent error relative to the average 1982 corn price (only slightly greater than that attained over the estimation period). The MAE for equation (3) is slightly larger, with 21.3 cents per bushel representing an 8.9-percent error. Two 1-quarter TPE's occur for equation (2) in 1982, but no 4-quarter TPE occurs. Equation (3) has one 1-quarter TPE and one 4-quarter TPE.

Equation (2) continues to perform well in 1983, although equation (3) performs less satisfactorily. The MAE of 13.2 cents per bushel for equation (2) represents a 4.4-percent error, considerably less than that attained over the estimation period. The MAE for equation (3), however, represents an 18.3-percent error. One 1-quarter TPE occurs for equation (2) in 1983, but no 4-quarter TPE occurs. Equation (3) again has one 1-quarter TPE and one 4-quarter TPE.

The largest 1983 forecasting error for each equation occurs in the fourth quarter, partly because of the combined effects of the PIK program and the 1983 drought which decreased stocks. Fourth-quarter free stocks—as adjusted by the PIK considerations discussed earlier—represented a much lower share of use than occurred for any fourth quarter in the estimation period. The 1983 fourth-quarter ratio of free stocks to use was 78 percent of the minimum value for that ratio in fourth quarters from 1971 through 1981. Anytime exogenous variables attain values far outside the range from the estimation period, forecasting problems can occur. With the hyperbolic function we used, this problem is greater at the lower end of the range because lower stocks-to-use ratios move the price estimates into the steeper sections of the quarterly hyperbolae where prices are more sensitive to stock changes.

Large supplies of wheat may have also contributed to the forecasting errors in the fourth quarter of 1983. Wheat feeding in the second half of 1983 was larger than in most years. This situation probably held corn prices lower than otherwise, but would not have been captured by the current model.

Quarterly corn price estimates, 1982 and 1983

Item	Units	Corn prices		
		Actual	Equation (2) estimates	Equation (3) estimates
1982:				
Jan.-Mar.	Dollars/bushel	2.48	2.37	2.43
Apr.-May	do.	2.57	2.59	2.49
June-Sept.	do.	2.39	2.91	2.96
Oct.-Dec.	do.	2.12	2.28	2.27
1983:				
Jan.-Mar.	do.	2.54	2.50	2.24
Apr.-May	do.	2.99	3.11	2.65
June-Sept.	do.	3.21	3.30	3.71
Oct.-Dec.	do.	3.16	3.43	4.19
Summary statistics—				
1982:				
MAE	do.	—	.201	.213
TPE1	Number	—	2	1
TPE4	do.	—	0	1
1983:				
MAE	Dollars/bushel	—	.132	.544
TPE1	Number	—	1	1
TPE4	do.	—	0	1

— = Not applicable.

Conclusions

Quarterly hyperbolic equations have been estimated relating corn prices to ending corn stocks. Higher stocks relative to use in any particular quarter give lower corn prices in that quarter. A given level of stocks yields lower prices later in the marketing year than does the same level of stocks earlier in the marketing year. New crop expectations based on preharvest information, such as acres planted and weather, influence prices in the June-September quarter. Estimates of these effects enable analysts to respond to questions regarding the short-term effects of preharvest information.

Corn price estimates for 1982 and 1983 indicate reasonably good model performance for quarters outside the estimation period. Although some forecasting problems were encountered in the 1983 estimates, these problems were largely related to unusual circumstances caused by the PIK program and the drought. The explanatory variables used here are typically monitored in situation and outlook activities.

The relationships we estimated should help analysts forecast corn prices and respond to other situation and outlook questions.

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(1) Green, Robert C. "Forecasting Quarterly Grain Prices by Means of the Relation of Stocks to Use." Unpublished, U.S. Dept. of Agr., Econ. Res. Serv., Oct. 1983.

(2) U.S. Department of Agriculture. "USDA Updates 1983 Acreage Reduction Programs Report." USDA press release, May 4, 1983.

(3) Van Meir, Lawrence W. "Relationship Among Ending Stocks, Prices, and Loan Rates for Corn," *Feed Outlook and Situation Report*, FdS-290, U.S. Dept. of Agr., Econ. Res. Serv., Aug. 1983, pp. 9-13.

Appendix

Estimated equation (3) in the text is equivalent to the following four equations, one estimated for each quarter.

January-March quarter:

$$P = \underset{(0.5)}{0.276} + \underset{(4.6)}{0.849}\ \text{lag}(P) + \underset{(0.1)}{0.243}\ (S/U)^{-1}$$

$$\bar{R}^2 = 0.892 \qquad (3.1)$$

April-May quarter:

$$P = \underset{(0.4)}{0.110} + \underset{(6.2)}{0.852}\ \text{lag}(P) + \underset{(0.4)}{0.331}\ (S/U)^{-1}$$

$$\bar{R}^2 = 0.948 \qquad (3.2)$$

June-September quarter:

$$P = -\underset{(3.0)}{6.525} + \underset{(4.5)}{0.744}\ \text{lag}(P) + \underset{(5.9)}{0.757}\ (S/U)^{-1} - \underset{(2.5)}{0.0418}\ \text{COAPLD3} + \underset{(3.9)}{0.119}\ \text{JT7}$$

$$\bar{R}^2 = 0.942 \qquad (3.3)$$

October-December quarter:

$$P = -\underset{(2.6)}{1.697} + \underset{(6.7)}{0.804}\ \text{lag}(P) + \underset{(2.8)}{5.224}\ (S/U)^{-1}$$

$$\bar{R}^2 = 0.888 \qquad (3.4)$$

In Earlier Issues

The general conclusion was that these short-term price movements are unpredictable. This implies that prices adjust almost instantaneously to changes that take place in the basic factors that affect the immediate supply and demand situation. No significant relationships were found between short-term changes in receipts and in prices of corn. This would be expected of a storable commodity; if receipts were temporarily out of line with market requirements, an adjustment could be made at low cost by moving part of the supply into or out of storage.

Richard J. Foote and G. L. Jordan
Vol. 7, No. 1, January 1955

Agricultural Development in Three Asian Countries: A Comparative Analysis

By Chinkook Lee and David W. Culver*

Abstract

This article examines the role of agriculture in economic development in three Asian countries: Japan, Korea, and Taiwan. Agricultural output increased substantially and agricultural exports were achieved at the initial stage of economic development in Japan and Taiwan. In Korea, however, agricultural performance was less satisfactory, particularly in exports. Land reform was a major element of agricultural development in all three countries.

Keywords

Agricultural development, role of agriculture, economic development

Our primary objective is to evaluate the role of agriculture in the initial stage of economic development in three Asian countries: Japan, Korea, and Taiwan. We examine the hypothesis of Rostow and others that an increase in agricultural output through the growth of agricultural productivity is essential for sustained economic growth to "take off" (*9*)[1].

A related objective is to evaluate whether the experience of these three countries confirms the conventional view (*6*) that countries pass through roughly similar development patterns. Thus, we evaluate similarities as well as dissimilarities of the development process.

We selected the following periods for this analysis: Japan, 1868-1920; Korea, 1954-77; and Taiwan, 1949-77. Japanese economic development is often regarded as a model for other developing nations, particularly in Asia. Thus, the factors determining early agricultural development in Japan are particularly relevant to the less-developed countries. We start by examining Japanese agricultural development in its historical perspective and use a similar approach for Korea and Taiwan.

*Chinkook Lee is an international training administrator, Economics and Management Branch, International Training Division, Office of International Cooperation and Development, U.S. Department of Agriculture (USDA), and David W. Culver is Director of the Commodity Credit Corporation Operations Division, Foreign Agricultural Service, USDA.

[1]Italicized numbers in parentheses refer to items in the References at the end of this article.

Researchers in Japanese economic development generally consider the Meiji Restoration beginning in 1868 as the starting point of modernization and 1920 as the point at which the country entered a period of sustained growth. The periods selected for Korea and Taiwan reflect recent economic development in those countries that promise sustained growth.

Agricultural Development in Japan

Rice was the staple food and by far the most important commodity in Japanese agriculture during the early stage of development, and rice output rose modestly compared with other agricultural products. Growth during the early period was more rapid in sericulture (production of silkworm cocoons), tea, and livestock production. Hayami (*3*) reports that during the 19th century growth rates of production for the major groups of agricultural commodities in Japan were 0.9, 2.1, 3.9, and 6.8 percent for rice, other crops, cocoons, and livestock products, respectively.

Table 1 shows that the output of six crops (rice, wheat, barley, naked barley, sweet potatoes, and white potatoes), which accounted for nearly 80 percent of Japan's domestic food production, increased steadily over the four decades (1880-1920) and that the final 10-year average (1911-20) was 77 percent above the first 10-year average (1881-90). It is also possible to fairly satisfactorily appraise the increase

Table 1—Indexes of area, yield, production, and productivity for six major crops, Japan, 1881-1920 (10-year averages)

Period	Area	Yield	Production	Productivity	
				Labor	Land
	Index				
1881-1890	100	100	100	100	100
1891-1900	113	113	127	114	110
1901-1910	116	125	146	137	125
1911-1920	121	146	177	179	143

Sources: (*2, 3, 5*).

in agricultural productivity in Japan in 1880-1920. The last two columns of table 1 show the growth of Japanese agriculture during this period was accompanied by increases in productivity of both labor and land, particularly labor. Labor productivity increased 79 percent while land productivity increased 43 percent above the level of the 1880's.

