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Articles

A Critique of the World Agricultural Economics Research Establishment

Interest Rates and Commodity Prices

Marginal Costs of Managing Endangered Species: The Case of the Red-Cockaded Woodpecker

The CARD Linear Programming Model of U.S. Agriculture

Book Reviews

Toward A Well-Fed World

First the Seed

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Family Farming: A New Economic Vision

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In This Issue

In the second of the series of invited essays on the state of agricultural economics, Hildreth examines the research establishment and comments on its performance. Hildreth brings to the discussion a long career of making the system work. From such experience, one would not be surprised at some indication of occasional frustration or impatience, yet his evaluation of the profession is decidedly positive and complimentary. Despite his encouragement for the kinds of things we do in this journal, he cautions agricultural economists to beware of excessive attention to the discipline, and stresses the importance of being "useful."

Kitchen and Rausser examine the relationship, if indeed any exists, between interest rates and commodity prices. The theory that well-oiled storage or arbitrage systems completely reflect interest rates in commodity prices has been challenged recently. An alternative theory is that commodities have their own implicit rate of return, positively related to the real rate of interest. The issue is whether monetary effects have reallocative economic effects or only nominal price effects. They examine recent literature, state a general framework, and relate commodity own rates to real interest rates. The rates appear unrelated.

The article by Hyde is a marginal-cost analysis of habitat management. The habitat in question is the nesting area for an endangered species, the red-cockaded woodpecker, which raises its young in the cavities of mature pine trees. Harvesting the pine at commercial timber age reduces the woodpecker's nesting possibilities. Management requires developing a balance of mature trees consistent with the objectives of species preservation and commercial timber. Hyde examines both permanent site preservation and rotation harvest alternatives and concludes that the preservation cost is small.

The note by Hertel, Preckel, and Huang presents a test of the responsiveness of a linear programming model to price changes. The model is a reduced form of the basic design created by Iowa State University's Center for Agriculture and Rural Development. They conclude that the model produces little response of input price on national aggregate demand for factors, but produces much response, apparently too much, on production locations.

Hite's review of Paarlberg's book, *Toward a Well-Fed World,* is supportive and insightful. He recommends it for professional agriculturalists "...whenever internal doubts stir about the value of what we do...." It is not an economics book, but it is a book economists should read. We've inserted some of Paarlberg's deeply felt, but simply stated, thoughts in the review. A remarkable complement to Paarlberg is Kloppenburg's *First the Seed.* Perhaps counterpoint would be a better word. Knudson gives Kloppenburg high Marx in scholarship for his thorough examination of the seed industry. She is less than satisfied with his analysis and its policy implications.

The Strange book on family farming is reviewed by Boxley. He credits Strange with being "challenging," but faults the book's reasoning on the relative efficiency of large farms and the needs for public intervention in the credit, commodity, and land markets. Here is a book that, despite its minor faults, gives a helpful perspective on farm structure and farm policy.

Hiemstra reviews Litan's answer to the question: what should banks do as they face deregulation? Hiemstra credits Litan with a thorough, technically competent, study of banking history and organization. He generally supports Litan's reforms which create deposit companies organizationally separated from lending entities.

Nightingale reviews the book, edited by Mellor and Ahmed, on price policy in developing countries. The book was undertaken under sponsorship of the International Food Policy Research Institute. Among the policies suggested in the book is the allocation of public resources away from input subsidies and price supports and toward distribution and employment.

Randall, in his comments on the book edited by Sutton, notes the difficulty of gathering a set of authors around a topic of many subtle relationships, such as trade and natural resources. His review is generally favorable, but clearly, there are subjects that at some point in their development require the integration of thought and purpose that only single authors can produce.

To return to Hildreth's inquiry about the state of agricultural economics, we could ask about the merits of individual performance relative to collective accomplishment in organizations. Are there analogies in economic research to the structural alternatives in agriculture, that is, a system of sole proprietors versus a system of corporate entities? How does an economic organization, or simply a project, provide for individual synthesis and creativity as well as collective mass and interaction? The answers are elusive.

Gene Wunderlich

A Critique of the World Agricultural Economics Research Establishment

R.J. Hildreth

At times, a good way to look at a profession is to step back, strip away the complexities, and simply ask: How are we doing? The answer for agricultural economics: Our work matters but innovation and flexibility will make us better.

My assessments of the state of the profession are:

- Agricultural economics research results increasingly affect policy debate and dialogue.
- The agricultural research establishment is expanding its use of agricultural economics.
- Agricultural economists are doing their jobs well.
- Agricultural economics research needs to balance emphasis among problem solving, subject matter, and disciplinary analysis.

Research Affects Policy

How its analysis is used is an important measure of a profession's effectiveness. There appears to be growing demand for agricultural economics research by public and private officials for use in public policy debates. Economic analyses are gaining acceptance by government officials, especially in many developing countries. For example, the drought and other food concerns in many African countries have expanded the use of agricultural economics information in policy decisions in these countries. Administration officials, legislators, and other authorities in the United States, Europe, and other countries are strengthening their reliance on agricultural economics research analysis.

Improved methods of analysis are perceived as useful and are used more quickly now in policy debates. For example, the time between the development of the concept of producer and consumer subsidy equivalents and their use in General Agreement on Tariffs and Trade (GATT) negotiations was comparatively short. The use of risk analysis techniques has expanded as the problems facing individual firm managers and government become more complex because of the internationalization of agriculture and increased uncertainty.

A significant measure of the quality of agricultural economics' analytic services can be inferred from the quality of the public debate on food and agricultural policy issues. A democracy's quality of public debate is a better measure of the usefulness of agricultural economic analysis than the "rightness" of policy decision. World agricultural policy has moved from debates that have included myth and dogma to a more realistic approach to problems. Examples include the current GATT negotiations and the U.S.-Canada free-trade dialogue about structural change in both agricultural organization and incentives in most socialist countries. Agricultural economic analysis has also made significant contributions to the quality of the debate within and between international organizations like the Food and Agriculture Organization of the United Nations (FAO), World Bank, and Organization for Economic Cooperation and Development (OECD).

Research Expands Role

Results of agricultural research have recently gained wider acceptance. The rising influence of international research centers, the growing concern about profitability as opposed to maximum yield per acre, and the broad-ranging implications of the internationalization of agriculture in all countries have led users in the agricultural industry to value agricultural economics research more highly.

Ironically, the profession of agricultural economics was developed in many countries mainly by agronomists and other biological scientists. They turned to economic analysis in an attempt to deal with the problems and opportunities faced by decisionmakers in agriculture. Advancements in theory, funding, and structure of agricultural research widened the gap between agricultural economics and other agricultural research fields. Many of the farm firm-oriented economics researchers worked closely with their biological science counterparts. The application of the pure

Hildreth is managing director of the Farm Foundation and secretary-treasurer of the International Association of Agricultural Economists. He appreciates the comments of Walter Armbruster, Dale Hoover, Glenn Johnson, John Longworth, Michel Petit, B.F. Stanton, and the editors of this publication for reviews of earlier drafts.

theory of production economics to farm production processes by Earl Heady, his colleagues, and students is a model linkage between the two fields. Expansion in the use of computer-assisted decision aids by farmers has led to more joint efforts.

The recent farm financial crisis in many countries, especially the United States, has led to closer cooperation between economists and other agricultural researchers. And, a growing concern about the impact of farming practices on the environment has brought a focus on low-input, sustainable agriculture and profitability. For example, much of the rapid adoption of minimum tillage with high energy prices can be explained by lower cost and soil conservation.

Most of the international research centers recognize the need for agricultural economics research. Some of the efforts join economics and biological scientists, and some are economic research on policy and institutions that affect adoption of new genetic material and production practices developed by the centers.

Expanding is the number of agricultural economists appointed to research administrator roles in international centers, agricultural research organizations, agricultural experiment stations, universities, and government agencies. The leadership and perspective of these individuals have added to acceptance of agricultural economics by the agricultural research establishment.

