Research Review

EXCHANGE RATES IN INTERNATIONAL COMMODITY MODELS THE COMMON CURRENCY QUESTION

By William H Meyers*

In a review of problems with international commodity models, Labys (*5*) questions the omission of monetary factors such as inflation and exchange rates [1] Monetary factors have been more volatile in recent years, and their effects have consequently become more important This note presents an evaluation of alternative methods of incorporating exchange rates in commodity models with particular emphasis on pooled cross-section time-series estimation

Two communications in the American Journal of Agricultural Economics (AJAE) have dealt briefly with methods of incorporating exchange rates in estimated supply and demand equations for use in international commodity models Bjarnason, McGarry, and Schmitz (*1*) advocated converting variables to common currency prior to estimation Elliott (*2*) argued that equation coefficients should be estimated in national currency and converted to common units Both results were derived from time-series analysis Neither study addressed the common currency question in the context of a pooled cross-section time-series estimation model

Pooling time-series data across two or more countries is sometimes desirable, especially in demand studies where short data series and multicollinearity in prices and income combine to limit the precision of the estimates In this note, alternative methods of handling currency differences in time series analysis are compared and the common currency question is examined in a pooled, cross country time series model Elliott thought that the estimation procedure could limit the flexibility of the model, therefore, the estimation of equation coefficients and the operational use of these coefficients are both considered here

Currency Conversion in a Time-Series Model

Bjarnason, McGarry, and Schmitz (BMS) advocated the use of a fixed "base"exchange rate rather than the annual exchange rates for conversion purposes regardless of whether they used a price deflator When prices are deflated, the base years of the deflator and the exchange rate should coincide Elliott implied that the BMS method lacked the flexibility required to consider exchange rates differing from those used in estimation He preferred to estimate the equations in national currencies and then to convert to a common currency by multiplying the price coefficients by the appropriate exchange rates

These methods are now compared through use of a simple time series estimation model As the BMS method merely transforms all currency data by a constant multiple (r), it is easily shown that

$$B = rC \qquad (1)$$

where

- B = Vector of national currency coefficients of Elliott,
- C = Vector of common currency coefficients of BMS,
- r = Scalar base exchange rate

Thus, if B is an unbiased estimator of the true coefficients, rC is also However, if annual exchange rates are used to convert the data (that is, if r is a vector of annual rates), it can be shown that least squares estimates of the coefficients are biased

Constant Exchange Rate

Let us consider a time-series demand model with K independent variables Demand responds to internal price and income levels, therefore, all variables are assumed to be in units of national currency Let the true model be

$$Y = X\beta + e \qquad (2)$$

where

- Y = Vector of T observations on the dependent variable (for example, food consumption per capita),
- X = Matrix of T observations on the K independent variables (for example, prices and income per capita),
- β = Vector of K true parameters,
- e = Vector of stochastic disturbances

The least squares estimator of β is B

$$B = (X'X)^{-1}X'Y \qquad (3)$$

Let r be the constant base exchange rate in dollars per unit of national currency,[2] and define the price and income variables in dollars as Z equal to rX Thus the estimation model in dollars is

$$Y = ZC + v \qquad (4)$$

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

[2] If the variables are deflated by a price index, the Bjarnason, McGarry, Schmitz method would use the exchange rate for the year which is the base of the price index

As r is scalar, the relationship between the least-squares estimators C and B is

$$C = \frac{1}{r}(B) \qquad (5)$$

It is clear from the relationship between the estimated coefficients in equation (5) that, having done the regression in dollars using a fixed exchange rate, one can always find the national currency parameters B And it is clear that one can always convert to a different exchange rate r^* if necessary—for example for projection or simulation purposes—by calculating new coefficients C*, so that

$$C^* = \frac{r}{r^*}(C) = \frac{1}{r^*}(B) \qquad (6)$$

These changes can be made directly in the model equations as in Elliott's method—precisely what Elliott implied was not possible with the BMS method It demonstrates that converting with a fixed base exchange rate does not cause loss of flexibility

Variable Exchange Rate

Bjarnason, McGarry, and Schmitz did not make explicit why it is preferable to convert with a base exchange rate rather than annual rates Using a base exchange rate merely changes the estimated coefficients by a known constant, whereas using annual exchange rates would generally give estimates of β that are biased and not merely "less than favorable "

Considering the case of conversion with a vector of annual exchange rates (r_t) that vary across time will demonstrate this bias Let the estimation model in dollars be redefined as

$$Y = ZD + v \qquad (7)$$

where

$$Z = PX$$

$$\text{and } P = \begin{bmatrix} r_1 & 0 & & 0 \\ 0 & r_2 & & \\ & & 0 & \\ 0 & & 0 & r_T \end{bmatrix}$$

The least squares estimator D is

$$D = (X'P'PX)^{-1}X'P'Y \qquad (8)$$

Substituting (2) into (8) and taking the expected value of D yields

$$E(D) = (X'P'PX)^{-1}X'P'X\beta \qquad (9)$$

The expected value of D is not equal to a constant transformation of the true coefficient vector β except in the trivial case where X is nonsingular and there are zero degrees of freedom

The conclusions are clear For estimation purposes it makes no difference whether one uses national currencies or transforms the data to a common currency with a fixed exchange rate The choice of method is a question of convenience to the researcher However, conversion with variable exchange rates gives parameter estimates that cannot be interpreted as constant multiples of the national currency coefficients

Currency Conversion in a Pooled Model

A pooled cross section time-series model represents an important instance in which it may be necessary to convert all values to a common currency If there are no cross-sectional constraints on the estimated coefficients, either national currencies or fixed exchange rates can be used This is the case when estimating the coefficients of "seemingly unrelated regression" equations However, if a cross-sectional constraint is imposed on a price or income variable in a pooled model, it is imperative to convert that data to a common currency prior to estimation A simple example of this case is that of using cross-country time-series data to estimate an Engel curve to test the hypothesis of equal income elasticities across countries

Unconstrained Model

To illustrate the case of "seemingly unrelated regression" equations, let us consider two countries with estimation models of the form specified in (2) above with no cross-sectional constraints on coefficients

$$Y_t = X_t B_t + u_t \qquad t = 1,2 \qquad (10)$$

The unconstrained pooled model is

In Earlier Issues

Efforts to survey the quality of housing are not new
In the unhappy event that the civilian population must be moved away from industrial areas during an emergency, rural shelter will be greatly in demand A quick method of recording the quality of houses might be needed