Japanese rice yields in the 1880's are estimated by Hayami and Yamada (*4*, p. 108) to have been 2.36 tons of paddy per hectare, compared with yields in other Asian countries in the 1953-62 period of 1.17 tons per hectare in the Philippines, 1.36 tons in India, and 1.38 tons in Thailand. However, yields of 2.75 tons in South Korea and 2.93 tons in Taiwan during 1953-62 compared favorably with Japanese yields during the 1880's.

Although many factors contributed to Japanese agricultural development during this period, we consider only some of the more important ones here. First, the abolition of feudalistic landownership allowed farmers to take full responsibility for agricultural production, including decisions on land use and crop choice. The new landowners were exempted from the feudal taxes in kind, and new taxes were levied in cash based on the value of land. This Land Tax Revision in 1872 was cited by Hayami (*2*) as the single most important institutional change of the Meiji era. The new conditions encouraged farmers to produce cash crops such as silk, tea, tobacco, and livestock and to increase rice yields. The new taxes, based on the value of land, increased Government revenues which were used in part to finance a network of research and experiment stations.

An important related point was the Government's initiation of export incentive measures for sericultural products (mostly raw silk) and tea. Raw silk alone provided 61 percent of the country's export earnings from 1868 to 1875. These exports at the initial stage of economic development were a crucial factor contributing to agricultural development.

Development of infrastructure during this period contributed to market expansion for agricultural products to satisfy domestic demand. During 1883-98, railroads, both national and private, were extended to 5,500 kilometers from an initial system of 72 kilometers. This system was further extended by 1920 to 25,900 kilometers. The development of the railroad system encouraged farm-sector purchases of industrial inputs in larger volumes at lower prices, and it allowed farmers to sell their products at higher prices. The terms of trade for the agricultural sector had improved.

What is of interest to other countries is not so much the fact of a striking transformation in the productivity of Japanese agriculture as that it took place within a traditional framework of small-scale farming and with no significant reduction in the agricultural workforce. Moreover, the Japanese experience illustrates how agriculture was to fulfill its traditional role in the strategy of overall development. Japanese agriculture during the course of modernization and rising productivity also earned foreign exchange and provided investment resources for other sectors. Thus, the Japanese pattern of economic development can be characterized as moderately rapid with balanced growth of agriculture and industry, based on small-scale units.

Agricultural Development in Korea

Rice has historically dominated Korean agriculture as the main staple food grain. The long period of Japanese influence (1910-45) until the end of World War II included improvements in crop varieties, irrigation, and other crop practices along the Japanese model. These improvements helped Korea boost farm production; overall agricultural output rose 7 percent annually from 1946 to 1949. However, during the Korea war (1950-53), agricultural production decreased, with growth starting again in 1954.

Table 2 shows output growth rates of major agricultural commodity groups from 1954, the year after the Korean War ended, to 1977. The growth rate was 3.9 percent per year from 1954 to 1965, but only 2.2 from 1965 to 1973. This slower growth rate during 1965-73 was associated with a slower growth rate in rice production during this period. Agricultural output was still dominated by rice production. Thus, even with a sharp increase in silkworm cocoon production, overall agricultural output grew more slowly. It grew about 8.8 percent annually from 1973 to 1977 because of an initial success with new rice varieties and a big push in livestock production.

From 1970, the Government encouraged planting of high-yield rice varieties derived from crosses of the native japonica types with indica varieties; initial yields were approximately 30 percent over indigenous varieties. Furthermore, the Government also stressed irrigation, reshaping of paddies, and heavy use of fertilizers and herbicides. This program generally succeeded through 1977 when Korea produced a record 6 million tons of rice.

Table 3 shows growth rates of major inputs and labor and land productivity during 1954-77. Labor input, measured as the farm labor force, increased 3.7 percent annually during 1954-65, but declined thereafter. Land input, measured by cultivated land, increased slightly during 1954-65, but did not change much during 1965-77. Although fixed capital, such as farm machinery and equipment, did not increase during the initial stage of economic and agricultural development, working capital (comprised of expenditures for chemical fertilizers and herbicides) increased rapidly following construction of a nitrogen fertilizer plant in the late 1950's.

Thus, the growth of land productivity (particularly paddies) was associated with the increasing application of fertilizers and pesticides accompanied by the development and adoption of high-yield rice varieties and the improvement of irrigation facilities. Labor input in agriculture increased significantly in 1954-65 with the influx of refugees from North Korea and workers displaced from devastated urban industries. Labor productivity increased slightly during this period. Therefore, inputs contributed more to increases in total output (64 percent) than did productivity (36 percent). Labor productivity rose 6.9 percent during 1965-73 and 13.7 percent during 1973-77.

Table 2—Growth rates of major agricultural commodity groups, Korea

Year	Total output	All crops	Rice	Silkworm cocoons	Livestock
	Percent per year				
1954-65	3.9	3.7	2.7	2.3	6.5
1965-73	2.2	2.2	1.3	19.2	5.2
1973-77	8.8	8.7	7.8	– 1.2	11.7

Source: *Yearbook of Agriculture and Forestry*, Republic of Korea Ministry of Agriculture and Fisheries, various years.

Table 3—Growth rates of major inputs and productivity, Korea

Year	Labor	Land	Fixed capital	Working capital	Productivity	
					Labor	Land
	Percent per year					
1954-65	3.7	1.3	—	8.3	0.7	3.0
1965-73	– 2.9	—	1.2	19.5	6.9	2.4
1973-77	– 2.4	– .1	1.7	12.7	13.7	9.6

Source: (*1*).
— = No change.

Land reform was also delayed. Even though a land reform act was passed in 1949, the program was not implemented until 1965, delaying farmers' incentives to increase yields (*10*). Another delayed initiative was the new agricultural cooperative law, passed in 1961 to assist the land reform program. Thus, significant progress in agricultural development, with laborsaving technology and further development of landsaving technology, was not evident until the late 1960's.

Agricultural Development In Taiwan

Taiwan's economy was in disorder at the end of World War II. Inflation threatened the people's living, and the large influx of migrants from the Chinese mainland aggravated food shortages. However, this situation did not last long. With favorable prices for farm products and increased supplies of production inputs, particularly through the United Nation's Relief and Rehabilitation Administration, agricultural production was quickly revived. Increased crop area planted, rather than crop yields, was initially the main contributor to rising crop output. The increased area came largely from multiple cropping rather than from new lands. For instance, the multiple cropping index rose from 112 in 1945 to 170 in 1951.

The role of agriculture was critical in Taiwan to the balanced strategy of developing agriculture and industry jointly in the early stage of economic development. As table 4 shows, outputs increased sharply even in 1946-51 (the early recovery period from wartime) for all major categories, with total output up over 10 percent per year. Vegetable production, which increased substantially, was stimulated by the production of new crops such as mushrooms and asparagus, largely for export. Growth in total agricultural output slowed in 1951-67, mainly because of the slower growth of rice production. However, growth in ouput of fruits, vegetables, and livestock and livestock products remained strong.

The high growth rate of agricultural output in the initial period was achieved with significant increases in both land input and productivity (table 5). Land use rose slowly, but labor use was up substantially in the initial period and then rose more slowly from the mid-1960's. However, the most rapid increase in inputs was in current capital, where high growth rates persisted throughout the period. Rising agricultural productivity was a major source of national growth in the early years, with labor and land productivity growth rates of 7.6 and 10.9 percent, respectively, during 1946-51.

Table 4—Growth rates of major agricultural commodity groups, Taiwan

Year	Total	Rice	Fruit	Vegetables	Livestock and products
	Percent per year				
1946-51	10.3	9.5	5.6	8.2	14.5
1951-67	4.6	3.1	11.3	8.1	7.6
1967-77	4.0	.6	5.4	8.4	7.9

Source: *Taiwan Agricultural Yearbook*, Department of Agriculture and Forestry, Taiwan, various years.

Table 5—Growth rates of major inputs and productivities, Taiwan

Year	Labor	Land	Fixed capital	Current capital	Rice yield	Productivities	
						Labor	Land
	Percent per year						
1946-51	3.4	1.0	4.3	23.7	5.4	7.6	10.9
1951-57	1.4	1.6	3.3	8.5	4.5	6.0	6.6
1957-67	1.4	1.6	7.2	8.5	3.1	4.6	5.1
1967-77	.9	.2	7.2	10.6	.9	5.4	3.8

Source: *Taiwan Agricultural Yearbook*, Department of Agriculture and Forestry, Taiwan, various years.

Labor and land productivity grew throughout the period, with growth rates after 1951 generally 4-6 percent per year.