Agricultural Economists Do Their Jobs Well

"The typical product of social science research is information," according to Bob Lindner in his 1987 presidential address to the Australian Agricultural Economics Society (*5,* p. 96).[1] Placing a value on the information produced by the world agricultural economics research establishment is a way to judge how well agricultural economists do their jobs. If an easily observable market for information existed, a demand curve for information could be estimated and shifts in the demand and supply curves identified. Although a demand for the information produced by agricultural economists exists, it is not easily observable, especially on a worldwide basis, and that leaves personal observation and interpretation.

The demand for information and the value of information is reflected in the perceived usefulness of the services of agricultural economists. The demand for services of agricultural economists includes a demand for services other than that of researchers. Economists educate undergraduate and graduate students as well as firm managers and citizens through extension services.

The price (salaries) of agricultural economists is a function of both the supply and demand. The salaries of agricultural economists appear to be climbing. The inference: agricultural economists are doing their jobs well.

Most agricultural economists are employed by public bodies, such as government agencies, universities, and international organizations. Both government agency and university employment jobs appear to have leveled off or declined. Some universities in the United States and United Kingdom are not filling vacancies. Reduced spending by governments, budget deficits, and, in the case of universities, slower growth in numbers of students due to demographic factors have contributed to the stagnation. However, the share of employment and budget for agricultural economics compared with other professions in agricultural research appears to have increased somewhat.

The employment patterns of private firms have changed greatly in the past decade. Middle management numbers have declined significantly as firms responded to market conditions and lower profits. The proportion of the membership of the International Association of Agricultural Economists (IAAE) from private firms appears to have slipped over the past 10 years. Many firms have eliminated their economic research departments with finance or marketing units often taking over economic analysis.

I conclude that while agricultural economists are doing their jobs well, they will have to do their jobs better to offset the political, social, and economic forces that affect the organizations for which they work.

What Agricultural Economists Do

Glenn Johnson examined the roles of agricultural economists at the 1976 International Conference of Agricultural Economists (*4*). Johnson discussed the contribution of agricultural economists in three significant roles: participants in decisionmaking, doers of subject matter analysis, and doers of disciplinary analysis.

Participants in decisionmaking focus on a particular problem, either public or private, and they merge theory, empirical knowledge, and command over qualitative techniques to develop empirical information into public or private prescriptions. Doers of subject matter analysis develop and gather information on a specific subject that is relevant for solving a set of problems. Doers of disciplinary analysis improve theories, qualitative techniques, and data.

[1]Italicized numbers in parentheses cite sources listed in the References section at the end of this article.

Ken Hunt, Oxford University, assessed changes in the thrust of agricultural economics over time, beginning with the 1920's in Great Britain (*3*). According to Hunt, the principal aim of agricultural economists in the 1920's and early 1930's was supplying management advice to farmers. Many of these economists came from the biological science side of agriculture. Hunt wrote that the increased professionalism among agricultural economists has encouraged segmentation of the subject and created an interest in the academic aspects of the profession, an increase in the pursuit of knowledge and not in application. Hunt saw that the concerns of agricultural economists have become broader and more diverse. Most agricultural economists specialize but still claim to be agricultural economists.

Castle and I have argued that the range of problems needing agricultural economic analysis will continue to expand, but a lack of agreement exists on how these problems should be investigated. We said that some agricultural economists and some academic departments of agricultural economics will become more pragmatic and interdisciplinary, while others believe that greater disciplinary depth will yield better returns over time (*1,* p. 12).

Debate about the thrust and role of agricultural economics has existed since the beginning of the profession. Taylor and Taylor reported the cleavage between rural economics and farm management in the early 1900's (*7*). The policy statement of the new international journal *Agricultural Economics* lists three areas of coverage: disciplinary topics, subject matter topics, and problem-solving topics. Hedley (*2,* p. v) commented: "This last area of problem solving is a particularly difficult one from which to obtain well-documented research and endeavor since many professionals involved in this work, even though they may have considerable training in agricultural economics, have little encouragement to publish."

A Survey of Agricultural Economics Literature, edited by Martin and sponsored by the American Agricultural Economics Association (AAEA), showed the changes in emphasis in roles over time (*6*). Reviews of agricultural economics literature published in the Australian *Review of Marketing and Agricultural Economics* and the British *Journal of Agricultural Economics* also contain illustrations of changes in roles.

Clearly, excellence in disciplinary and subject matter research is necessary, but not sufficient, for useful problem-solving analysis. The ability to perform useful problem-solving research demands advances in analysis. Undue attention to the discipline of economics for its own sake leads to a neglect of useful analysis. Thus, the world agricultural economics research establishment needs to give continued attention to achieving a proper balance of the roles of disciplinary, subject matter, and problem-solving analysis.

Conclusions

Introspection is helpful in charting future directions and needed corrections whether by individuals or organizations, and within limits, its benefits promote resourcefulness. This article has been one professional's view of the status and condition of the agricultural economics research establishment. A brief essay like this one cannot attempt a comprehensive assessment of the details of agricultural economics. Instead, my four assertions represent my personal perspective and observations.

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Interest Rates and Commodity Prices

John Kitchen and Gordon Rausser

Abstract. *The theory of storage and arbitrage approaches fully incorporate nominal interest rates in far-near commodity price spreads. Alternative frameworks admit a relationship between interest rates and commodity own rates of interest, and as a result, the commodity price spread would not completely incorporate the nominal interest rate. This study examines the views on interest rate-commodity price relationships, the potential role of nonneutralities, and empirical evidence on the relationships. The evidence does not support the hypothesis of a close relationship between commodity own rates and the real interest rate.*

Keywords. *Theory of storage, arbitrage, interest rates, commodity own rates, risk premium, nonneutralities.*

Much recent research has focused on the relationship between interest rates and commodity prices. Most studies are based on, and support, the theory of storage. Under a strict interpretation, the theory of storage indicates that the percentage difference between simultaneously quoted prices for contracts of different delivery dates completely incorporates nominal interest costs. Recently, however, some analysts have suggested that the commodity own rate, an implicit rate of return to commodities, is positively related to the real interest rate, and as a result, the far-near commodity price spread would not incorporate the full nominal interest cost.

Interest rate-commodity price relationships are key in examining macroeconomic linkages to primary commodity sectors like agriculture (*24*).[1] The relationships are particularly important for examining nonneutral monetary impacts. Nominal money supply changes produce no real economic impacts, only nominal price effects, with money neutrality. With nonneutralities, money supply changes induce changes in the real interest rate and real prices. The real price impacts may be particularly strong for primary commodities due to the highly flexible nature of their prices. Examinations of the importance of real interest rates in the determination of commodity prices and expected commodity price dynamics can, therefore, provide important information for understanding nonneutral monetary impacts.

Theoretical Issues and Relationships

The literature on the relationship between commodity prices and interest rates has a long history. For example, Keynes examined futures prices and the relationships among commodity prices, commodity own rates, and the money rate of interest (*15, 16*). Many of these relationships have also been used in a well-developed literature on the theory of storage.[2] The theory of storage is the basis of the arbitrage approach used by Frankel (*7, 8*) and examined by Kitchen and Denbaly (*18*). Kitchen and Denbaly, and Fama and French (*6*), used essentially identical approaches, giving results that support the role of interest rates as specified in the theory of storage and the arbitrage approach. According to Fama and French (*6,* p. 55), "the theory of storage is not controversial."

In a dynamic world of uncertainty, Working's theory of storage is a self-contained but static formulation of intertemporal price relationships (*28*). A conceptual inconsistency in Working's hypothesis was demonstrated by Weymar (*27*) who used Muth's (*19*) rational expectation hypothesis to show that the spread between futures prices for two different dates of delivery should depend on expected stocks, not stocks already in existence. Expectations about stock relationships, and the way such expectations are formed, critically affect storable commodity prices. In contrast, Working stated, "It is only supplies already in existence which have any significant bearing on. . . current intertemporal price relationships."