Roy Burroughs
AER, Vol IV, No 2
April 1952, pp 33 and 40

$$\begin{bmatrix} Y_1 \\ Y_2 \end{bmatrix} = \begin{bmatrix} X_1 & 0 \\ 0 & X_2 \end{bmatrix} \begin{bmatrix} B_1 \\ B_2 \end{bmatrix} + \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$$

or

$$Y = X\,B + u \qquad (11)$$

Let the currency in country 1 be dollars and that in country 2 be francs, and let r_2 be the constant base exchange rate for country 2 in dollars per franc Then the pooled estimation model in dollars is

$$Y = Z\,C + v \qquad (12)$$

where

$$Z = XR$$

$$R = \begin{bmatrix} I & 0 \\ 0 & r_2 I \end{bmatrix}$$

I = KxK identity matrix

As R is nonsingular, the relationship between the OLS estimators of B and C is

$$C = R^{-1}B \qquad (13)$$

The OLS estimator is consistent but not efficient for "seemingly unrelated regressions " An efficient estimator is Aitken's generalized least-squares (GLS) formula (*4*, p 504), and the relationship between the Aitken GLS estimates of B and C is also

$$C^a = R^{-1}B^a \qquad (14)$$

In both the OLS and GLS results, all the coefficients in country 2 are changed by the multiple $1/r_2$ when the variables are converted into dollars The coefficients in country 1 remain the same because the units of measurement have not been changed These results do not differ from those for a single-country model

Constrained Model

To illustrate the case of a constrained estimation model, let us consider an Engel curve which is estimated with data from two countries to test for the equality of income elasticities across countries [3] Estimation with nominal and real values should be compared as the results of these two cases differ

For this purpose a simple 2-variable estimation model for an Engel curve is specified

$$\ln Q_{it} = a_i + b_i \ln X_{it} + u_{it}$$

$$i=1,2,\ t=1,2,\ \ldots,\ T \qquad (15)$$

or

$$\ln Q_{it} = c_i + d_i \ln Y_{it} + v_{it} \qquad (16)$$

where

- Q = Per capita food consumption in country i,
- Y = Real per capita income expressed in national currency units,
- X = Nominal per capita income expressed in national currency units

If only the income coefficients are constrained to be equal in the two countries, the intercepts may differ and the pooled estimation model can be written in matrix notation as

$$Q = YE + u \qquad (17)$$

where

$$Q = \begin{bmatrix} \ln Q_{11} \\ \ln Q_{1T} \\ \ln Q_{21} \\ \ln Q_{2T} \end{bmatrix}$$

$$YE = \begin{bmatrix} 1 & 0 & \ln X_{11} \\ 1 & 0 & \ln X_{1T} \\ 0 & 1 & \ln X_{21} \\ 0 & 1 & \ln X_{2T} \end{bmatrix} \begin{bmatrix} E_1 \\ E_2 \\ E_3 \end{bmatrix}$$

$$u = \begin{bmatrix} u_{11} \\ u_{1T} \\ u_{21} \\ u_{2T} \end{bmatrix}$$

In the corresponding model using real income, Y_{it} replaces X_{it} in the Y matrix

It is clear that the X (or Y) variables must have the same units of measurement in the two countries The question is whether a fixed exchange rate or the annual exchange rates should be used to convert country 2's francs to dollars In this case, "the same units of measurement" means that the current francs in the "nominal values" model should be converted to current dollars, and in the "real values" model, real francs should be converted to real dollars

Conversion of current francs to current dollars requires the use of annual exchange rates

$$r_{2t}X_{2t} = \$X_{2t} \qquad (18)$$

[3] The Fisher F-test determines whether or not the sum of squared residuals increases significantly when the elasticities are constrained to be equal (3)

where

$X = Nominal per capita income in dollars,
r = Annual exchange rate in dollars per franc,
X = Nominal per capita income in francs

However, equation (9) above shows that converting with the varying annual exchange rates changes the within-country variation and biases the estimated coefficients

If a fixed base exchange rate (r_{2b}) is used to convert X, the result is

$$r_{2b}X_{2t} = \$X_{2t} + (r_{2b} - r_{2t})X_{2t} \quad (19)$$

Thus, converting with a constant base exchange rate introduces measurement error unless the exchange rate is in fact constant This method will generate the correct nominal value ($\$X_{2t}$) only in years when the annual exchange rate equals the base exchange rate Therefore, for a "nominal values" model, neither conversion approach is entirely satisfactory when exchange rates are changing If exchange rates do not vary significantly over the period of estimation, a fixed rate can be used

For a "real values" model, the price deflator must have the same base year in both countries Let us suppose the base year is 1975 Then the 1975 exchange rate would convert 1975 francs to 1975 dollars

$$r_{75}Y_{2t} = \$Y_{2t}$$

where

$Y = Per capita income in 1975 dollars,
r_{75} = 1975 exchange rate in dollars per franc,
Y = Per capita income in 1975 francs

In this case there is no conflict The conversion factor preferred for the "real values" pooled model does not have undesirable effects on the country 2 estimates The country equations can be separated after the pooled estimation, and the country 2 coefficient can be converted to a national currency coefficient if that is desired for simulations or projections

These results can be extended to price variables and to any number of countries The estimated coefficients from a constrained regression are not generally identical to those of the unconstrained or separate country regressions But the Fisher F test of equality of coefficients among regressions can be used to determine whether or not the constraint causes statistically significant changes in the coefficients

CONCLUSIONS

When supply or demand equations are estimated for individual countries, currencies may be converted with a fixed exchange rate prior to estimation or national currencies may be used In either case, there are no constraints on the exchange rate assumptions when the equations are subsequently used in an equilibrium model The conversion to alternative exchange rates for simulation or forecasting can be made with price linkages or by appropriate changes in coefficients of the equations

Supply or demand equations can be estimated with a pooled cross-section time-series model and cross-country constraints can be imposed on any coefficients The corresponding variables must be in common units of measurement In a model specified in nominal values, neither a variable annual exchange rate nor a fixed exchange rate conversion is fully satisfactory If little or no variation in exchange rates occurs during the estimation period, a fixed rate may be used In a model specified in real values, the exchange rate for the base year of the price deflator should be used to convert variables to a common currency

REFERENCES

(1) Bjarnason, Harold F , Michael J McGarry, and Andrew Schmitz "Converting Price Series of Internationally Traded Commodities to a Common Currency Prior to Estimating National Supply and Demand Equations " *American Journal of Agricultural Economics*, 51 (1969) 189-192
(2) Elliott, David P "Converting National Supply and Demand Equations to a Common Currency for Internationally Traded Commodities " *American Journal of Agricultural Economics*, 54 (1972) 538
(3) Fisher, Franklin M "Tests of Equality Between Sets of Coefficients in Two Linear Regressions An Expository Note " *Econometrica*, 38 (1970) 361-366
(4) Kmenta, Jan *Elements of Econometrics*, New York MacMillan Company, 1971
(5) Labys, Walter C "The Problems and Challenges for International Commodity Models and Model Builders " *American Journal of Agricultural Economics*, 57 (1975) 873 878