The land reform program, allowing farmers to own their own land, was started in 1949 and encouraged rapid agricultural growth in Taiwan. The first step was the reduction of land rent, which increased the incentives for more intensive use of both human and land resources. The second stage of land reform was the sale of public land in 1951. The third stage was the land-to-the-tiller program started in early 1953. Under this program, the Government purchased all privately owned tenanted holdings exceeding 3 hectares of paddy land or 6 hectares of dry land and resold the land to the tenants. The program encouraged multiple-crop farming and widened employment opportunities of agricultural workers. The application of power machinery to rice cultivation in Taiwan began in 1954 with imports of small tractors. Mechanization of land preparation in Taiwan, especially of paddy fields, is now widespread.

The land reform was only part of a systematic and successful agricultural development effort. Taiwan, like Korea, built on the modernization dating from the long Japanese occupation prior to World War II. The agricultural progress allowed transfers from agriculture to the nonagricultural sectors and also provided large agricultural exports, a major source of foreign exchange in the 1950's. Agricultural research sponsored by the Government accelerated growth in the postwar years; great technical advances boosted crop yields, and a better crop rotation system further increased the opportunities for multiple cropping.

Taiwan's most important natural resource is its agricultural land, but only 20 percent of the total area is arable. Thus, if natural resources alone had determined the rate of economic growth, rapid development in Taiwan could not have been expected. However, the experience in Taiwan strongly supports the notation that, in an environment conducive to market expansion through international trade, labor, capital, and entrepreneurship can substitute for natural resources.

Similarities and Dissimilarities

Land reform was common to all three countries. In Japan, the reforms of the Meiji Restoration removed the restraints of the feudal system. The land tax reform, which granted a fee simple title to the farms and transformed a feudal share-crop tax to a fixed rate cash tax, increased the farmers' incentives. In Korea and Taiwan, as in Japan, land reform encouraged tiller-ownership of the land, and farmers were free to choose what to produce based on market conditions. However, the land reform in Korea was not completed until a later stage of economic development.

The main difference lies in the less satisfactory performance of Korea's agricultural sector, particularly in agricultural exports at the initial stage of economic development. The agricultural infrastructure in Korea was less extensive than in Taiwan, and the postwar Korean Government was less active and successful in raising agricultural productivity. The Korean countryside was very heavily damaged by the Korean war and required prolonged efforts to regain prewar production potential. Korea simply started behind Japan in terms of the ability of its agricultural sector to satisfy domestic food and fiber needs and never caught up (especially in per capita terms); it, therefore, never managed to achieve an exportable surplus. Thus, the dynamic role of agriculture in economic development is more apparent in Japan and Taiwan than in Korea during the periods of precondition for takeoff.

Agricultural development was the backbone of industrialization in Taiwan's economy. Use of Japanese small-scale machinery was clearly a characteristic of agricultural modernization in Taiwan. Agricultural growth was less significant in Korean economic development. Modernization of agriculture was not achieved in Korea until well after the manufacturing sector developed and industrialization was well underway.

In Taiwan, foreign exchange earnings from agricultural exports helped finance necessary imports of capital goods and intermediate products. This process was similar to the early stage of economic development in Japan. Japan exported raw silk and tea at the initial stage of economic development whereas

Taiwan exported mainly fruits and vegetables. Korea, on the other hand, had to depend on manufactured exports, heavily supplemented by foreign capital inflow (*8*). U.S. grants and loans were a major source of import finance through the early 1960's. Korea's export drive based on manufactured products gained momentum in the mid-1960's, and export earnings took over more of the burden. Furthermore, a booming economy attracted greater foreign investment and enabled Korea to borrow large amounts of capital from the International Bank for Reconstruction and Development, Japan, and the United States. Here again, the argument that "agricultural societies must generate a surplus of food and other agricultural products which can be traded for non-agricultural goods through export markets to provide revenues for initial technology and equipment imports" (*7*, p. 56) is generally supported by experience in Japan and Taiwan, but not in Korea.

Conclusion

The role of agriculture in economic development in these three Asian countries was somewhat different. In Japan and Taiwan, agricultural output increased substantially in the initial stage of economic development. Furthermore, agricultural and processed agricultural goods were the principal sources of foreign exchange to finance initial industrial growth. In Korea, agricultural output growth was less impressive and significant agricultural exports were not achieved. Korea relied instead on the growth of manufacturing to spur economic growth.

We conclude that the theory of growth in agriculture as a precondition to takeoff applies reasonably well to Japan and Taiwan, but not to Korea. Even for Japan and Taiwan, agricultural development in the initial stage may not have been wholly separate from other economic changes.

The analysis of these countries confirms, however, the conventional view that countries pass through a broadly similar development process. Each experienced systematic changes in the composition of output as economic development progressed, a decline in agriculture's share of the gross national product, and increases in the shares of manufacturing, construction, and public utilities. Improvement in the rural-urban terms of trade was substantial for Japan and Taiwan, but less important in Korea. Finally, all three countries had strong exports.

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Research Review

When Are Export Subsidies Rational? A Comment

By David Orden*

In a recent article, Paarlberg suggests that export subsidies may be an optimal policy when certain assumptions of a standard neoclassical trade model are relaxed. In particular, he concludes that, if greater weight is placed on the welfare of producers than others, an export subsidy may be the appropriate policy.

The purpose of this comment is to illustrate that Paarlberg's argument in this regard is not correct. The critique draws on two important concepts from trade theory: the existence of a social welfare function when weights attached to different individuals are known (*2*), and the nonoptimality of a trade intervention (such as an export subsidy), as opposed to other forms of intervention, in cases where the objective is other than exploiting monopoly power in trade (*1*).[1]

The problem with Paarlberg's analysis stems from his specification of the Government's criterion function in terms of only one market:

$$w = \gamma^p \int_0^P S(P)dP - \gamma^c \int_0^P D(P)dP - \gamma^t \alpha X$$

where γ^p, γ^c and γ^t are the marginal weights policymakers place on the welfare of producers, consumers, and taxpayers, respectively; α is the export subsidy; X is the volume of exports; P is domestic price of the export good; and S(P) and D(P) are domestic supply and demand.

As an alternative, consider the more general social welfare function:

$$\tilde{w} = \gamma^p U^p(C_1^p, C_2^p) + \gamma^c U^c(C_1^c, C_2^c) + \gamma^t U^t(C_1^t, C_2^t)$$

where $U^p(C_1^p, C_2^p)$, $U^c(C_1^c, C_2^c)$, and $U^t(C_1^t, C_2^t)$ are the utility functions of producers, consumers, and taxpayers, respectively. Samuelson has shown that it is possible to derive social indifference curves with the usual properties of indifference curves derived from budget-constrained welfare maximization by an individual, if the weight γ^p, γ^c, and γ^t are known and income is always reallocated among individuals in such a way as to maximize social welfare.

On the basis of this principle, the effects of an export subsidy in a two-good general equilibrium context are illustrated in figure 1. Equilibrium production is initially at A. Domestic and world price ratios are equal, and welfare-maximizing consumption is at A′. Good X is exported and good Y is imported. An export subsidy shifts the domestic price ratio facing producers and consumers in favor of the export good. Production shifts along the production possibility frontier to B. Trade must still take place at world prices. If domestic production has no impact on these prices (the "small country" case), then consumption shifts to B′, with a loss of welfare—assuming income transfers to maximize $\tilde{w}$ given total income from production at B—represented by the movement to a lower social welfare indifference curve (A′ to B′).[2] If shifts in domestic production affect world prices (the "large country" case), movement from A to B is likely to cause the relative price of X to fall. Welfare-maximizing consumption would then be at B″, entailing an additional welfare loss.[3]

As Samuelson's principle makes clear, the analysis illustrated in figure 1 is completely general with

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[1]Italicized numbers in parentheses refer to items in the References at the end of this note.

[2]The location of point B′ is justified as follows: consumers face the same domestic prices as producers. For these prices, imagine an income expansion line (not shown in the graph) indicating utility-maximizing consumption of X and Y as income expands. Trade must occur on the world price ray through B. The intersection of the income expansion path and this world price ray will determine the location of B′. The utility indifference curve is tangent to the domestic price ratio rather than to world prices.

[3]This situation assumes an export subsidy sufficient to shift production from A to B in the large country case. This subsidy will be larger than the subsidy required to attain such a shift in production at constant world prices. The reader may wish to verify that *equal* subsidies would result in less of a shift in production in the large country case, with welfare being higher or lower than at B′.