There appears to be some controversy about whether the far-near commodity price spread exactly incorporates the nominal interest rate. Cornell and French (*2*) showed empirical results that suggest that commodity price spreads (the commodity basis as they define it) adjust to money shocks by an amount that is less than the adjustment in the nominal interest rate. Cornell and French theorize that this smaller adjustment of the commodity basis is due to the relationship between commodity own rates and the economywide real interest rate. Gordon introduced similar concerns by suggesting that the convenience yield is related to the nominal interest rate (*13*).

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[1]Italicized numbers in parentheses cite sources listed in the References section at the end of this article.

[2]See (*27*), and for more recent reviews, see (*21, 10,* and *6*).

The General Case

A general formulation, which admits a host of special cases, presents the basis or price spread as:

$$\ln F(t,t+j) - \ln S(t) = a_1\, i(t,j) + a_2\, sc(t,j) - a_3\, cy(t,j) + a_4\, p(t,j) + a_5\, ar(t,j), \quad (1)$$

where ln represents the natural logarithm, F(t, t+j) is the futures contract price in period t for a commodity to be delivered in period t+j, S(t) is the spot price in period t, i(t,j) is the j-period nominal rate of interest in period t, sc(t,j) is the j-period physical storage cost percentage in period t, cy(t,j) is the j-period convenience yield in period t, p(t,j) is the j-period risk premium in period t, and ar(t,j) is the j-period arbitrage cost in period t. The parameters $a_1 \ldots a_5$ are assumed to have two settings, zero or one, depending on the specifications of each alternative case.

The Strict Arbitrage View

In the arbitrage studies conducted by Frankel (*7, 8*) and Frankel and Hardouvelis (*9*), the general formulation is simplified by setting $a_1, a_2 = 1$ and $a_3, a_4, a_5 = 0$, or:

$$\ln F(t,t+j) - \ln S(t) = i(t,j) + sc(t,j) \quad (2)$$

This formulation suppresses the convenience yield and potential risk premium and arbitrage cost components. Frankel's work concentrates on the expected change in the commodity price (thus replacing F(t,t+j)) with $E_t S(t+j)$, where E_t represents the rational expectation formed in period t.[3] In this setting, the nominal interest cost would be completely reflected in the contracted commodity price change.

Expectations and the Risk Premium

An alternative view addressed by Fama and French (*6*) splits the futures price into the expected spot price change plus a risk premium associated with price uncertainty, $p(t,j) = \ln F(t,t+j) - \ln E_t S(t+j)$, shown as:

$$\ln F(t,t+j) - \ln S(t) = \ln E_t S(t+j) - \ln S(t) + p(t,j), \quad (3)$$

so that $a_5 = 0$ and $a_1, a_2, a_3, a_4 = 1$. This formulation imposes a joint efficient markets-rational expectations constraint in the determination of $\ln E_t S(t+j)$, such that the spread between the current spot price and the expected future spot price is determined by the convenience yield and carrying cost. Fama and French examined equation 2 and found great variation in the relationships across commodities. For example, in the case of crop and animal product commodities, futures prices had forecast power for subsequent spot prices, while for precious metals, there was little forecast power. The relationship between the risk premium and futures prices was also highly variable across commodities. For some commodities, futures price variation was related to variation in the premium, while for others, particularly precious metals, no evidence related futures prices to time-varying premiums. Fama and French gave marginal evidence that the premium was nonzero on average, interpreting this result as consistent with the "normal backwardation" in future prices suggested by Keynes (*15*). With normal backwardation, the premium in equation 3 would tend to be less than zero, $p(t,j) < 0$, and futures prices would be downward-biased predictors of subsequent spot prices.[4]

Commodity Own Rates

Keynes (*16,* pp. 226-27) carefully examined the various components of the returns to commodities as revealed in the commodity own rate of interest and in the commodity rate of money interest:[5]

> It follows that the total return expected from the ownership of an asset over a period is equal to its yield minus its carrying cost plus its liquidity premium, i.e. to q – c + 1. That is to say, q – c + 1 is the own-rate of interest of any commodity, where q, c, and 1 are measured in terms of itself as standard. . . . To determine the relationships between the expected returns on different types of assets which are consistent with equilibrium, we must also know what the changes in relative values during the [period] are expected to be.

Cornell and French (*2*) specify the commodity own rate by using the equation:

$$\ln F(t,t+j) - \ln S(t,j) = i(t,j) - k(t,j), \quad (4)$$

where k(t,j) is the j-period commodity own rate. From equations 1 and 4, we see that the commodity own rate may be comprised of various components:

$$k(t,j) = -\alpha_2\, sc(t,j) + \alpha_3\, cy(t,j) - \alpha_4\, p(t,j) - \alpha_5\, ar(t,j) \quad (5)$$

[3]Frankel (*7,* p. 565) downplayed the importance of the risk premium: "With conventional estimates of the coefficient of risk aversion and the variances of asset prices, the [Capital Asset Pricing] model suggests that the risk premium cannot be much more than a few basis points."

[4]See (*1, 3, 6,* and *14*) for more details.

[5]The commodity own rate of interest and the commodity rate of money interest are apparently the real and nominal rates of interest in commodity markets referred to by Telser (*26,* p. 214).

Keynes' "yield" and "liquidity premium" terms together comprise the convenience yield, cy(t,j), in our notation, while the carrying cost is analogous to sc(t,j). Keynes (*16,* p. 240) stated:

> The liquidity premium . . . is partly similar to the risk premium, but partly different; . . . however, in calculating the own-rate of interest we must allow for both.

Thus, Keynes also acknowledged the importance of the risk premium, p(t,j), as a component of the own rate.

Commodity Own Rates and the Real Interest Rate

While the commodity own rate examined by Cornell and French (*2*) is not a new idea, their concept of the commodity own rate being related to, even determining, the real interest rate in the economy is new. The Cornell and French theory specifies the real interest rate in the economy as a weighted average of the k(t,j) own rate terms across commodities (weighted by the commodity expenditure share). Their analysis concentrated on commodity own rates as a measure of the real interest rate and also on the far-near commodity price spread (the commodity basis) as a measure of expected inflation, the expected change in the value of commodities relative to money.

The difference between the Cornell and French view and the strict arbitrage view centers on the fact that the arbitrage approach implicitly assumes that, in addition to the inflation component of the nominal interest rate, the real interest rate is also completely incorporated in the far-near commodity price spread. The Cornell and French approach requires a relationship between the variables of the right-hand side of equation 5 and the real interest rate, while the theory of storage does not specify any relationship.

We are left with two different interpretations. Cornell and French view commodity own rates (or the component parts: liquidity premiums, convenience yields, carrying costs, or risk premiums) as positively related to the real interest rate. The alternative interpretation from the theory of storage and the arbitrage studies views commodity convenience yields and liquidity and risk premiums as commodity-specific and unrelated to the interest rate, that is, own rates are unrelated to the real interest rate.