USE OF PROBABILITY ASSESSMENTS AND SCORING RULES FOR AGRICULTURAL FORECASTS

By David A Bessler and Charles V Moore*

Analysts in Government agencies, universities, private research firms, and other institutions often make predictions about random variables that interest large groups of users Examples include aggregate fore casts of agricultural yield and produc tion levels, forecasts of aggregate price and employment levels for the general economy, and forecasts of price levels for particular commodi ties These predictions are often given as point forecasts– elicited with little or no explicit motivation and often with no explicit feedback or systemat ic evaluation

The existing systems for reporting these forecasts implicitly recognize their uncertainties, yet these uncer tainties usually are not stated pre cisely Qualifiers such as "around," "about," or "should be around," are often used These rather imprecise suggestions do not summarize fully the information possessed by the commodity experts [1]

We investigate here the plausi bility of forecasters' reporting, along with possible qualitative statements, their subjective degrees of belief of alternative future events More precisely, we consider the following first, the usefulness of the more detailed probabilistic statements to potential users, second, methods for derivation of these probabilistic statements, and third, applications of these methods with groups of interested subjects

WHY THE ENTIRE DISTRIBUTION?

In the last fifty years, economists have gone far in establishing the theoretical relationships concerning choice under uncertainty Individual behavior, consistent with the expected utility hypothesis (*6*) will involve an ordering over the entire distribution of consequences [2] A user of information on future events, who behaves (or would like to behave) according to these postulates of rational choice would, therefore, be interested in probability weights assigned to all possible outcomes

Despite this theoretical motivation, some may argue that users are not properly trained to use proba bilistic forecasts That is, farmers, consumers, and Government re search workers generally are trained to work with only point forecasts This may often be true, yet training in use of probabilistic forecasts can yield great benefits—in particular, the benefits from making decisions based on a more complete description of an uncertain future Lindley makes a similar point

> experiments have been performed which show that individuals do not reason about uncertainty in the way described in these volumes (probabilistic reasoning) To spend too much time on description is unwise when a normative approach exists, for it is like asking people's opinion of 2 + 2, obtaining an average of 4 31, and announcing this to be the sum It would be better to teach them arithmetic (*8*)

In our example here, instead of accepting a statement from a user of information that he cannot reason without one particular "best" guess, we can often instruct him in the use of probabilities

It would also seem possible that forecasters themselves would prefer expressing their views as probabilities instead of single point estimates As future events *are* uncertain, an expert should not be forced (as frequently occurs) into picking a specific figure Doing so seemingly represents as certain that which every one recognizes as uncertain Some will argue that a point estimate will do enough by centering the distribution, but we believe that ignoring all possible densities can waste poten tially useful information It may not allow the expert to describe fully his knowledge about future events

In Earlier Issues

> Confusion abounds in the literature describing investigations of consumer acceptance and consumer preference The two basic causes are the same two that cause confusion throughout the whole field of investigative research The first is the failure to define precisely, and suitably restrict the subject of investigation The second is the failure to employ a technique which can meet the objective
>
> Glenn L Burrows
> AER, Vol IV, No 2, p 52
> April 1952

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[1] The recent step taken by USDA of specifying ranges (lower and upper bounds) for some forecasts exemplifies what we consider to be a step in the right direction, however, as we argue in this note , a more general procedure can be followed

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

As future events are uncertain, an expert should not be forced (as frequently occurs) into picking a specific figure.

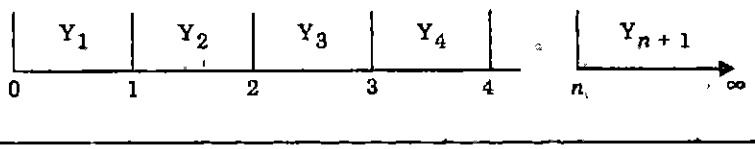
METHODS OF ELICITATION

In the past no suitable theory of elicitation existed, and any venture into this area could have been described as mere conjecture by the expert However, in the last 10 years, a rich theory of assessment has been developed and applied in areas of similar interest—most notably weather forecasting By use of the proper scoring rules, an expert can be encouraged to state his beliefs so that they correspond to his true beliefs (*10*) That is, the use of proper scoring rules implicitly recognizes the possibility that a probability assessor may not have sufficient motivation to make his stated beliefs correspond to his true beliefs The rules provide such a motivation In addition, the rules can be used to rank assessors, after the fact, as to the "goodness" of their assessments [3]

An assessor may be faced with the task of forecasting the future value for a continuous random variable Y (Y might be a future price or yield level) The assessor can be asked to state subjective probabilities associated with $n + 1$ mutually exclusive and collectively exhaustive intervals $Y_1, Y_2, \ldots, Y_{n+1}$ That is, the range of possible outcomes which Y can take can be broken up into $n + 1$ intervals (fig 1)

We can ask each forecaster to state his best guess of the chance that the actual outcome falls into the defined categories The intervals chosen for our example are arbitrary, yet, chosen carefully, they should represent well the uncertainty present in the assessor's mind Clearly, the improper choice of intervals (too many or too few) can misrepresent our assessor's beliefs Thus, considerable care and possible experimentation will be required to use the rules we described

FIGURE 1
Hypothetical partition of possible outcome line



Because the true beliefs exist only in the assessor's mind, there is no obvious way to determine whether the stated beliefs actually correspond to the true beliefs To motivate the expert to make this equalization, let us present him or her with a scoring rule $I_k(r)$ The rule rewards the assessors, depending upon the probability assessment they give (r) and the event which actually occurs (k) Of course, assessors will not know their actual scores at the time of the assessment, but they will be able to make a judgment about its expectation That is, they will have an expected score or payoff which depends upon their true beliefs (p) and their stated beliefs (r) Their expectation will thus be given as

$$I(r, p) = \sum_{k=1}^{n+1} P_k I_k(r),$$

where again r and p represent $n + 1$ vectors of the assessor's stated and true beliefs, respectively, while p_k represents the true belief on event k

In choosing specific rules, we want to select one that encourages the assessors to set r equal to p A particular class of rules, which does just this, has been defined and studied under the label of proper scoring rules A scoring rule is said to be strictly proper if $I(p, p)$ is greater than or equal to $I(r, p)$ That is, strictly proper scoring rules give the expert the highest expected payoff for setting stated beliefs equal to his or her true beliefs, p equals r