Figure 1

Effect of an Export Subsidy on Production, Consumption, and Welfare

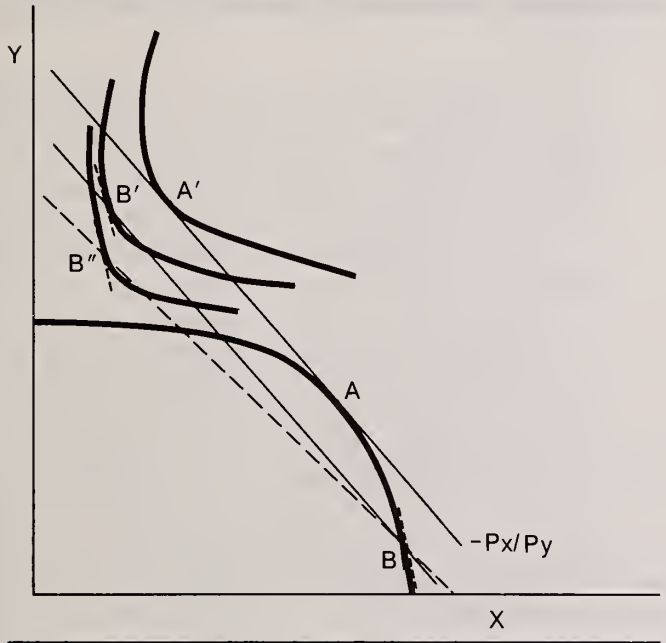
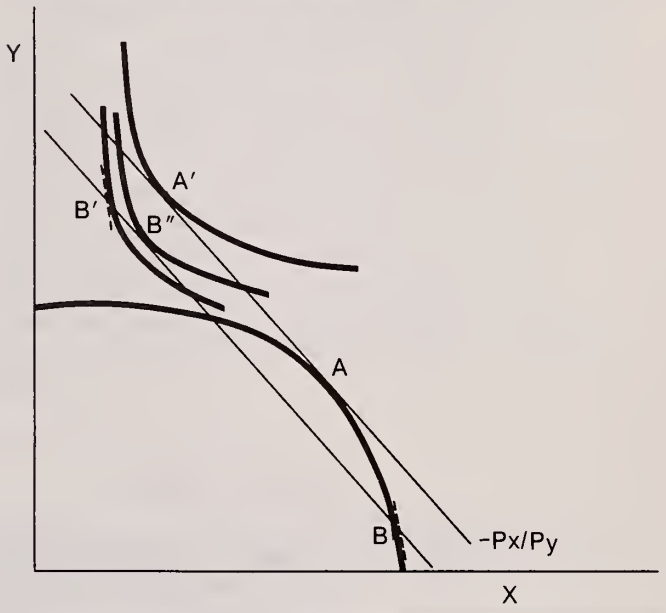


Figure 2

Effect of An Export Subsidy Versus A Production Tax (on Y) and Subsidy (on X) on Production, Consumption, and Welfare



respect to the weights given to the utility of different individuals in the social welfare function, $\tilde{w}$. The analysis does not depend on equal weights.

If income transfers of the type suggested by Samuelson are not feasible, one could interpret the notion of Government's favoring export producers as suggesting some intervention to increase the relative price and level of output of good X. One can obtain such an objective at less welfare loss by using a tax on Y production and subsidy to X production, rather than an export subsidy. Figure 2 illustrates the analysis for the "small country" case. Again, initial equilibrium is at A and A′, and introduction of the export subsidy shifts the domestic price ratio facing producers and consumers. Production shifts to B and consumption to B′. With a tax on Y production and a subsidy to X production, relative prices facing producers are altered (again inducing a shift from A to B), while consumers continue to face world prices. Consumption would be at B″, with less of a welfare loss than at B′.[4]

It may not be difficult to envision situations in which export subsidies appear rational, at least from the shortrun perspective of policymakers. However, to the extent that one justified such an intervention by drawing upon a formal model, it is appropriate not to violate its fundamental properties. Paarlberg's suggestion that assumption of unequal weights associated with welfare of different individuals may justify export subsidies as an optimal policy fails on two counts in the context of a static, two-good general equilibrium model.

[4]The general claim that welfare is higher at B″ than at B′ is open to question in the absence of optimal income transfers. In this case, use of the tangency of an indifference curve and world prices as a criterion for welfare maximization is justified if preferences are identical and homothetic among individuals. The desired income distribution is presumably attained by the shift in domestic producer prices, which raises the return to factors used intensively in production of the export good.

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In Earlier Issues

. . . farmers are well aware that their incomes seldom turn out to be those planned, that price expectations are seldom realized. Their best expectation of output prices is uncertain. Contrary to this fact, the neoclassical analysts of competition assumed something called "perfect knowledge," an assumption that even though demand schedules were not known, the equilibrium prices that would be obtained were known exactly.

Richard H. Day
Vol. 14, No. 4, October 1962

Export Subsidies Are Still Irrational

By Bruce Gardner*

Paarlberg (*2*) shows that an export subsidy is a rational policy choice, as compared with *laissez-faire* or an export tax or equivalent, for plausible U.S. coarse grain parameter values under a criterion function that places greater weight on producers' than on consumers' welfare.[1] Yet, in standard welfare economics of trade distortions (*1*), export subsidies are suboptimal because greater amounts can be transferred to producers if one uses appropriate domestic distortions. This situation suggests that Paarlberg's analysis should have considered other policy options; in the U.S. grains policy case, natural candidates are a target price/deficiency payment scheme or production controls (or both). This note shows that the suggestion is appropriate—that both producers and consumers/taxpayers are worse off under an export subsidy than under alternative policies.

Consider Paarlberg's case 2 for U.S. coarse grains. The elasticity of supply is 0.2, and the elasticities of demand are -0.2 for domestic use and -1.5 for U.S. exports. The United States produces 212 million tons annually, of which 150 million are used domestically and 62 million are exported. The base price is \$100 (really an index number, but we aren't far wrong in thinking of price in dollars per metric ton). The parameter θ which weights producer as against consumer/taxpayer welfare is taken as 1.5, well in the range that makes an export subsidy optimal in Paarlberg's analysis. If one uses his equation (7), the optimal subsidy expressed as a fraction of world price is:

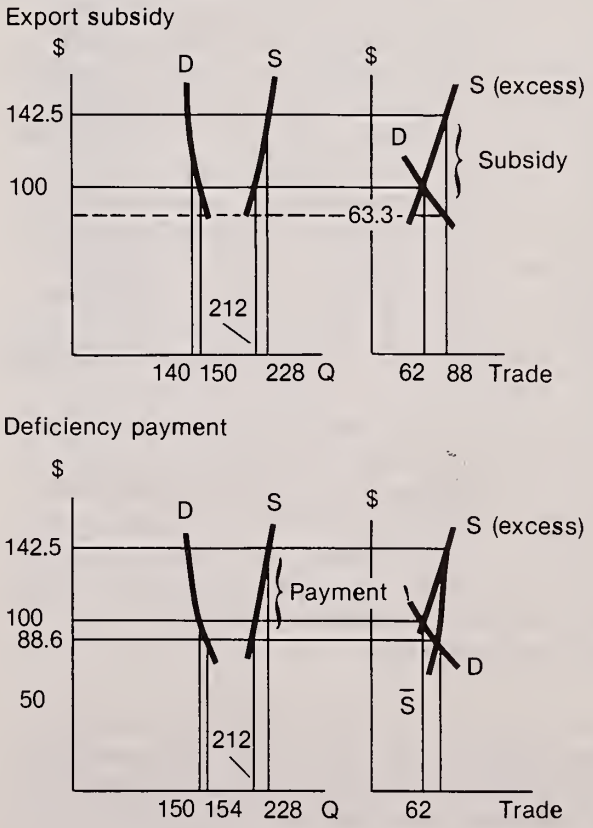
$$\frac{1}{-1.5} + \frac{212\,(-0.5)}{100\,(-0.424\,-\,0.300)} = 0.80$$

The elasticity of U.S. excess supply at the quantities given is 1.17.

Figure 1 shows the implied U.S. domestic and trade-sector equilibria. Producer gains are $(142.5 - 100) \times 220 = \$9{,}350$ million. Subsidy costs are $63.3 \times 88 = \$5{,}570$ million, and U.S. consumers lose $(142.5 - 100) \times ((140 + 150) \div 2) = \$6{,}160$ million for a total loss of \$11,730 million. Giving the producers' gains a weight of 1.5 means that their weighted gains of \$14,025 exceed the losses of consumers and taxpayers; thus, under the criterion assumed there is a net gain to the program of 2,300 million "weighted" dollars.

Figure 1

Graphic Depiction of Export Subsidy and Deficiency Payment



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[1]Italicized numbers in parentheses refer to items in the References at the end of this note.