Empirical Evidence in the Recent Literature

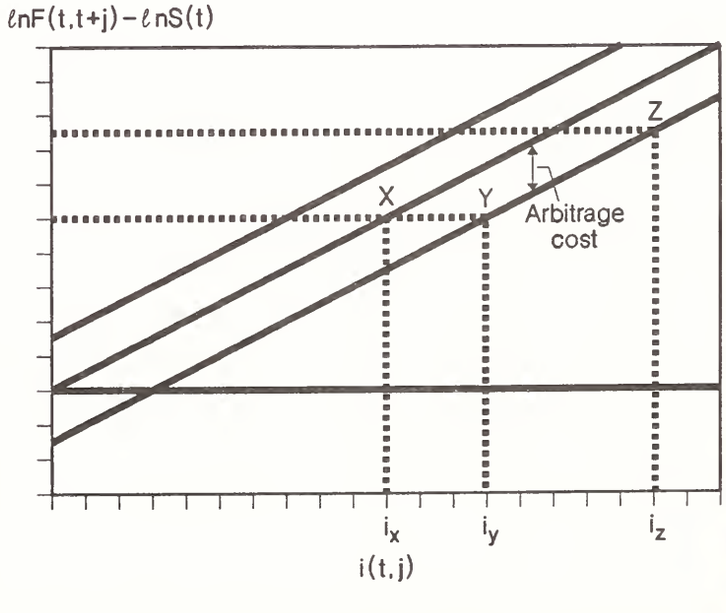
The empirical results of Cornell and French showed that, in response to money shocks during 1980-82, the nominal interest rate change was greater than the change in the far-near commodity price spread (the commodity basis). Their results, in conformance to their theory, suggested that commodity own rates and the real interest rate are related. However, since Cornell and French did not account for arbitrage costs and nonneutralities, their empirical results are subject to other interpretations.

Transactions and other arbitrage costs can lead to problems and potential bias in estimating parameters based on arbitrage relations.[6] If the cost of arbitrage between financial and commodity markets (represented in equation 1 as the percentage ar(t,j)) is large relative to the change in interest rates, there may be no profit incentive to produce a response in the commodity price spread.

Figure 1 shows upper and lower arbitrage boundaries. Begin with a case where the strict commodity-financial parity relation holds, as at point X in figure 1. If a change in the interest rate does not exceed the cost of arbitrage, that is i_x to i_y, then no profit incentive would exist to change the commodity price spread, producing a point such as Y. Or, suppose the initial position was inside the arbitrage bands (for example, point X) and that the change in the interest rate was relatively large, like i_x to i_z, thus producing a commodity price response (a change to point Z, for example).

[6]See (*11, 22,* and *23*) for more information on the role of transactions costs in foreign exchange and commodity markets.

Figure 1
Arbitrage boundaries



This case requires that arbitragers initially have a net long position in the commodity, allowing for the simultaneous spot sale of the commodity, forward purchase of the commodity, and purchase of a security with relevant maturity. The analagous opposite case is not as restrictive. Arbitragers could either sell off currently held securities or they could borrow funds at the current interest rate. In each case, arbitrage costs arise for each of the transactions. For example, we have $ar(t,j) = t_s + t_f + t_b$, where t_s, t_f, and t_b are the percentage transaction costs for spot contracts, forward contracts, and securities, respectively.

The commodity price spread response is less than the interest rate response in these examples. As a result of arbitrage costs we would expect percentage changes in the commodity price spread to be less than the changes in the interest rate.

Cornell and French also did not address the issue of nonneutral monetary impacts, which were assumed away (*2*, p. 9, note 7). Frankel and Hardouvelis (*9*) and Rausser, Chalfant, Love, and Stamoulis (*25*) discussed the importance of nonneutralities showing that the commodity price response to monetary shocks is consistent with such an interpretation. Monetary shocks that drive real interest rate changes also drive real primary commodity price changes.

Frankel and Hardouvelis (*9*) examined the response of spot commodity prices to Federal Reserve Board (FRB) monetary stock announcements. Spot prices of primary commodities increased in response to a larger than anticipated money stock during periods when the FRB was not committed to strict monetary aggregate targets (1977-79 in the analysis). However, spot prices of primary commodity prices fell in response to a larger than anticipated money stock during periods of monetary aggregate targeting and questions about FRB credibility (1980-82). Their model provides an explanation for both policy periods with the spot commodity price overshooting equilibrium.

Figures 2 and 3 show likely paths for prices under the two monetary policy regimes in a steady-growth-state economy with inflation. The market learns of a larger than anticipated money stock at time t(0). In periods without commitment to monetary aggregate targeting (fig. 2), both the equilibrium price and the (flexible) primary commodity price increase, with the flexible price overshooting the equilibrium. With a monotonic adjustment to equilibrium, the deviation is eliminated over a j-period horizon. During periods of commitment to monetary aggregate targeting (fig. 3), the news of a larger than anticipated money stock triggers a decline in equilibrium prices and the flexible spot commodity price again overshoots the equilibrium.

The paths shown in figures 2 and 3 follow a model similar to that of Frankel and Hardouvelis (*9*), where the equilibrium general price level is a monotonic function of the series of log differences of the expected nominal money supply and expected real income. Without monetary policy credibility (fig. 2), unexpected money stock increases signal that the nominal money stock is expected to be larger relative to real income in future periods, producing an increase in the equilibrium general price level. With money stock targeting and policy credibility (fig. 3), unexpected money stock increases signal that real income is higher than expected relative to the expected money stock over time, producing a decline in the general price level.

Cornell and French saw the response of the commodity basis (the far-near price spread) as a measure of the response of inflation expectations to money shocks. Accounting for nonneutralities makes clearer that the commodity basis is actually measuring flex-price inflation rather than general or equilibrium inflation. For example, figure 3 shows that flex-price inflation (C to E*) exceeds equilibrium inflation (E′ to E*). Thus, with nonneutralities, the commodity basis cannot be used as an accurate measure of expected (aggregate or equilibrium) inflation. A large positive response in the flex-price commodity basis could occur, and yet the aggregate rate of inflation over the horizon

Figure 2
Price reaction to money shock, with no monetary authority credibility

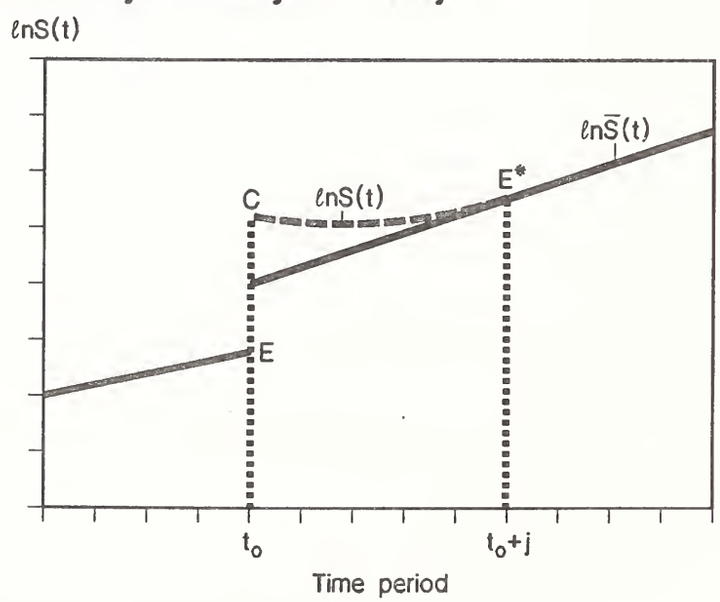
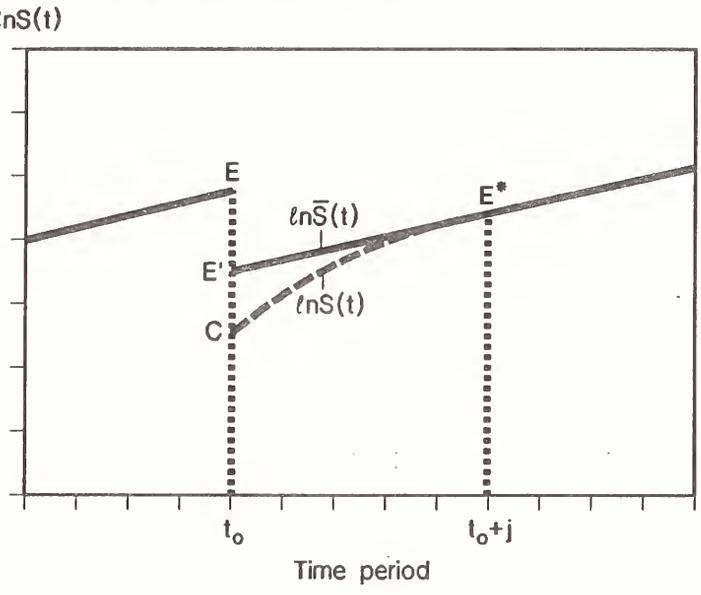


Figure 3
Price reaction to money shock, with monetary authority credibility



could be expected to decline. The point is that nonneutralities exist and money shocks can drive real commodity prices. The far-near commodity price spread would then incorporate the real interest rate in addition to the inflation expectation components of the nominal interest rate.