Specific proper rules which have been proposed are the logarithmic rule (*7*), the quadratic rule (*3*), the spherical rule (*9*), and the ranked probability score (*5*) The logarithmic rule will be discussed here Also see (*1* and *12*)

The logarithmic rule rewards or penalizes the assessor according to the stated probability associated with the event which actually occurs

$$I_k(r) = \ln(r_k) \qquad (1)$$

Because it involves only the stated probability of the event which actually occurs, this rule is rather easy to understand and can be quite useful for assessors not in the habit of stating their beliefs in probabilities The other rules listed above define pay offs as the entire set of stated beliefs (the entire vector r) As one might expect, these more complex rules can be somewhat confusing, especially for untrained assessors Thus, the logarithmic rule has been urged for use by untrained probability assessors (*1*)

[3] We will not treat the goodness evaluation aspect of these rules here For discussion of this point, see Winkler and Murphy Suffice it to say, that the same rules can be used to rank assessors afterwards as to goodness

It is desirable, other things being equal, to pick the rule which is most responsive to deviations of the stated beliefs (r) from the true beliefs (p)

Obviously, the rule defined in equation (1) will give an assessor negative payoffs Its range is minus infinity to zero While this interval is theoretically acceptable, it presents a practical problem we usually do not wish to give assessors extremely large negative payoffs (how do we give, for instance, a payoff of minus infinity?) Usually, in elicitation work, we do not wish to give negative payoffs at all To avoid this problem, Shuford and others suggest we modify the rule given in equation (1) by truncating the payoffs at some arbitrarily selected small probability and adding a constant to all payoffs—a constant sufficient to make all payoffs positive (*11*) That is, we can amend equation (1) as follows

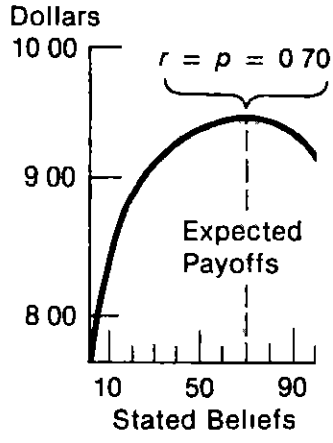
$$I_k(r) = \begin{cases} b, & 0 \leq r_k < 0.01 \\ a + \ln r_k, & 0.01 \leq r_k \leq 1 \end{cases}$$

The constant b should be selected to be less than the payoff given to the stated belief of (0 01), a should be selected so all payoffs are positive

The truncated rule is not strictly proper As one might guess, problems exist in meeting the proper conditions at the point of truncation However, in most practical situations (except when small probabilities are desired), the truncated rule ought to give good results

We now graph the expected payoff from a logarithmic rule applied to the probability assessment for two mutually exclusive and exhaustive events We apply the truncated rule with $b = 0$ and $a = \$10$ We assume for illustration that the assessor's true belief on the first event occurring is p equals 0 70 Thus, the belief on the second event occurring is $(1-p)$ equals 0 30 In figure 2, the horizontal axis represents alternative stated beliefs or assessments on the first event The vertical axis represents the expected payoff associated with each of these stated beliefs As one can see, the assessor will maximize the expected score by choosing stated beliefs to correspond with his or her true beliefs, so that r equals 0 70 and $(1-r)$ equals 0 30 Any other assessment will result in a lower expected score For example, if the expert sets r equal to 0 40, the expected payoff would be \$9 21, which is less than the \$9 37 if r equals 0 70

Figure 2
Hypothetical Expected Payoff from the Truncated Logarithmic Rule



A scoring rule needs to be sensitive to deviations of r from p It is desirable, other things being equal, to pick the rule which is most responsive to deviations of the stated beliefs (r) from the true beliefs (p) One can see in figure 2 that the logarithmic rule is not highly sensitive to small deviations Winkler and Murphy confirm this low sensitivity (*15*) They compare the sensitivities of three rules—logarithmic, quadratic, and spherical—and find the logarithmic rule the least sensitive The practical researcher, then, must weigh the benefit of using the logarithmic rule against the cost of its lesser sensitivity When lengthy training sessions are feasible for assessors, the research worker may opt for the more sensitive quadratic or spherical rules

EMPIRICAL APPLICATIONS

Scoring rules have been used to encourage "good" assessments in various fields, with probably the greatest success in weather forecasting (*13*) Applications in other fields include stock market price forecasting (*12*) and football score forecasting (*14*) We have adapted the logarithmic rule for elicitation of price and yield distributions for California field crops

In our particular studies, we found the truncated logarithmic rule to be convenient and reasonably accurate (*1* and *2*) We wanted many assessments (50-75 assessors) and had a relatively short period for assessor training By forcing the assessors to respond in predetermined discrete probabilities (0 00, 0 10, 0 20, , 1 0, see (*4*)), we could get sensible assessments from them in sessions lasting a little over an hour We can never be absolutely sure that such assessments are accurate Yet substantial agreement exists among assessors in similar environments and the assessments agree (in a probabilistic sense) with their time series representations (*2*) Thus, we feel encouraged about future use of scoring rules in probability assessment tasks

In our particular studies, we found the truncated logarithmic rule to be convenient and reasonably accurate

REFERENCES

(*1*) Bessler, David "Foresight and Inductive Reasoning, An Analysis of Expectations of Economic Variables by California Field Crop Farmers " University of California Davis, 1977 (unpubl)

(*2*) ———— "An Empirical Study on the Representation of Aggregate Subjective Beliefs on Crop Yields Using ARIMA Time Series Processes " Purdue Univ , 1979 (unpubl)

(*3*) de Finetti, Bruno "Does It Make Sense to Speak of 'Good Probability Appraisers'?" *The Scientist Speculates—An Anthology of Partly Baked Ideas*, I J Good, ed , Heinemann, London, 1962, pp 357-364

(*4*) ———— "Discriminating Levels of Partial Knowledge Concerning a Test Item " *British J Math and Statis Psychology*, 1965

(*5*) Epstein, E S "A Scoring System for Probability Forecasts of Ranked Categories " *J Applied Meteoro* , Vol 8, 1969, pp 985-987

(*6*) Fishburn, Peter *Utility Theory for Decision Making* Wiley, New York, 1970

(*7*) Good, I J "Rational Decisions " *J Royal Statis Society*, Series B, Vol 14, 1952, pp 107-114