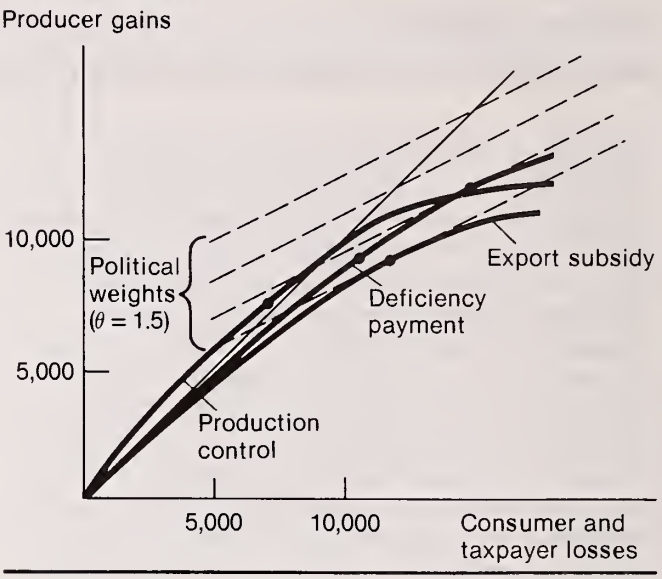
Consider an alternative policy in which we guarantee U.S. farmers a price of $142.50 per ton by means of deficiency payments. Producers gain the same $9,350 million as above. But, this quantity is thrown on the U.S. and export market to determine the market price for U.S. and foreign buyers. This situation shifts the U.S. excess supply curve to $\bar{S}$, generating a market-clearing price of $88.60. Thus, U.S. consumers gain 11.4 × 152 = $1,730 million. But, taxpayers must pay deficiency payments of (142.5 − 88.6) × 228 = $12,290 million. The losses to consumers and taxpayers together are $10,560. Thus, the Nation as a whole is better off by $1,170 million if one uses a deficiency payment scheme rather than an export subsidy. This is a particular case of the general result that a domestic distortion is preferable to a trade distortion; the trade distortion in this sense, therefore, is irrational as a means to aid producers.

Consider a third possibility, that production controls are imposed. The possibility has promise because the demand function for U.S. exports is not perfectly elastic. Consequently, foreign consumers will pay for some of the price gains to U.S. producers. Now, when we raise price to $142.50, we find that U.S. consumption falls to 140 tons and exports fall to 36.4 tons. Thus, the production control must hold U.S. output at 176.4. Producers gain 42.5 × 176.4 = $7,500 million. However, they must leave some resources idle or switch them to other uses. Let the program be a voluntary production control in which the Government pays producers for idled land enough to compensate them for returns that could have been earned. Thus, $7,500 is the net producer gain. Consumers' losses are 42.5 × ((140 + 150) ÷ 2) = $6,160 million. Taxpayers pay the sum necessary to rent the idled land. Let us suppose land accounts for 30 percent of costs, so the payments are (212 − 176.4) × 100 × 0.3 = $1,070 million. The loss to consumers and taxpayers together is $7,230, less than the gain to producers. Thus, we have a positive-sum game; it would be rational to choose this program even if producers' income were weighted equally with consumers and taxpayers.

The net gains occur because the United States exploits its market power in exports. This possibility becomes much less as export demand becomes more elastic. Consider Paarlberg's case 1, in which the

Figure 2

Transfer Curves



elasticities of export demand, domestic demand, and supply are −5.0, −0.5, and 0.4, respectively. Applying his equation (7) now gives an optimal export subsidy yielding a lower markup of the U.S. price over the world price of 46 percent. The table shows the resulting producer, consumer, and taxpayer gains and compares deficiency payments and production controls. Production controls now look much worse, although they yield net benefits to producers despite the high export demand elasticity. It is still the case, however, that deficiency payments dominate the export subsidy policy.

A handy means of both comparing alternative programs and choosing the optimal scale of each is given by the surplus transfer curves shown in figure 2 for case 2 (low elasticities). Paarlberg's θ parameter determines the slope of the social indifference curves, shown as dotted lines following his assumption of a fixed θ. Tangency with a surplus transfer curve locates the optimum characterized by political weights on producer versus consumer/taxpayer well-being. The fact that the deficiency-payment transfer curve is steeper at the tabulated values, shown as heavy dots, implies a deficiency payment program could be specified that would be even more efficient at redistribution than the ones in the table. These

values simply use the domestic producer price generated by Paarlberg's optimal export subsidy as the target price. The optimal target price would be higher, generating even more gains to producers, at the tangency point indicated by a circular dot. Note also that, given any point on the export-subsidy curve,there are points on the deficiency-payment curve to the northwest; that is, both producers and consumers/taxpayers can be made better off. It is in this sense that the choice of an export subsidy is always an irrational choice, whatever political weights we place on producer as compared with consumer/taxpayer welfare.

It remains possible that an export subsidy might be efficient as a second-best intervention, given another distortion that an export subsidy might offset. It is also possible that an export subsidy might be optimal at redistributing income to a more narrowly defined interest group—for example, grain export shippers. But it is a suboptimal policy choice in the context of Paarlberg's discussion.

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Gains from programs in coarse gains

Elasticities	(1) Producers	(2) Consumers	(3) Taxpayers	(1) ÷ (2) + (3)
	Million tons			*Ratio*
Low:				
Export subsidy	9,350	– 6,160	– 5,570	0.80
Deficiency payments	9,350	1,730	– 12,290	.89
Production controls (paid)	7,500	– 6,160	– 1,070	1.04
Production controls (unpaid)	6,430	– 6,160	0	1.04
High:				
Export subsidy	6,990	– 4,380	– 4,370	.80
Deficiency payments	6,990	840	– 8,670	.89
Production controls (paid)	4,580	– 4,380	– 1,960	.72
Production controls (unpaid)	2,600	– 4,380	0	.59

When Are Export Subsidies Rational? A Reply

By Philip L. Paarlberg*

The comment by David Orden illustrates a central theme of my article on export subsidies (*5*).[1] Orden uses a neoclassical general equilibrium model to demonstrate that export subsidies are not a socially optimal policy choice. I argue that, from a policymaker's perspective, use of export subsidies may be understandable (rational). These two arguments are not incompatible. Rather, they represent different views on how the "world" works. Orden's analysis mirrors what many perceive ought to be, whereas my analysis attempts to understand why policymakers might use export subsidies, which they frequently do. My article begins by noting the contradiction between observed behavior and received theory. It then investigates what modifications of the traditional framework are required to obtain a frequently observed outcome which is not explained by theory.

The first part of Orden's comment is an expanded treatment of my equation (1), which represents the traditional neoclassical trade model. That model assumes a policymaker for the entire economy who can use any set of policies and who can reallocate income among agents to maximize social welfare.

Orden notes that Samuelson (*6*) has shown that, even with different weights on the agents, under these assumptions one can derive social indifference curves with the usual properties. With these assumptions, Orden correctly argues that export subsidies are not optimal. As there are no market failures, no policy intervention is justified, except for a tariff for a large country. I show the same result and make the same points on pages 2 and 3.

The difficulty is that intervention in the economy is widespread and frequently takes the form of export subsidies. Cochrane and Ryan (*3*) estimate that in the late fifties and early sixties as much as 30 percent of U.S. agricultural exports received U.S. Government assistance. Even now export subsidies are repeatedly advocated by producer groups. The purpose of my article is to try to understand why policymakers might resort to such intervention. My argument is that policymakers are rationally responding to a world which is not accurately captured by the neoclassical model. Which framework is preferable is not the issue; it depends on the problem one is analyzing.

The model I discuss assumes a policymaker sets policies in only a part of the economy. This means that an agricultural policymaker has no influence over policies in other sectors. In my view, this extreme separability of policy decisions is more accurate than that represented by a policymaker for the entire economy. The agricultural policymaker's welfare, not society's, is maximized in my formulation. The welfare of the agricultural policymaker is a weighted sum of the welfare of political interest groups, and the weights reflect the ability of those interest groups to lobby the policymaker for favorable treatment. Thus, the weights are political parameters which reflect the political environment in which policy decisions are made.

Under some very restrictive assumptions about the political environment, this formulation of the policymaking process will yield the familiar neoclassical results. For a large exporting country, if all the weights on the political interest groups equal 1, then the agricultural policymaker's welfare can only be increased by taxing exports. In this political environment the agricultural policymaker has no incentive to treat domestic interest groups differently when setting policies, but the policymaker does have the incentive to tax exports to increase taxpayer welfare. If the agricultural policymaker is not concerned about taxpayer welfare, no incentive to intervene in the sector exists. Maximizing the agricultural policymaker's criterion function in the former case yields the partial-equilibrium socially optimal export tax formula, whereas the latter case yields no intervention (competitive) solution.

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[1]Italicized numbers in parentheses refer to items in the References at the end of this note.

The point is that there is no need for the political influences confronting an agricultural policymaker to reflect those of the society at large. An agricultural policymaker selects a set of policies which enhances the welfare of interest groups that person values greatly at the expense of others. Consequently, a situation can arise where the policymaker chooses a policy which lowers national social welfare (*2*). If the agricultural policymaker values the welfare of producer groups over consumers and taxpayers, the policymaker's welfare can be increased by subsidizing exports. Whether society as a whole benefits or loses is not of concern so long as the policymaker benefits. I argue that the adoption of export subsidies by a policymaker is a result of lobbying by producer groups for policies which increase their welfare.

In the second part of his comment, Orden relaxes his assumption that income can be reallocated and argues that if policymakers are going to intervene, a production subsidy is preferred over an export subsidy (*1*). Bruce Gardner's comment is similar, and he uses numerical examples. However, that is not the issue I am concerned about. I excluded production subsidies from my model for several reasons. First, I was primarily concerned in the article with understanding why a policymaker might subsidize exports rather than tax them as received trade theory suggests. That is, if the structure of the policymaking process is changed, can the sign of the trade intervention rule be positive rather than negative? If the political weights are equal to 1, then the sign of α/p^w is unambiguously negative. I argue that the sign can be positive if producers are viewed relatively favorably by the agricultural policymaker.