Additional evidence on the relationship between commodity own rates and the nominal interest rate comes from the empirical results in (*18*) and (*6*). Consider the regressions:

$$\ln F(t,t+j) - \ln S(t) = a + b\, i(t,t+j) + e(t,t+j), \text{ and} \quad (6)$$
$$\ln S(t) - \ln F(t,t+j) + i(t,t+j) = c + d\, i(t,t+j) + w(t,t+j), \quad (7)$$

where e(t,t+j) and w(t,t+j) are regression errors, and a, b, c, and d are regression coefficients. The following constraints hold for the estimated coefficients (*4, 5*):

$$a + c = 0 \quad (8)$$
$$b + d = 1.0 \quad (9)$$

The standard errors of these coefficient estimates are identical across equations, that is, s(a) = s(c) and s(b) = s(d). These contraints *must* hold since the left-hand side (LHS) variables in equations 6 and 7 sum to the right-hand side variable used in each regression. Since the LHS variable in equation 7 is simply the commodity own rate examined by Cornell and French, evidence on the relationship between commodity own rates and interest rates is implicitly contained in the regression estimates of equation 6. The c and d coefficients of equation 7 can be derived from the a and b coefficient estimates in equation 6 (table 1). The derived c coefficients reveal that significant nonstochastic own rates of interest (convenience yields) exist for the agricultural commodities. No significance of the c coefficients is observed for the metals. Contrary to the results observed by Cornell and French, and the relationship between the convenience yield and the interest rate hypothesized by Gordon, the d coefficient estimates reveal no significant relationship between commodity own rates and the interest rate.

Direct Evidence on Commodity Own Rates and the Real Interest Rate

By using the definition for the commodity own rate (equation 4), we see that the values of 6-month own rates were calculated for eight primary commodities for sample periods covering the 1970's and 1980's. *Ex ante* 6-month real interest rates were also calculated.[7]

The 6-month own rate used the 6-month ahead futures price for the value of F(t,t+j) (j=6) and the current delivery futures price for the value of S(t) at the first business day of the observation month. The interest rate used was the market yield on Treasury bills with

[7]Mishkin recently presented some statistical analysis of 2-month own rates (*19*). While evidence suggested that the real interest rate process shifted as a result of the October 1979 FRB policy change, Mishkin found no support for a similar shift in commodity own rate processes.

Table 1—Implied coefficient estimates for own rate regression[1, 2]

Commodity	c	(c)	d	s(d)
Metals:				
Gold	–0.88	1.08	0.13	0.24
Silver	1.34	1.84	–.29	.41
Grains:				
Corn	4.03	2.60	.42	.61
Oats	9.08	4.68	0	1.09
Soybeans	8.57	3.29	–.91	.71
Wheat	8.81	4.24	–.70	.99
Stacked grains	7.62	1.91	–.30	.45

[1]ln S(t) – ln F(t,t+j) + i(t,t+j) = c + d i(t,t+j) + w(t,t+j)
[2]These data were derived from results presented in (*17*). Similar estimates for the d coefficient can be obtained from the results presented in (*6*). The results for the intercept and intercept dummies used in (*6*) were not reported, so c coefficients cannot be derived.

maturity closest to the first delivery day for the 6-month ahead futures contract. February and August contract prices were used in the own rate calculations for gold, hog, pork belly, live cattle, and feeder cattle futures contracts. March and September contract prices were used for corn, soybean, and wheat contracts.

We calculated the *ex ante* 6-month real interest rate as the 6-month nominal interest rate minus the expected inflation over that period. Expected inflation was determined from the Consumer Price Index forecasts reported in the *Economic Outlook Survey* of the National Bureau of Economic Research and the American Statistical Association.

Table 2 shows cross-correlations between the individual commodity own rate and the relevant *ex ante* real interest rate series. The coefficients reveal that none of the commodity own rates were closely correlated with the real interest rate. The own rates of the agricultural commodities were highly volatile over the entire sample period. While gold own rates appeared to be more closely correlated with the real interest rate during October 1979-October 1982 than during other periods, there was no obvious relationship that existed between agricultural own rates and the real interest rate during that period. This evidence suggests that there is little relationship between commodity own rates and the real interest rate.

Conclusions

Subtle differences exist in analyses that link interest rates and intertemporal commodity prices. Our analysis suggests that the change in primary commodity basis, contrary to the Cornell and French interpretation, would be a poor measure of the change in (aggregate or equilibrium) inflation expectations. And, a change in primary commodity own rates (even in weighted average form) would not be a good signal of a change in the real interest rate in the economy.

We are led to these conclusions from several observations. First, the pass-through of interest rate effects to commodity prices can be dampened by factors that restrict efficient price adjustment, for example, arbitrage costs. Second, the rigidity of the economy's general price level and the highly volatile nature of primary commodity prices together enhance a negative relationship between real primary commodity prices and real interest rates. Third, little evidence supports a hypothesized positive relationship between *ex ante* real interest rates and commodity own rates. Neither gold nor agricultural commodity own rates were closely correlated with the *ex ante* real interest rate. While commodity prices are related to nominal interest rates as suggested by the theory of storage, commodity prices do not communicate precise knowledge about the components of nominal interest rates. Commodity futures price spreads do not generally appear to provide clear information about inflation expectations, and commodity own rates are not closely related to the real interest rate.

Table 2—Cross-correlation coefficients for commodity own rates and the *ex ante* real interest rate[1]

Commodity	Cor(k(t,j),r(t,j))
Gold	0.064
	(.229)
Feeder cattle	.504
	(.189)
Live cattle	.349
	(.182)
Live hogs	−.162
	(.182)
Frozen pork bellies	−.228
	(.182)
Corn	.299
	(.182)
Soybeans	−.010
	(.182)
Wheat	.027
	(.182)

[1]Numbers in parentheses are standard errors, which are determined by sample size.

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Marginal Costs of Managing Endangered Species: The Case of the Red-Cockaded Woodpecker

William F. Hyde

Abstract. *This case study of red-cockaded woodpecker management in the Croatan National Forest in North Carolina demonstrates that a schedule of opportunity costs for endangered species management (1) is easy to calculate and (2) can help clarify management and policy alternatives. The study also shows that the greatest gains from biological research will come from improved understanding of how the woodpecker chooses new habitat. Finally, it shows, in this case, management of endangered species need not impose large costs on society.*

Keywords. *Endangered species, red-cockaded woodpecker.*

The purpose of this article is to consider management of one endangered species, the red-cockaded woodpecker (RCW), in the Croatan National Forest in North Carolina as an example of a general economics problem for all endangered species. The RCW is on the national endangered species list and its management is a contentious issue for USDA Forest Service, which is concerned with conflicts between endangered species and other forest uses and the Interior Department's (USDI) Fish and Wildlife Service, which is concerned with strictly upholding the endangered species law. This article shows that even an incomplete analysis based on readily available data can help managers and policymakers understand the relevant tradeoffs. It also shows, in this special case, that there is great variation in costs depending on where and how RCW management proceeds. This is important information considering the highly speculative, and often inflammatory, statements made by both proponents and opponents of endangered species protection.