(*8*) Lindley, D V "Preface " In *Theory of Probability*, Wiley, New York, 1974, pp vii ix

(*9*) Roby, T B "Belief States and the Uses of Evidence " *Behavioral Science*, Vol 10, 1965, pp 255-270

(*10*) Savage, Leonard J "Elicitation of Personal Probabilities and Expectations " *J Amer Statis Assoc* , Vol 66, 1971, pp 783-801

(*11*) Shuford, E H , A Albert, and H E Massengill "Admissible Probability Measurement Procedures " *Psychometrika*, Vol 31, 1966, pp 125-145

(*12*) Stael von Holstein, Carl Axel *Assessment and Evaluation of Subjective Probability Distributions* The Economics Research Institute, Stockholm School of Economics, 1970

(*13*) Thompson, J C , and G W Brier "The Economic Utility of Weather Forecasts " *Monthly Weather Rev* , Vol 83, No 11, 1955

(*14*) Winkler, R L "Probabilistic Prediction Sum Experimental Results " *J Amer Statis Assoc* , Vol 66, 1971

(*15*) Winkler, R L , and A H Murphy "Good Probability Assessors " *J Applied Meterology*, Vol 7, 1968, pp 751-758

In Earlier Issues

It is clear that economists know what inflation is, how it arises, and what tools are necessary to prevent it, although some of the proposals suggested by economists are not easily accepted politically Perhaps the major differences among economists relate to the importance allocated to each of these tools It is also clear that no single tool will suffice

Nathan M Koffsky
AER, Vol IV, No 2, p 61
April 1952

UNCERTAINTY AND THE CHOICE OF AGRICULTURAL POLLUTION ABATEMENT POLICY

By Klaus F Alt and John A Miranowski*

The environment interacts with agricultural production activities in two primary ways it contributes raw material inputs and it accepts the residues of production and consumption activities Historically, farmers could either treat wastes at their own expense or they could let the environment absorb them Now, a portion of the environment's absorptive capacity has been preempted by residuals from nonagricultural activities, and today's agricultural wastes are often less biodegradable Thus, the absorptive capacity of the environment is frequently exceeded, and the demand for a cleaner environment is rising The result has been an increasing demand for pollution abatement policies

POLLUTION ABATEMENT OPTIONS

The policy options proposed for agriculture include charges, subsidies, marketable rights, and direct regulation The objective of each policy is to encourage farmers to lower their emissions of pollutants Charges penalize emissions, which induces polluters to find disposal methods which are less costly than the penalty that they would pay for releasing untreated residuals Subsidies act like bribes The response to a subsidy is generally considered symmetrical to that of a tax or charge Marketable rights allow limited residuals to be disposed of after competitively purchased permits have been acquired Direct regulations specify what actions the polluters must take

The merits of these policies can be examined through use of pollution abatement demand and supply functions The demand function measures society's willingness to pay for alternative levels of pollution abatement It quantifies society's desire for a cleaner environment The supply function measures the added cost of supplying various levels of abatement It should account for all the social costs of abatement, including the information, enforcement, and administration associated with the abatement policy, as well as the direct abatement costs incurred by farmers As we have demonstrated, ignoring these costs will underestimate the added costs of abatement activities and may lead to establishing excessive levels of abatement (*4*) [1]

CHOOSING THE OPTION

The optimal level of pollution abatement is defined as the level at which the cost of supplying the last unit equals the price that society is willing to pay for that last unit This level can then be imposed administratively by any of the policy options mentioned, each of them could be equally efficient in the absence of real-world transaction costs, as Fisher and Peterson point out (*2*)

However, we know little about society's demand for a cleaner environment, or alternatively, the strength of society's willingness to pay for the implied pollution abatement So we are operating with inadequate and imperfect knowledge about the demand function We have only normative estimates of the abatement supply curve Given this quality of-information problem, the level of pollution abatement selected will likely be in error, which implies a suboptimal abatement level and a misallocation of resources Thus, an important aspect of policy research is to isolate pollution policy instruments that are likely to minimize the social cost of an error We now demonstrate that knowledge of the elasticity of the abatement supply function can be used to determine which policy instrument will minimize such cost

MINIMIZING SOCIAL COSTS OF AN ERROR

Figure 1 presents elastic (SE) and inelastic (SI) abatement supply curves and a possible demand curve (D) [2] Consider establishing the level of abatement (through marketable rights or direct regulation) in the absence of perfect knowledge In the elastic supply case, the social cost of requiring abatement at level b when level a is the optimum is the area α In the inelastic case, the social costs of level b when a is the optimum level is area $\alpha + \beta$

Also consider a policy instrument in which we set the price, with a tax/charge or a subsidy/bribe (fig 2) For these policy options, the social cost of an error for an elastic abatement supply curve is area α, which is greater than area β for an inelastic supply situation

The elasticity of the abatement supply function, then, is important in selection of an appropriate policy instrument If the abatement supply

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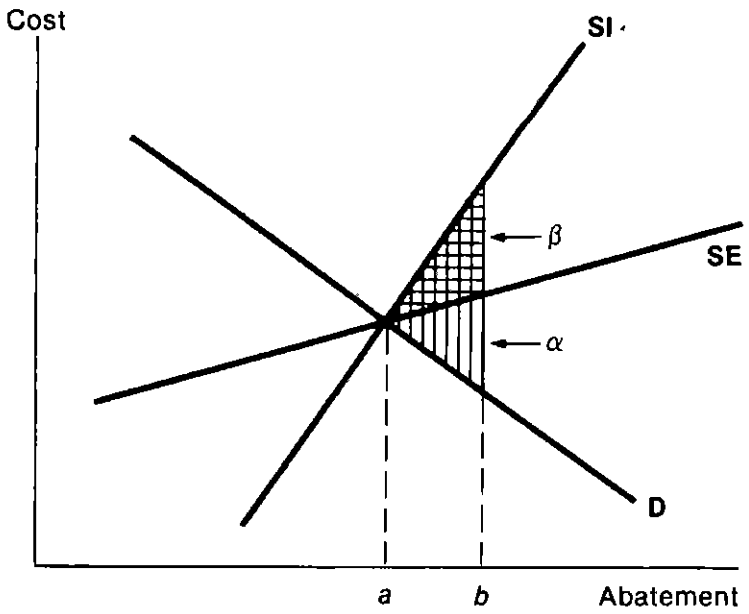
[1] Italicized numbers in parentheses refer to items in References at the end of this note

[2] Previous work by Alt and Miranowski (*1*) demonstrates that the result is insensitive to the elasticity of the demand curve