Orden and Gardner extend my analysis to argue that there are policies such as direct payments to producers which are better than export subsidies even when producer welfare is favored relative to other groups. This issue is separate from the one I discussed in the article. However, I would argue that the preference of direct producer subsidies to export subsidies is less general than Gardner and Orden suggest. In the context of the neoclassical model there is no dispute. However, I would argue that, when the political process is included through different weights on political interest groups, the ranking of policies becomes ambiguous. In such circumstances, a case-by-case analysis is necessary to reflect the political environment.

Gardner uses a numerical example to illustrate his point when producer welfare is valued 50 percent more than consumer or taxpayer welfare. In his illustration, the weighted net welfare gain *to the policymaker* from an export subsidy is $1.2 billion less than if a direct payment scheme is used.

As a counter example, I will use the same welfare measures, but impose a different set of political weights on the measures. For convenience, in the article, I required taxpayer and consumer welfare to be valued equally, but empirical analysis of the world wheat market shows that taxpayer welfare in most major countries is more valued in the political process than is consumer welfare (*4*). In the wheat market, the extreme instance of this valuation difference is in Japan. Relative to wheat producers' welfare, consumer welfare in 1974 and 1975 was valued at 0.07 and taxpayer welfare was valued at 0.12 (*4*). If, for purposes of illustration, the welfare measures for the United States are ranked with these weights, the export subsidy policy would yield a weighted welfare gain of $8.3 billion, whereas the direct payment scheme would yield only $8.0 billion. Thus, with these political weights, the agricultural policymaker prefers the export subsidy over direct payments because the policymaker is more concerned about budget exposure, which is smaller for export subsidies, than about the cost to consumers.

My conclusion is that, when the political process is incorporated, the policymaker's ranking of policies cannot be established *a priori*, but only after the political influences on the policymaker have been established. Political influences can be imposed by the researcher prior to ranking policies or can be determined empirically. In either case, policies can only be ranked given a political environment as their rankings are not independent of that process. In the wheat market, empirical estimates of the political process suggest that, for the major exporters, policymakers prefer direct payments over export subsidies. However, as my counterexample illustrates, that is not general conclusion, but a conclusion based on the specific political environments in the wheat-exporting countries. Whenever policies are ranked, a political environment is implicitly assumed.

As I have shown elsewhere (4), this framework can be expanded to a more comprehensive treatment of the policy formation process. In a model of the world wheat market, I included five interest groups, six policies (including producer subsidies and export subsidies), and five countries. This model allows the policymaker to select levels of policy intervention in all six instruments, thereby obtaining a mixture of direct and indirect intervention. The message of that research is the same. These policies exist and reflect the response of policymakers to the political pressures they face. When judged on the basis of social welfare, the policy responses may not be optimal. But, for the policymaker operating in response to political pressure, they may well be optimal.

My article on export subsidies is not intended to advocate or justify export subsidies, but to understand why policymakers select export subsidies as a form of trade intervention, which they frequently do. This model is not incompatible with the neoclassical trade model; the two models just have different objectives and assumptions.

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Modeling Farm Decisions for Policy Analysis

Kenneth H. Baum and Lyle P. Schertz (eds.). Boulder: Westview Press, 1983, 418 pp., $21.00

Reviewed by Charles V. Moore*

Firm-level analysis (micromodeling) is not dead. It is alive and well, even flourishing. This book provides a showcase for micromodelers working on the methodological frontier, allowing them to present their wares. This parade of paradigm peddlers, this panoply of policy pedagogues provides some possible panaceas.

Baum and Schertz brought together an outstanding group of model builders at Airlie House, VA, in 1981; this book presents the proceedings of that conference. As an attendee I was privy to the discussion and debate surrounding the papers which unfortunately could not be contained in this volume.

The conference, as well as the book, was organized into nine parts with all but the last having formal discussant papers. These discussants should not be treated lightly because they put forth some very succinct and cogent observations, oftentimes winnowing out some of the choicer grains in their limited time and space. Part 1, as expected, develops "The Historical and Theoretical Setting" of micromodeling in the profession.

Richard Day presents a nontraditional approach to modeling the firm, based on adaptive economics. A simulation approach based in part on Forrester's "Industrial Dynamics" is posited. Defining an economy as a system of agents who interact with one another and their environment means it may be thought of as a set of interacting adaptive processes. Behavior in this system breaks down into a sequence of economic, physical, and institutional components and feedback effects. Day cautions at the end of the paper that, "Adaptive economics should not be thought of as *the* theory or even *a* theory. Rather, . . . it is a way of thinking about an approach for understanding economic change both in terms of explanations and of policy design" (p. 47).

Part 2, in attempting to broach the problems of macro-micro relationships, immediately runs afoul of the modeler's nemesis: aggregation error. Taylor reviews this now familiar ground, but brings no new breakthroughs offering consistency between micro and macro results.

Mitchell and Black discuss the information requirements of farmer decisionmaking with special emphasis on incorporating aggregate forecasts into farm decision models. They report positive results for farm operators using such information series and predict a rapid increase in the demand for U.S. Department of Agriculture forecasts and outlook reports.

Miller, one of the discussants, argues that modeling technology may be ahead of the development of human capital. At least at the institutional level, "the analytic deficiency lies in our failure to be able to link up the policy evaluation function and the understanding gained in the modeling process by individuals in ERS, at universities and at other institutions and to place this unique human capital directly in a policy analysis role" (p. 94).

Parts 4 and 5 both focus on institutional considerations and risk. Berry and Eidman concentrate on the stochastic processes inherent in agricultural production and marketing. Their two papers present comprehensive reviews of the literature and contribute numerous observations and insights into modeling risk. These chapters are a must reading for any researcher, novice or seasoned, interested in working in this broad and fertile area. Papers by the six discussants for these two parts flesh out the subject and should not be missed.

Nonoptimization simulation techniques as exemplified by FLIPCOM, FLOSSIM, and FAHM are reported in part 6. These acronyms represent three models available in the literature which are excellent examples of the flexibility and computational robustness obtainable with combinations of simulation or

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optimization submodels. The most interesting of the three is the Multiple-Farm Opportunity Set Simulation Model presented by Skees. This model simulates a land market with different sized firms competing for resources, and it tracks the growth path of these firms over time. Results clearly show how single-firm growth models tend to overstate actual growth rates.

Methodological advances in optimization models are showcased in part 7. Two of the papers, although modifications of earlier models, demonstrate the ingenuity of individual model builders in solving specific problems. One is a polyperiod firm model; the other is a recursive goal programming model. King and Oamek present what appears to be a significant advance in optimizing under risk with their GREMP model. Stochastic dominance with respect to a function is used to group outcomes and operators into smaller tractable groups, thus avoiding many of the measurement problems associated with decision models incorporating direclty estimated utility functions. But this chapter would have fit better into part 5, "Risk Management." In a book of readings such as this it might get lost in its present placement.

The final section of formal presentations is addressed to a major group of users of the output of micromodels—cooperative extension specialists. The authors of part 9 agree with those in part 2 that micromodeling in policy analysis suffers from the curse of aggregation error. However, these final writers assert that micromodels can still be useful to the public policy specialists in demonstrating the impact of policy variables on individual farm firms. Doering feels that they are most useful if the anlayst has anticipated the possible policy alternatives and has available at the "teachable moment" sufficient results to allow clientele to make informed decisions.

John Lee in his opening remarks traces the Economic Research Service (ERS) drift away from the use of micromodels for policy analysis due in part to the aggregation problem. A cost of this drift to macromodels is the loss of information on the distributional impacts of national policy. Another loss is the human capital developed within the profession in micromodeling expertise. In this reviewer's opinion, the recent policy to concentrate ERS resources in Washington will exacerbate the problem.

Who would benefit from reading this book and how? I have observed over the years that a high proportion of graduate students and young professionals have difficulty making the leap from the idealized examples in the textbook to the real world of field research. I would strongly urge persons so afflicted and teachers of research methods courses to read this book. Professionals young and old interested in descriptions of what is going on along the micromodeling frontier should do likewise. They will find it much more rewarding than searching a voluminous stack of current journals. And besides, the review comments are published alongside the original papers, so they needn't wait for one or two issues to find a critique.

Selected Writing on Agricultural Policy and Economic Analysis

Frederick V. Waugh (ed. James R. Houck and Martin E. Abel), Minneapolis: University of Minnesota Press, 1984, 466 pp., $29.50.

Reviewed by J. Dawson Ahalt*

Few have had as much impact on the field of agricultural economics as Fred Waugh. Not only was he among the earliest to apply mathematics and statistics to economic analysis, but he pursued and further developed this rigorous approach throughout his long career. His contributions clearly have helped agricultural economists in their achievements in the past several decades.