Previous economics literature on preservation focuses on either maximizing a social welfare function, which includes both development goods and natural assets, or satisfying a safe minimum standard. The welfare maximization approach has yet to be successfully applied to an example involving an actual endangered species (*6, 12, 16*).[1] The safe minimum standard literature accepts a normative decision to preserve, provided that costs are within socially acceptable limits, and then searches for the minimum viable population given irreversibility and uncertainty (*2, 3, 4, 5*).

This article takes an intermediate approach. Given the normative decision to preserve, the article searches for the least-cost management alternative for preserving any population level, implicitly including the level of the safe minimum standard.[2] Miller discusses some conceptual aspects of this approach (*13*). There is an empirical solution arising from this approach for any species and for any set of management alternatives.

This article shows how managers and policymakers can use this approach to make cost-effective endangered species decisions at the margin. The article shows the critical RCW management variables and suggests where biological research can provide information useful to managers. The discussion begins with an introduction to the important characteristics of RCW biology and habitat. It continues with development of an economic model that emphasizes the tradeoff between RCW habitat and timber production, the highest valued alternate use of most RCW habitats.

Biological Background

The red-cockaded woodpecker inhabits mature pine forests (50-150 years old) in the South. It lives in population units called clans, each of which consists of a mated pair and its (up to seven) helpers. Clans roost in areas known as colonies and mated pairs nest in cavity trees within these colonies. Cavity trees are mature, live pines in which the woodpeckers excavate cavities for nesting. The existence of cavities is essential because without them males cannot attract females.

Hyde is an economist with the Resources and Technology Division, ERS. The USDA Forest Service Southeastern Forest Experiment Station funded this research while the author was at Duke University. Patrick Hepner, Rebecca Judge, and Randy Strait provided research assistance. Michael Leonard furnished wildlife management advice. The analysis was first discussed in abbreviated form at the 49th North American Wildlife and Natural Resources Conference, 1984. Reviews by Richard Bishop and others clarified the interpretation of previous literature and the analysis.

[1]Italicized numbers in parentheses cite sources listed in the References section at the end of this article.

[2]The stochastic nature of species populations and the uncertainty surrounding our means for their measurement imply that the safe minimum standard is actually a range in population, not a population level.

Apparently, woodpeckers do not select cavity trees for age alone. Rather, they choose and excavate trees that contain substantial heartwood (which is positively correlated with age), and, of trees with heartwood, woodpeckers prefer those with red heart fungus (*10*). The fungus softens and destroys heartwood, thereby making excavation easier.

Colony sites must include a replacement stock of cavity trees because woodpeckers abandon nests in dead trees. Woodpeckers also abandon nests in live trees when the hardwood and sapling pine undergrowth reaches the height of the cavity (*7*). Prescribed burning can control the undergrowth, preventing this cause of abandonment.

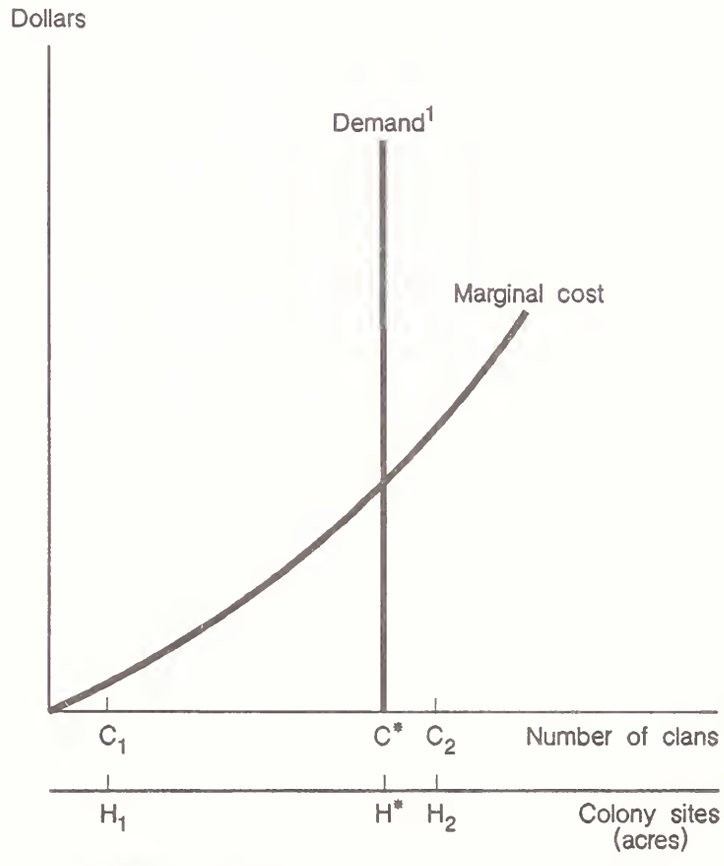
The land area for each colony site ranges from 7 to 90 acres. Clans defend territories ranging from 100 to 250 acres around colony sites, and they forage on live pines of all ages within this territory.

Economic Analysis

This analysis assumes an exogenous demand. That is, a public law requires endangered species management. The law imposes the demand for RCW management. The analysis itself is composed of a search for the management alternative that satisfies this demand at the least marginal cost.[3] The most important costs for RCW management are the implicit costs of foregone timber opportunities. Neither the Forest Service nor the Fish and Wildlife Service makes claims for other competitive uses on RCW habitat in the Croatan National Forest. The costs associated with prescribed burning to maintain understory height below cavity level are also the costs of the more basic stewardship responsibility of the Forest Service for all national forestlands, commercial or otherwise. There are no incremental direct RCW management costs. The cost management unit is the clan. Therefore, the marginal cost function measures the timber opportunity cost per clan or the cost per colony site. No change in timber management is necessary in woodpecker-foraging territories because foraging and timber management are naturally compatible.

The Croatan National Forest manages its important timber species, loblolly and longleaf pine, on 70-year rotations in accordance with multiple use-sustained yield criteria and the National Forest Management Act of 1976.[4] RCW biologists recommend average ages

Figure 1
Endangered species modeling



1/ Demand is externally set by a law which requires protection of all known populations of the endangered species.

of 95 years for longleaf and 75 for loblolly, although there are woodpeckers nesting in Croatan loblolly stands as young as 46 years (*10*). The costs of delayed harvests imposed by the biological recommendations are not constraining everywhere in the Croatan because not all timberstands in the forest are commercially productive. The noncommercial stands tend to be biologically mature and RCW preservation can occur on these without conflict with timber management. The marginal cost function, in this noncommercial case, runs along the horizontal axis in figure 1.

Where the timberstands are commercial, either of two alternate approaches may extend timber management rotations for woodpecker management: (A) permanent cessation of all timber harvesting on currently occupied colony sites or (B) extended rotations and harvests on a sequence of timberstands recruited as colony sites.

[3]Where the law is not indicative of marginal social valuation, then the approach in this article says nothing about social optimality. This analysis only shows the least expensive manner of accomplishing any given level of endangered species protection.

[4]The Forest Service prescribes these long rotations regardless of the presence or absence of other resource values on these lands. Rotations for the same species grown on private lands tend to be closer to 40-45 years. The literature on this difference is extensive and rotation differences of this magnitude make a large financial difference. (See (*9*), ch. 2, and the citations in that chapter.) Forest Service rotations are relevant for this article where laws and management practices other than those specifically designed for endangered species management are held constant.

Neither alternative is a perfect preservation solution. Nevertheless, these are the solutions that focus current management discussion. The first alternative fails to consider the 4-9 percent annual rate of mortality among occupied cavity trees and makes no provision for their future replacement.[5] The understory is unlikely to provide replacement trees because pines tend to grow in even-aged stands with large gaps between the older age classes. The second alternative assumes that clans easily relocate when their colony sites are harvested, although there is no empirical evidence supporting this assumption. Thus, in the short run, the second alternative provides uncertain results. In the long run, however, we can expect that biologists will learn more about colony establishment and the second alternative may become more attractive.