An important aspect of policy research is to isolate pollution policy instruments that are likely to minimize the social cost of an error

Figure 1
Cost of Error in Permit Program for Alternative Abatement Supply Functions



curve is inelastic, a price incentive scheme implies less potential social cost of an error If the abatement supply curve is elastic, setting the level of abatement by direct regulations or by auctioning a fixed quantity of pollution rights implies less potential cost of an error [3]

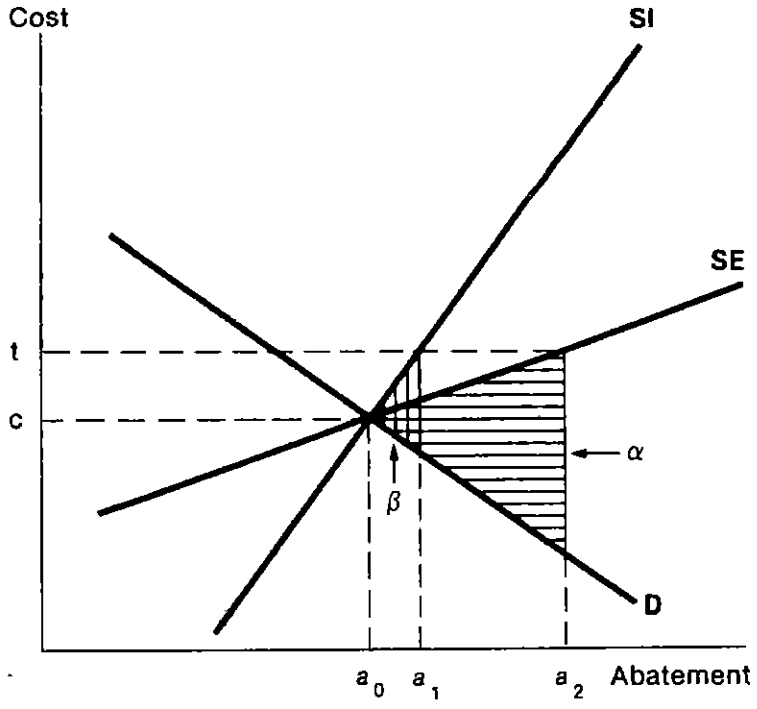
An abatement supply function is likely to have both elastic and inelastic ranges, and the elasticity in the relevant range must be determined Taylor and Frohberg illustrate abatement supply curves for alternative policy instruments in controlling nonpoint source pollution in agriculture (*5*) At lower levels of control, the abatement supply curve is elastic, at higher levels, it becomes inelastic Kneese and Schultz document similar increasing marginal costs of abatement for industrial firms (*3*) Thus, at less restrictive levels of pollution control, the social cost of an error tends to be minimized when the policy selected prescribes the desired level of abatement (marketable rights or direct regulation) As abatement demand increases and abatement supply becomes inelastic, policy instruments relying on price incentives (taxes or subsidies) tend to minimize the social cost of an error

The transaction costs of policy instruments should be included in estimates of the abatement supply function These costs may alter the shape and the elasticity of the curve Particularly at higher levels of abatement, the marginal enforcement costs likely will rise because of higher resistance by polluters Increased

[3] Of course, the choice may not always be as clear, particularly if the abatement supply curve is unknown and the elasticity cannot be determined

Figure 2

Cost of Error in Tax Program for Alternative Abatement Supply Functions



transaction costs will tend to make the supply curve more inelastic at higher levels of abatement and increase the advantages of a price-incentive scheme

REFERENCES

(*1*) Alt, K F , and J A Miranowski "Theory and Practice of Water Polluting Rights " *Irrigation and Drainage and Water Resources Planning and Management* American Society of Civil Engineers, New York, 1978

(*2*) Fisher, A C , and F M Peterson "The Environment in Economics A Survey " *J Econ Lit* , Vol XIV, No 1, 1976

(*3*) Kneese, A V , and C L Schultze *Pollution, Prices, and Public Policy* The Brookings Institution, Washington, D C , 1975

(*4*) Miranowski, J A , and K F Alt "Policy Costs in the Theory of Externalities and the Selection of Nonpoint Pollution Policy " *J Econ* Vol 4, 1978

(*5*) Taylor, C R , and K K Frohberg "The Welfare Effects of Erosion Controls, Banning Pesticides, and Limiting Fertilizer Application in the Corn Belt " *Amer J Agr Econ* , Vol 59, No 1, 1977

NONTARIFF AGRICULTURAL TRADE BARRIERS

Jimmy S Hillman University of Nebraska Press, Lincoln, Nebraska, 1978, xviii and 236 pages, $13 50

*Reviewed by William E Kost**

Nontariff trade barriers are important, though generally overlooked, aspects of international trade in agricultural products Hillman is concerned with the proliferation of these trade barriers This concern hinges on the conventional free trade arguments Nontariff trade barrier growth is viewed as an impediment to future international cooperation and to world agricultural efficiency He maintains that unless nontariff trade barriers are reduced, world markets will become further fragmented and the development of efficient, low-cost agriculture will be severely hampered The theme of the study is that

> Agricultural trade barrier problems residual to the Kennedy Round negotiations, buttressed by the nature of their uniqueness, are likely to become more complicated and important The likelihood of international trade breakdown will increase proportionately to the unwillingness of the major agricultural producing and trading nations to reduce the adverse impact of their domestic farm policies upon international trade (p 181)

Any obstacle to the flow of trade, except traditional customs duties, that discriminates against foreign countries is considered a nontariff trade barrier Hillman analyzes the development of nontariff trade barriers, classifies them by type, catalogues barriers of several countries, and discusses the problems of international negotiations aimed at relaxing barriers

His first three chapters review the emergence of nontariff trade barriers Prior to the thirties, tariffs were the principal tool of agricultural protection in the developed countries During the financial and commercial breakdown in the thirties, major agricultural trading countries implemented domestic agricultural price and income policies to cope with low agricultural prices and mounting surpluses A series of nontariff trade barriers were devised and implemented by the developed countries, as tariffs were unable to protect domestic agriculture These barriers effectively supported domestic agriculture Hillman concludes that "most of the effective trade restrictions on agricultural products that countries have adopted have been adjuncts to their domestic farm policies nations have not developed a separate and identifiable trade policy for farm products "

Trade liberalization negotiations have been conducted through the General Agreement on Tariffs and Trade (GATT) framework but these have focused primarily on tariff reductions Not only were tariffs more tangible to negotiate, they were also less critical in terms of their domestic policy impacts To the extent that negotiated tariff reductions create severe domestic hardship, offsetting nontariff trade barriers could be implemented This process, over time, has brought nontariff trade barriers, relative to tariff barriers, to the forefront of current trade policy issues