James Houck and Martin Abel have performed a helpful service for agricultural as well as other economists by pulling together into one book some of Waugh's key published works. For the up and coming generation of economists, this book will stimulate new approaches to research problems. It will also jog the memories of many others who knew Waugh or who were sparked by his ideas.

While Waugh's published works may be fewer in number than those of others who have written in the field, his articles cover an extremely broad array of relevant topics. More important, his writings stand as landmarks in a number of major subject areas.

Houck and Abel divided their selections of Waugh's articles into three principal categories: economics, mathematics and statistics, and econometrics. The editors included work produced by Waugh during the 1923-70 period, which demonstrate the longevity of his productive career and the ability of his work to stand the test of time.

Waugh was interested in more than just theory. He encouraged its application. The papers contained in the economics section are divided into "Theory and Application" and "Marketing Policy." In the section on theory, Houck and Abel included Waugh's lucid article, "Cobweb Models," which addresses some of the fundamental issues that economists have long struggled with in microeconomics. Also included in this section are articles on price instability, distribution of sales among markets, and excise taxes on commodity marketings. The central topics addressed in these three articles rank high on the current agricultural policy agenda. Waugh's article on price instability is especially interesting because he argues that consumers can benefit from fluctuating prices. And, for producers, he shows that the shape of the demand curve determines how they are affected by price volatility.

Much of Waugh's published work was associated with demand-related problems. However, that did not keep him from examining a host of different issues. The policy selections that Houck and Abel include show the breadth of Waugh's talents. His pioneering role in developing food stamps and his views on other approaches to simultaneously help farmers as well as low-income consumers is laid out in an excellent article on using agricultural surpluses written in 1940.

Today's agricultural policymakers, farm organizations, commodity groups, and legislators could gain some useful insights from Waugh's 1945 article on how to dismantle the high price-support structure that had been put in place during World War II. In this work, written almost 40 years ago, he urged the United States to push for free trade and recommended prompt action to deal with high and rigid price supports. In fact, he proposed a mechanistic method for adjusting support levels depending on whether commodity surpluses or deficits were occurring. Some policymakers would like to have access to such a device today. Waugh favored production controls only "as a last resort." As always, he made a strong case for expanding the demand for farm products as a way to help the agricultural economy.

Waugh's mathematical, statistical, and analytical skills were deeply appreciated and well-known for decades by employees in the Economic Research Service and its predecessor organizations in the U.S. Department of Agriculture. To know him was a unique experience. Unlike pathfinders in many fields

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who are often busy and have little time, especially for neophytes, Waugh was always willing to help. When approached for assistance on a knotty mathematical problem, he had been known to reply, "I never was much of a mathematician." Then he would proceed to help solve the problem, offer advice, or suggest an idea or two that would eventually lead to the solution. The 11 articles that Houck and Abel selected in the "Mathematics and Statistics" section cover topics ranging from regression analysis to a series of articles on the uses of matrices and various quantitative applications in economic analysis. There is also an interesting piece on the use of probabilities in playing bridge. For those who may be into advanced arithmetic, he produced an interesting article on "aligation."

My main quarrel with the editors is that they chose not to reprint any of the material from Waugh's handbooks on graphic analysis. While these self-help handbooks did not break new ground in a scientific sense, they did much to raise the level of basic analytical skills for many economists and statisticians. Moreover, these handbooks illustrate Waugh's unique and untiring efforts to teach and help others. (For a free copy of his "Graphic Analysis—Applications in Agricultural Economics," write the editor of *Agricultural Economics Research.*)

Simple and straightforward solutions to problems were a trademark of Waugh's. His article, "The Place of Least Squares in Econometrics," as the title promises, states his well-known position in favor of least squares and the single-equation approach over more sophisticated econometric formulations and solution techniques. His work on "Cobweb Models" further supports that strongly held view.

Commodity price analysts will find the 1923 article on potato pricing worth reading, even today. Others will find this article helpful in appreciating Waugh's pioneering work and insightful skills early in his career. In the twenties, he cautioned readers on the limitations of analytical tools and the care in interpreting results. That advice is valid today.

Waugh's work will remain relevant for a long time to come. He was a "great" in the field. Those who knew him and had an opportunity to work with him were indeed fortunate. Houck and Abel are to be commended, for this volume will permit others to more readily benefit from the rich legacy that Waugh has left behind.

Land Reform, American Style

Charles C. Geisler and Frank J. Popper (eds).
Totowa, NJ: Rowman and Allanheld, 1984, 353 pp., $28.00.

Reviewed by Gene Wunderlich*

When this book was being planned, editors Geisler and Popper were counseled not to include all the wide-ranging topics of their original outline. The counsel was only partially accepted. The result is a book of fine readings, but too diverse to sustain a central theme. It lacks the methodological cohesion of a text, but the high quality of the articles and the quantity of references make it an excellent book of readings for the professional or student.

Charles Geisler and Frank Popper are, respectively, a sociologist at Cornell University and a political scientist in urban studies at Rutgers University. Their particular perspectives in topic and author selection as well as their own contributions result in a book that should be especially interesting to institutionally oriented land economists. The editors do not attempt a theory of land reform, but instead provide a history, several examples of reform policies or activities, and some implications and prospects. Having adopted the title, "land reform," the editors found it necessary to explain at length how the American style differs from that of the Third World. Because of their emphasis on distributional justice and political power, one can understand, if not agree, with their choice of title. A less fetching, but descriptive, title might have been "Landownership Policy in America." The contents are best revealed by a brief narration of individual chapters.

The book is well supported by Geisler's history of land tenure in the United States. He begins his history with the Ordinances of 1785 and 1787, arguing that they set the pattern for American landownership. He thus omits completely the impact of colonial experience and English institutions and reforms which probably had as much influence in America as in England. However, Geisler's sweep across two centuries of land settlement, speculation, conservation, populism, and New Deal agriculture is an excellent background for the study of American rural land tenure.

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Popper's individual contribution focused on a topic of great current urgency at the time of the book's preparation: the Sagebrush Rebellion. He discusses how the political issue of giveaways of Federal land to individuals, corporations, and States was defused and coopted. Popper states that "[t]he Reagan administration found clever, politically appealing ways to start to transfer some public lands—serious amounts, but nothing on a genuinely West-wide scale." Popper concludes that "[t]he Sagebrush Rebellion did not fail—it ended."

The 16 chapters which follow the Introduction and History are collected under five "Land Reform and..." sections: Agriculture, Natural Resources, Minorities, Rural Communities, and Urban Communities. Under "Agriculture," Dean MacCannel and Jerry White contrast the intentions of the Reclamation Act to foster family-sized units with experience in the Westlands Water District which yielded 2,000-acre units and a two-class social structure. Frederick Buttel deflates some myths about superior productivity of small farms, notes bimodalism in agricultural structure, argues for public intervention in the land market, and argues also for improvements in wage and working conditions for agricultural labor. John Hart, with text from the Catholic Church's *Strangers and Guests*, extends the notions of stewardship to support for land reform. David Holland, with arguments based on energy efficiency, questions the common notions about small-scale superiority and recommends more attention to shaping agricultural development which includes control of interests in efficient large-scale farms.

In the section captioned "Resources," Popper's chapter on public lands is combined with energy development in Appalachia by David Liden and settlement control in the New Jersey Pinelands by Kevin Rielley, Wendy Larsen, and Clifford Weaver. Within the space of a short chapter, Liden provides great detail on the condition and implications of the separation of ownership of Appalachia's mineral wealth and its residents: "The development of

Appalachian severed minerals inherently threaten the surface land and water over and near them." He notes and supports a movement to join surface and mineral interests: "The Appalachian land reform movement has begun to explore the ways in which the right to private property can be balanced against the right of local communities...." Rielly, Larsen, and Weaver describe legislation, organization, and planning processes involved in protecting and preserving the New Jersey Pinelands, a unique natural asset facing development pressures. Their chapter contains little evaluation, but concludes indirectly that the program is a success.

The equity or fairness issues relating to specific classes of persons—Amerindians, blacks, and Mexican-Americans—comprise a section on "Land Reform and Minorities." Roxanne Ortiz opens with a historical justification of contemporary Indian claims to interests in land. The contemporary issue is "fundamentally an economic issue of production and livelihood. But it is also a social issue of basic human rights...." She is explicit on measures that would help Indians: halt agricultural, mineral, and forest development by non-Indians on or near Indian lands; inventory Indian resources; encourage Government finance; encourage United Nations technical assistance for development plans; restore original reservation territories; and reconstruct communal Indian enterprises. Harold McDougal examines five policies or experiences relating to black landownership: General Sherman's "40 acres and a mule" policy, uniquely successful in the Sea Islands of South Carolina and Georgia; the Oakland self-held land purchase schemes in the late 19th century; Marcus Garvey's "back to Africa" efforts; the Southern Tenant Farmers Union; and the post World War II off-the-land movement of black farmlandowners. A Mexican-American view of land reform is presented by Guillermo Lux as "violations of the treaty of Guadalupe Hidalgo" which in 1848 ended the war between Mexico and United States. Lux recounts the weakness of original titles and the events resulting in ambiguous claims to land, discusses perceived injustice by Anglo-oriented courts and governments, and predicts increased agitation by Hispanics based on ancient land claims.