Alternative A: Preserving Existing Colonies in Perpetuity

Current woodpecker management in the Croatan corresponds to this alternative. Forgone net timber receipts V_1 can be calculated according to the familiar Faustmann equation modified to include revenues from a sequence of harvests Q(t), including both thinnings and final harvests which vary in diameter and, therefore, value; increasing relative stumpage prices p(t); costs c(t) from a sequence of inputs; and the number of acres A comprising the known colony site.

$$V_1 = A[(\sum_{t=0}^{T} p(t)Q(t)e^{-rt} - \sum_{t=0}^{T} c(t)e^{-rt})]/(1-e^{-rT}) \quad (1)$$

Equation (1) describes the present value of an infinite series of rotations beginning now. Table 1 describes the empirical data used to estimate this value.

Further modification is necessary to include the value of currently standing timber on an existing colony site. The present value of standing timber is equal to:

$$V_2 = A[(\sum_{t=0}^{T-a} p(t)Q(t)e^{-rt} - \sum_{t=0}^{T-a} c(t)e^{-rt})], \quad (2)$$

where the revenues and costs generated by the current stand are calculated from the present (t=0) to the time of their final harvest (t=T–a, where T=70 years and a=the current stand age).

The combined value of the standing timber V_2 plus the value of all future rotations V_1 equals the total value of the colony site V_3 where:

$$V_3 = [V_2] + [V_1 e^{-r(T-a)}] \quad (3)$$

The discount term is $e^{-r(T-a)}$ because the perpetuity rent V_1 is not forthcoming until after the current timberstand is harvested. V_3 is the final measure for management alternative A, the timber opportunity associated with permanent removal of the existing colony site from timber production.

Alternative B: Rotating Recruitment Stands

The cost of implementing management alternative B equals the difference between net timber revenues from current 70-year rotations and net revenues from the extended rotations necessary for recruitment stands of potential cavity trees. Its calculation depends on two important assumptions, one having to do with the length of RCW habitation in recruitment stands and the other having to do with current stand age structures and harvest scheduling.

Biological evidence suggests that woodpeckers mate in their second year and inhabit colony sites until their eighth year when they die. The sites then can be harvested and descendants of the mated pairs may relocate to adjacent recruitment stands (*11*). This assumption, together with Lennartz's recommendation of stands averaging 75 years for loblolly and 95 years for longleaf, recommends sequences of 13 loblolly sites (that is, the oldest between 72 and 78 years where 13 equals 78 years divided by 6 years per mated pair occupancy) and 17 longleaf sites (98 years divided by 6 years). In addition, we can assume that each colony site is 11.7 acres, the average size of current RCW colonies in the Croatan, and that the various loblolly and longleaf sites in the Croatan have sufficient adjacent acreage to allow the necessary sequences of recruitment stands.[6] Conversion from 70-year rotations to extended rotations poses no immediate stand age problems because the Croatan has an excess of mature and noncommercial timberstands that can fill the RCW management gap until current commercial stands reach ages 75 and 95 for loblolly and longleaf, respectively.

[5]With an average of 1.5 cavity trees per colony in the Croatan and an annual mortality rate of 4-9 percent, all existing cavity trees will be dead in 17-38 years. Clearly, an alternative to preservation of existing stands must be found and implemented soon.

[6]Forest Survey data show that sufficient acreage exists within each site index, but they provide no indication regarding its locational distribution. The 200-acre foraging areas recommended for the Croatan National Forest are not constraining. That is, 11.7 acres for each of 13 loblolly or 17 longleaf stands implies 152.1 or 198.9 acres per colony, respectively, less than the 200-acre constraint.

Table 1—Abbreviated cost-revenue stream used in the calculation of perpetuality rents[1]

$$V_2 = A[(\sum_{t=0}^{T} p(t)Q(t)e^{-rt} - \sum_{t=0}^{T} c(t)e^{-rt})]/(1-e^{-rT})]$$

Year[2]	Treatment[2]	Output (Q(t)), by Site Index (SI)[3]					Costs (c(t))	Revenues[4,5]
	SI:	70	80	90	100	110		
Loblolly pine:								
							Dollars	
0	Site preparation	—	—	—	—	—	130/acre	0
0	Fertilizer	—	—	—	—	—	30/acre	0
1-T[6]	Annual management	—	—	—	—	—	2/acre/year	0
30	Commercial thinning (cordwood)	0.98	4.03	6.63	11.10	13.44	6/cord	7.75/cord
50	Commercial thinning (cordwood)	11.55	15.62	22.00	29.44	33.57	6/cord	7.75/cord
70[7]	Harvest (sawtimber)	22.55	29.50	36.60	44.95	53.10	10/Mbf[10]	148.00/Mbf
78[8]	Harvest (sawtimber)	23.65	30.60	37.95	46.10	54.70	10/Mbf	148.00/Mbf
Longleaf pine:								
	SI:	50	60	70	80			
0	Site preparation	—	—	—	—		130/acre	0
0	Fertilizer	—	—	—	—		30/acre	0
1-T[6]	Annual management	—	—	—	—		2/acre/year	7.75/cord
40	Commercial thinning (cordwood)	0	0	1.47	4.84		6/cord	7.75/cord
60	Commercial thinning (cordwood)	0	4.09	9.74	15.24		6/cord	7.75/cord
80[9]	Commercial thinning (cordwood)	0	7.50	14.71	25.05		6/cord	7.75/cord
70[7]	Harvest (sawtimber)	5.40	12.35	20.40	28.30		10/Mbf	148.00/Mbf
98[8]	Harvest (sawtimber)	9.60	18.50	27.35	36.55		10/Mbf	148.00/Mbf

[1]See text for discussion of formula. r = 4 percent, 7 percent, or 10 percent.
[2]Various sources: Asheville Office, National Forests of North Carolina.
[3]Source: USDA (1929, revised 1976).
[4]Source for prices: Norris (1979-81).
[5]Price sensitivity tested by assuming constant prices and rising relative prices, in separate runs.
[6]T denotes the final year of the rotation. Thus, T=70 for 70-year rotation, T=78 for loblolly extended rotations and T=98 for longleaf extended rotations.
[7]Projected cut under current rotation.
[8]Projected cut under extended rotation.
[9]Commercial thinnings in the 80th year occur only under the longleaf extended rotation management alternative.
[10]Mbf=Thousand board feet.

This completes the preparatory background necessary for modeling rotating recruitment stands. We can make the assumption that all recruitment stands grow from currently unmanaged standing timber. The existence of standing timber raises net timber values and depreciates the economic justification for RCW management. It is a conservative assumption with respect to promoting RCW management.

The present value of the perpetual net revenue stream from one colony site is:

$$V_4 = V_1(T) - (V_1(T_R), \quad (4)$$

where V_1 remains as defined previously, T is the mandated 70-year Forest Service rotation, and T_R is the RCW rotation. For a sequence of 6-year inhabited sites, opportunity costs totaling V_4 occur every 6 years on each 200-acre RCW habitat. The discounted total costs for maintaining one RCW clan in perpetuity are:

$$V_5 = V_4(e^{-6r} + e^{-12r} + \ldots + e^{-T_R r}) \quad (5)$$

The present value of the perpetual net revenue stream from 11.7 acres of loblolly pine on a 70-year rotation is:

$$V_1(T) = [11.7/1-e^{-70r})][(p(70)Q(70)-c(70) + (p(30)Q(30)-c(30))e^{-30r} + (p(50)Q(50)-c(50))e^{-50r}], \quad (6)$$

for stands currently 70 years old. Initial-year site preparation and fertilization costs enter as final harvest costs for the previous rotation.[7] Annual management costs are compounded, summed, and entered at year 30 and year 50. (Recall from table 1 that thinning occurs at ages 30 and 50 for loblolly.) Similarly, the present value of the perpetual net revenue stream from 11.7 acres of loblolly on 78-year rotation is:

$$V_1(T_R) = [11.7(1-e^{-78r})][(p(78)Q(78)-c(78))e^{-8r} + (p(30)Q(30)-c(30))e^{-38r} + (p(50)Q(50)-c(50))e^{-58r}] \quad (7)$$

[7]Again, this is debatable Forest Service timber management practice. It is also poor economics if these are only the costs of generating the next commercial timberstand. (See (*9*), ch. 2.) This article accepts this Forest Service practice on the grounds that the article is restricted to examining only management prescriptions specifically designed for endangered species.