Chapter four presents a classification of various nontariff trade barriers that ranges from quotas, subsidies, and variable levies all the way to mixing regulations, import calendars, labeling requirements, and health and sanitary requirements The major theme of this chapter is to impress upon the reader the myriad of existing trade barriers

The next three chapters catalogue nontariff trade barriers Chapter five focuses on the U S Section 22 quota system, the European Community (EC) variable levy system, and the Japanese import quota restrictions Chapter six catalogues the various barriers existing in the United States, the United Kingdom, the EC-6 countries, and Japan Chapter seven details the nontariff trade barriers for red meat animals and red meat in these same countries Barriers in developing countries are not discussed

The final chapter presents the problems involved in liberalizing nontariff trade barriers The delicate relationship between these trade policies and domestic farm policies creates major difficulties Countries are unwilling to negotiate domestic farm policy in an international forum This situation, coupled with severe difficulties in measuring levels of effective economic protection by these barriers, makes Hillman somewhat pessimistic as to the effectiveness of any negotiations in reducing nontariff trade barriers [1]

I have mixed feelings about this book The author raises an important and frequently overlooked issue in international agricultural trade He defines the problem and traces the evolution of nontariff trade barriers For these reasons alone, the book is useful and should be read However, I expected more

Hillman recommends two prerequisites for successful nontariff trade barrier negotiations measuring levels of effective protection and determining the impact of agricultural policies (including these barriers) on agriculture Although nontariff trade barriers are broadly catalogued, no attempt is

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[1] This book was written at the start of the Tokyo Round of GATT negotiations

Unless nontariff trade barriers are reduced, world markets will become further fragmented and the development of efficient, low-cost agriculture will be severely hampered

made to measure effective protection levels Nor does he consider the problems involved in measuring effective protection levels for nontariff trade barriers The effects of agriculture and trade policy on output, consumption, prices, and income are crucial in any negotiation Hillman does not analyze the economic impact of non tariff trade barriers on agriculture beyond offering the general statement that they restrict trade He does not discuss how one would incorporate nontariff trade barriers into economic analysis

My appetite was whetted In picking up this book I had hoped either to be able to analyze better the impacts of nontariff trade barriers or to find out what the impacts were Instead, I found only a repetitious statement of the problem What is said three or four different ways in 200 pages could have been said well in 50 For a shorter statement of the problem, read chapters two through four, and eight

In two technical areas I disagree with Hillman although neither significantly affects the overall usefulness of the study In his discussion of the EC variable levy (pp 81-88), he argues that the variable levy "must, of necessity, act like a quota " Like Koenig (p 203), I disagree The levy limits imports, but not to any specific level It is a variable specific duty and not a quantitative barrier

In his analysis of tariff versus quota impacts, Hillman gives examples of the imposition of quotas in the face of inelastic supply in the exporting country However, such quotas do not cause the price to fall to the point where the exporting country's supply equals its own demand, as Hillman shows Price will be above that level The country must export a volume equal to the importing country's quota-constrained imports

In summary, the book raises an important issue, one where relatively little analysis has been focused Read it, or parts of it, for a good statement of the problem For substantive analysis, you will have to look elsewhere

In Earlier Issues

Ideas are powerful forces for change, but in social science they include ethical ideas of equality, democracy, and justice—not merely the ideas of a self-regulating mechanism so characteristic of natural science

Bushrod W Allin
AER, Vol IV, No 2, p 59
April 1952

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Transit is defined as the privilege of stopping a shipment in route to enable a process or operation to be performed on the article, and of reshipping to final destination at the through rate applicable from the original shipping point to destination The impact of this device on American industry is great

Joseph E Rickenbacker
AER, Vol IV, No 2, p 63
April 1952

RURAL POLICY RESEARCH ALTERNATIVES

David L Rogers and Larry R Whiting editors, Iowa State University Press, Ames, Iowa, 1978, 245 pages, $6 95

*Reviewed by Melvin R Janssen**

In the private economic sector, the theory of the firm has been a relatively simple type of analysis The goal of maximizing profits limited attention to the economic sphere Traditionally, the number of decisionmakers in each firm was small, and effects of decisions external to the firm were generally not examined Complexities were largely confined to production-marketing relationships for multiproduct firms Recently, environmental and social concerns have widened the arena for private decisionmakers within the economic sector, although problems are less complex than those faced by public decisionmakers

Simple application of this theory of the firm is not adequate for dealing with emerging public problems The realm of public services presents measurement problems, which include the level of services to be provided The number of decisionmakers for public policy decisions is frequently larger than in the private firm, and they often conflict in their goals A decision is likely to have economic, social, political, and psychological implications that do not conform to the theory of the firm These problems prompted the North Central Regional Center for Rural Development to sponsor a conference on Alternative Methods for Public Policy Research in Rural America The edited papers from the conference comprise the volume reviewed here

In the lead paper, Daft expands the public policymaking arena to include evaluative, regulatory, and judicial activities often overlooked When considering why much information never gets through, he proposes the following seven standards of measurement of policy information relevance, timeliness, credibility, clarity, conciseness, appropriateness, and accessibility Much rural development research extends beyond the agricultural institutions and the clients with whom they traditionally have dealt Policymaking and information systems often do not get properly linked The most effective policy research has focused on specific programs or policy decisions Meanwhile, university research can contribute to policymaking because the university has freedom to evaluate Federal programs, can tap alternative disciplines and data bases, and has organizational flexibility Daft concludes that policymakers and researchers alike need to recognize the limits of knowledge in current rural development research

Huie recognizes that local research and information needs must be tailored to needs and interests of elected officials, program directors, policymakers, or the general public Information may be used to develop a consensus or to analyze a problem Three stages are helpful (a) clarifying the problem, (b) listing major alternatives, and (c) analyzing consequences of each alternative

Brown recognizes if policy research is to be relevant, values will enter into the process In the choice of the problem researched, a norm by which behavior or conditions are deemed inadequate must be established One must then decide who is entitled to satisfaction of needs and who ought to provide the resources to meet those needs Brown suggests the advocacy model used in court proceedings as one way to deal with values, but he also recognizes that, with unequal resources of contending groups, some values may not be adequately presented

Researchers in Ohio report on their study of provision of adequate fire protection How much protection should be provided? Most answers were based on available inputs But how much is enough when some losses will result despite the degree of protection available? The professional standards of the American Insurance Institute schedule specified adequacy levels for services that are subjective and do not measure outputs