In the first of three chapters comprising the section on "Land Reform and Communities," John Emmeus Davis, planner, presents a case for the adoption and use of community land trust (CLT) as an "equity reallocating" device. He describes carefully how the CLT is organized. The CLT is a "nonprofit organization with membership that is open to any resident of the surrounding community" and that has the power to acquire and hold land. The services of land are acquired from the CLT by lease. The leaseholder has title to improvements. The CLT, however, retains a claim on any appreciation obtained in sale above a reasonable return. Davis' case for the CLT is interesting, but his treatment of the economics of CLT operation ranges between weak and nonexistent. He explains that the CLT acquires land, for example, but says nothing about the price; without transfer of interests or value, the CLT could hardly be regarded as land reform. John Gaventa and Bill Horton tell the Appalachian landownership story again, summarizing the process and results of the Appalachian Regional Commission's (ARC) 1978 survey of 80 Appalachian counties reported by the Appalachian Land Ownership Task Force in a small volume (with introduction by Geisler), *Who Owns Appalachia? Landownership and Its Impacts*, and six thick volumes of detailed interview and observer results. Despite some serious statistical faults, the ARC study is an extremely useful work. Mark Lapping and Dale Forster in their chapter managed to expand the scope of American land reform in this book beyond the borders of the United States: "For well over two hundred years, classical land reform issues have been the focus of much of the political and economic life of Prince Edward Island (PEI)." As a result of studies in the late sixties, PEI created the Land Development Corporation (LDC) to deal with perceived problems of absentee ownership by Americans and Canadians from other Provinces. In a variety of ways the LDC intervenes in use and availability of land for agricultural and other purposes. The whole of the interesting Lapping-Forster chapter cannot be recounted here, but noteworthy is their reference to the importance of information on the creation and implementation of land policy. They describe briefly the model Maritime Land Registration and Information Service.

The final section on land reform and urban communities consists of three chapters on condominium conversions, residential displacement, and neighborhood regulation. These chapters, respectively by Daniel

Lauber, Chester Hartman, and Robert Nelson, raise issues of landownership and control not limited to urban or residential areas and are worth at least a quick review by agricultural economists.

Land Reform, American Style easily makes up in scope, energy, and content of individual chapters what it lacks in tractable or even identifiable theory. It is a contribution to the American land tenure literature. If you are interested in land policy, there will be something in it for you.

In Earlier Issues

Because of the prominent place of corn in the agriculture of our country, prospects for an oncoming crop are of interest and concern, not only to Corn Belt farmers, but to the public generally. Prospects for the crop are basic to the outlook for livestock production and to prospective supplies of meat, milk, and eggs. Changes in prospects for the crop are under continual observation, from the first indications of farmers' planting intentions, as reported in March, to the time of harvest in the fall.

Malcolm Clough
Vol. 3, No. 4, October 1951

Livestock Response Functions

Earl O. Heady and Shashanka Bhide (ed.). Ames: Iowa State University Press, 1984, 331 pp., $29.95.

Reviewed by Richard Crom*

Livestock Response Functions is an excellent technical reference for those interested in estimating the response of an animal to typical rations and other inputs used in common management practices. Although the introductory chapter gives a general notion of the production functions concept, the unfamiliar reader would need to refer to more basic references on that subect:

> This presents some livestock and poultry production functions estimated at Iowa State University—resulting from interdisciplinary experiments planned with the intention of estimating response surfaces. In all cases, they result from data generated by animal and poultry nutritionists working with economists (vii).

The experimental data range from recent observations to those gathered in the fifties. Functions based on the older data should still be applicable if management practices and the animal's genetic composition have not changed.

An "Overview" chapter follows the short introductory chapter. Here the editors briefly define the production function and response surface, identify problems associated with the definition of inputs and outputs, and review functional forms. Estimating response functions for livestock and poultry is more difficult because of the continuing flow of outputs and inputs over the animals' life cycles and, unless a very large set of sample observations is feasible, using the same set of animals for repeated observations lead to the statistical estimation problem of autocorrelation.

Separate chapters reporting the work of various researchers follow the overview. Chapters on milk, eggs, broilers, and swine report specific commodity response functions. Specific response functions for subsectors of the beef industry are reported under chapter titles dealing with grain and soilage rations, forage-concentrate substitution, silage-concentrate substitution, and beef gains in response to alternative levels of protein. The final chapter derives shortrun output supply and input demand functions.

The summary table reproduced here shows the design of the experiments underlying the production functions. Readers should be able to select the response function in which they are interested.

The book should be useful to both animal scientists and agricultural economists working in livestock and poultry production. The presentations are so technical they may preclude use by the lay person. However, many extension economists should be able to use the book when preparing materials for producer clientele. Commodity analysts will find the book lacks a chapter relating the response function developed from performance data on an individual animal to the more aggregate behavior of an entire lot or pen.

The book does fulfill its stated purpose—to report response functions estimated from experimental data. One can ask no more!

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Summary of experiments

Production function	Experimental design	Treatments	Major inputs	Observations
Milk (Ch. 3)	Two experiments were conducted; experimental design and treatments were the same for both trials. A 4 × 3 factorial design involving 72 milk cows was used for 3 years. Data for 12 weeks of experimental period each year were used in the analysis.	Four rations with varying levels of energy supplied by alfalfa hay, combined with three levels of feed per day, were used.	Alfalfa hay and grain	Daily weights of hay, grain, and milk production were recorded as were observations on daily temperatures.
Eggs (Ch. 4)	A 4 × 3 factorial design involving laying hens was used. The birds were assigned to 288 cages with 1, 2, or 3 birds per cage. The experimental period extended for 280 days.	Four rations with varying levels of protein were combined with three housing densities.	Corn and soybean meal	Daily records of egg production (number and weight) and feed consumption per cage were kept.
Broilers (Ch. 5)	A simple randomized block design involving 360 chicks assigned to 30 pens subject to 1:1 sex ratio was used.	Five isocaloric rations with varying percentages of crude protein constituted the treatments in the trial.	Corn and soybean meal	Records of live weight of broilers and time to consume 6, 12, 18, 24, 30, and 36 kg feed per pen were kept. Live weight of broilers and feed consumed after 2, 4, 6, 7, and 8 weeks of starting date of the experiment were recorded.
Beef (Chs. 6, 7)	A 6 × ± factorial design involving 112 steers in each of 3 years was used in the experiment. Trial was conducted at two sites.	Six rations with varying ratios of soilage to corn were used. One set of six rations included 10 mg of DES per steer per day.	Soilage (alfalfa and brome grass mixture) and corn grain	Records of live weight of steers and feed consumption at fixed time intervals were kept. Steers were graded at definite intervals of time. Daily temperatures were also recorded for the experimental period.

—Continued

Summary of experiments (Continued)

Production function	Experimental design	Treatments	Major inputs	Observations
Beef (Ch. 8)	A 6 × 2 factorial design involving 278 yearling steers was used. Steers were assigned to 12 pens, and the experiment was replicated over 3 years.	The treatments were represented by combinations of one of the six rations and one of the two methods of feeding. The six rations were isocaloric with varying proportions of energy supplied by corn silage. The two methods of feeding were: (1) constant energy per day, and (2) ad libertum feeding.	Corn silage, corn grain, and dehydrated alfalfa pellets	Records of live weight steers and feed consumption levels at fixed intervals of time were kept. Carcass characteristics and yield grades were analyzed at the end of the experimental peiod.
Beef (Ch. 9)	A 6 × 2 factorial design involving 84 steer calves was used in the experiment.	Each of the six rations was combined with one of the two methods of feeding. The six rations were isocaloric with varying proportions of energy, supplied by corn silage. The constant energy per day and ad libertum feeding were the two feeding methods. One of the ratios represented two-phase feeding.	Corn silage, corn grain, and dehydrated alfalfa pellets	Records of live weight of steers and feed consumption levels at fixed intervals of time were kept.
Beef (Ch. 10)	A simple randomized block design involving 96 steers assigned to 12 pens was used in the experiment.	Six levels of soybean meal per steer per day were used as treatments. Two replications per treatment were used.	Corn grain, corn silage, and soybean meal	Live weight of steers and feed consumption levels were recorded at fixed time intervals. Two quality scores were recorded.
Hogs (Ch. 11)	Two groups of hogs were used. A simple randomized block design was used to allocate treatments within each group. A total of 528 crossbred hogs with 88 lots of 6 each was involved in the experiments.	Combinations of a growing ration and a finishing ration constituted a treatment. Rations were distinguished by varying levels of protein. Six treatments were assigned within one group of hogs, and five treatments were assigned within the other group. Each treatment was replicated four times.	Corn grain and soybean meal	Live weight of hogs and feed consumption levels were recorded at fixed time intervals. Two quality scores were recorded.

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