Eberts and Sismondo show how five broad classes of social science research relate to policy research They point to a series of relationships in the research process and to complexities requiring increasingly more data One regional research committee discovered that its model required data not readily available For other models, secondary data were often unavailable Some data did not measure what the model required As results can be no better than the weakest data set, the complex model gave results that appeared more impressive than was warranted Discussion has centered on improving data, mainly primary data Little recognition has been given to developing secondary data better suited to needs or to improving current data sets

Hickman and Warren discuss alternative data sources and collection methods They briefly summarize the strengths and weaknesses of alternative field collection methods for primary data

Brooks discusses public opinion surveys, fully recognizing their strengths and weaknesses One problem is that people may not know enough to respond intelligently

Rural transportation problems require multidisciplinary team work Richards and others indicate problems

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In many institutions, the separation of research and extension creates a barrier which guarantees communication failure

of identifying regional socio economic characteristics and regional transportation conditions There are difficulties in eliciting value responses on transportation needs from residents of an area and relating those responses to current conditions Yet their experience may be useful to others

Land use, inevitably related to policy problems, often determines the location of social problems Libby and Shelton point out that people live in the short run, people find it difficult to act when failing to do so has serious longrun consequences Libby and Shelton recognize that decisions by researchers must be made quickly, although a professor-graduate student research team may move slowly An alternate model, a senior researcher fulltime research associate, has proved successful in many research efforts, especially "contract" research

Mikes discusses feasibility studies but leaves unanswered the problem of most public agencies—which studies should be undertaken? Universities might well conduct such studies with costs partially covered by a "contract" with the appropriate planning agency

Gathering and disseminating appropriate information to each group of clients for public policy research is essential Moe lists 10 factors that impede communication and 6 critical factors that facilitate dissemination of knowledge One example of successful research is the Northeast regional study on agricultural labor According to the client, "It is a rare occurrence when results of research conducted by the academic world bear such close and timely relationship to legislative proposals of the administration " Regional centers should have a key role in improving communication between researchers and their clients

This reviewer concurs with Moe's list of functions that need strengthening Yet Moe fails to point out that, in many institutions, the separation of research and extension creates a barrier which guarantees communication failure As the total university becomes involved in some problems, a new commitment by engineering, education, medical, and law faculties will be needed to provide multidisciplinary research and communication

The problem of how to do public policy research has not yet been solved, multidisciplinary research can help to deal with complex problems The entire university probably has a role here Data problems will need more attention, and secondary sources may become more useful Communication problems can be lessened with conscious effort Ideas that are not operational should be abandoned Most models need to be simplified This reviewer feels that this book should be studied by all those involved in research and extension in the public sector

In Earlier Issues

At first glance, data on food expenditures and income in the United States in the past 20 years indicate that a larger proportion of income has been spent for food in this postwar period of record high incomes than in less prosperous years This is contrary to what one would expect on the basis of Engel's famous law Engel's law is generally remembered as stating that families with higher incomes spend a smaller proportion of their incomes for such necessities as food than do families with smaller incomes If that is true of individual families, should it not hold for national averages? Engel's law applies under conditions that are relatively static certain forces arising from the war (diverted) an unusually large proportion of purchasing power to food The shift of population from rural to urban areas and the increased processing of food outside the home are likely to have a lasting effect on the relationship of aggregate food expenditure to income

Marguerite C Burk
AER, Vol III, No 3, pp 87, 97
July 1951

THE MERCHANTS OF GRAIN

Dan Morgan Viking Press, New York
1979

*Reviewed by Anne del Castillo**

Dan Morgan covered the Russian grain deal of 1974 for the *Washington Post* His research, which resulted in a detailed investigation of five multinational grain companies, is presented in The *Merchants of Grain*, an intriguing account of the grain merchants and their corporate penetrations into the grain industry and trade The book reveals a market whose structure and behavior belie traditional economic assumptions

The book opens with a history of the critical role of grain merchants from antiquity to modern times During the past 50 years, this role has been concentrated in the hands of five family companies Morgan provides a comprehensive account of the personalities who conduct this high-volume trade, highlighting the maneuvers and negotiations which are ultimately reflected in the commodity prices flashed across the Chicago boards

Morgan devotes several chapters to a detailed reporting of the recent series of "under-the-table" three way deals involving the grain companies and the Soviet and American Governments He relies on interviews of the companies' former and current employees and official and unofficial statements by persons in the U S Departments of Agriculture and State involved in these negotiations

Morgan's presentation of the myriad arrangements among the U S Government, the grain companies, and recipient countries of food under U S P L -480 gives the reader a sense of the political leverage and financial magnitude of the U S aid program The final chapter contains implications of this concentration of economic power and the world's reliance on these five companies to feed its population

The unique structure of the world grain trade raises an interesting question for the agricultural economist Is the convention of assuming a perfectly competitive market, with a string of modifying conditions, the best way to understand and interpret the world grain market? Perhaps a more accurate market portrayal would result if an oligopolistic structure were applied

International grain trade is an anomaly of the competitive market model Competition is keen, yet there are only a few players The difference between good and mediocre timing can be fatal The structures of the major companies are textbook examples of vertical and horizontal integration The grain companies are equipped to meet any market circumstances depending upon price developments, they can shift instantly from exporting soybeans to processing and selling meal and oil After decades of diligent business acquisitions and mergers, these powerful yet discrete companies control practically every facet of the marketing process, from inland transportation to storage to interoceanic shipping

The book raises a significant point regarding the structure and behavior of the world grain market Experts are asking whether the market requires more public regulation and supervision While economists are studying the welfare implications of proposed structural revisions of the market, the grain companies are struggling to preserve their prerogatives The failure of the grain negotiations intended to bring a degree of stability and order into the world wheat market represented a singular victory for the grain companies Proposals for establishing a national grain board in the United States or creating a wheat exporter cartel threaten the power of the grain companies Should these proposals gain momentum, the grain companies may well oppose them

Economists will find this book well written and reasonably well researched *Merchants of Grain* is recommended for anyone who wants to understand more about the complicated and dynamic world grain trade market

In Earlier Issues

The textbooks on economic statistics with which this reviewer is familiar describe the solution of "normal equations" in terms of elementary methods with which high-school graduates are presumed to be familiar Typically, the students work out a correlation problem on obsolete calculators, recording each individual cross-product, and finally solve the normal equations by the textbook method At the end of this process, all but the most ardent have concluded that regression equations are prohibitively difficult to come by, and that "research" reports can be written more rapidly if the data are merely described and not analyzed

Karl Fox
AER, Vol IV, No 2
April 1952, p 61

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