Subtracting equation 7 from equation 5 provides the loblolly opportunity cost for providing a single RCW colony site.

Incorporating the 6-year sequence of 13 sites yields the discounted total loblolly opportunity costs for maintaining an RCW clan in perpetuity:

$$V_5 = V(70)(1+e^{-6r}+\ldots+e^{-72r}) - V(78)(e^{-8r}+e^{-14r}+\ldots+e^{-80r}) \quad (8)$$

Analogous expressions describe longleaf opportunity costs for maintaining RCW clans in perpetuity.

Empirical Results

Table 1 shows our harvest projections, prices, and costs, and their sources. One modification and two sensitivity analyses are especially important. First, Hopkins provides data on the stocking of current stands (*8*). An additional generous assumption that all future stands will be fully stocked raises our timber opportunity perhaps as much as 50 percent.

The analysis may be sensitive to increases in relative stumpage prices over time and to various costs of capital. Real sawtimber stumpage prices are increasing at a 3-percent annual rate and cordwood prices are increasing at a 1.5-percent annual rate (*5*). Some evidence, however, suggests that these rates may decline early in the next century (*1*). Other evidence suggests that competing environmental amenity values may also be increasing in real value (*15*). Therefore, it is appropriate to examine real annual rates of 0, 1.5, and 3.0 percent for sawtimber and 0, 0.75, and 1.5 percent for cordwood. Finally, the Forest Service uses a 4-percent discount rate but only on appeal from the general Federal agency rate of 10 percent. We might test for both, as well as for the intermediate rate of 7 percent. The social opportunity cost of funds probably falls within this range.

A First Order of Results

Table 2 shows the range of results for management alternative A, preserving existing colonies in perpetuity. For example, for constant stumpage prices and a 4-percent discount rate, the costs of preserving the 52 existing colony sites in perpetuity range from $255 to $56,529 per site. These one-time-only costs are equivalent to streams of annual rents ranging from $10 to $2,261 per site. Table 2 also shows that these perpetual preservation costs are inversely proportional to changes in the discount rate and directly proportional to changes in rates of sawtimber and cordwood price increases.

Table 2—Costs of preserving existing colony sites

Price changes[1]	Discount rate 4 percent	7 percent	10 percent
	Dollars per colony		
0, 0:			
Present value	255-56,529	81-35,798	24-24,015
Annual rent	10-2,261	6-2,505	2-2,402
0.015, 0.0075:			
Present value	722-74,453	303-44,762	224-29,828
Annual rent	29-2,978	21-3,133	22-2,984
0.03, 0.015:			
Present value	1,537-100,862	512-56,025	349-36,912
Annual rent	61-4,034	36-3,922	35-3,691

[1]The first number is the rate of sawtimber stumpage price change and the second is the rate of cordwood price change.

Table 3 shows the range of results for management alternative B, rotating recruitment stands. It is strictly comparable with table 2, except that its results refer to the opportunity costs of extending current timber rotations and providing recruitment stands. The range of costs in each cell of the two tables directly relates to the acreage in the colony site, the site productivity for timber, species (loblolly sites tend to be higher valued), and the age and stocking of the current timberstand. The rankings of individual colony sites change somewhat within the cells of table 2 because younger current stands are more affected by the relative price change, but all stands are equally affected by discounting.

Comparing the results in table 3 with those in table 2 yields unsurprising conclusions. Management alternative B represents a land-intensive means of preservation requiring almost 20 times more land than alternative A. Although timber harvest revenues are permanently forgone under alternative A, the loss amounts to little more than the value of the standing timber. Revenues from future rotations are so highly discounted as to make them of little significance. Under alternative B, 70-year harvest revenues are forgone every 6 years on 13 loblolly or 17 longleaf land units, each 11.7 acres in size. While this loss is partially relieved by revenues from the 78-year or 98-year harvests, the discounted compensation cannot offset the large difference in the required acreage.

Final Results

Some woodpecker colony sites are on timberland that is not now fully managed for timber. Therefore, some RCW protection occurs without a timber opportunity cost, which means that some RCW management costs

Table 3—Costs of rotating recruitment sites of extended ages

Price changes[1]	Discount rate		
	4 percent	7 percent	10 percent
	Dollars per colony		
0, 0:			
Present value	11,824-118,349	13,632-98,193	12,553-93,769
Annual rent	473-4,734	954-6,874	1,255-9,377
0.015, 0.0075:			
Present value	8,966-131,342	14,249-107,895	13,607-94,600
Annual rent	359-5,254	997-7,553	1,361-9,460
0.03, 0.015:			
Present value	1,076-145,404	13,972-118,519	14,598-99,666
Annual rent	43-5,816	978-8,296	1,460-9,967

[1]The first number is the rate of sawtimber stumpage price change, and the second is the rate of cordwood price change.

are not as great as tables 2 and 3 indicate. Various generous timber cost estimates have been identified throughout the paper, but the most pervasive overestimation stems from our disregard of the expensive costs of access to timber management sites (including building the roads themselves).

For example, in 1982, timber managers harvested only 2.8 million board feet (MMbf), or 14 percent of the mature timber in the Croatan. If managers' judgments were financially rational, then only this 14 percent was commercial and the remaining 86 percent, in fact, had no timber opportunity cost. This 86 percent of timber sites was available for RCW management at zero opportunity cost.

Consider how this alters our cost estimates for preserving 52 RCW habitat sites under either management alternative. Assume the least-cost ordered ranking of sites is correct and assume our generous timber opportunity costs estimates are correct for the more valuable 14 percent of all sites.

Under alternative A the best 22 timber sites fall on longleaf site indices 70 and 80 and loblolly site indices 100 and 110. These sites provide nearly 3 MMbf, annually, or more than a sufficient volume to satisfy the 1982 harvest level for the Croatan. There are no forgone timber opportunities on the remaining 30 RCW colony sites. The large number of low-quality timber sites with RCW colonies suggests that low-quality sites were left undisturbed by timber managers before RCW protection became an issue and that timber managers displayed the economically rational tendency to harvest good sites first. Of the 22 sites with valuable timber opportunities, 6 have timber stands currently over age 85. Timber managers apparently found these sites unprofitable for timber even before recent discoveries of the woodpecker and requirements for its protection. Subtracting these 6 sites leaves 16 RCW sites on which the Croatan must forgo a viable timber option. Table 4 is the marginal cost schedule for these remaining 16 sites under each price and discount rate scenario. It leads us to the observation that the total perpetuity cost for preserving the 52 existing sites (at a 4-percent discount rate and zero rate of stumpage price increase) is $220,422. The annual payment associated with this level of protection is $8,817. (More than one-fourth of the cost is for one highly productive loblolly site which is near harvest age now.)

There are 54 200-acre preservation units on longleaf site index 50 and loblolly site index 70. These each satisfy the alternative B requirement for rotating recruitment stands in perpetuity. They are the poorest sites and the least likely ever to become commercially viable for timber. None are currently viable for commercial timber production and preserving 52 of them, one for each existing colony, requires no timber opportunity forgone.

Conclusions

The cost of preserving the 52 *existing* RCW colonies is relatively small. There is no cost for the 52 *recruitment* colonies. Indeed, the costs of timber opportunities forgone are probably lesser problems of RCW management than is the uncertainty clouding the efficiency of either preservation alternative.

Finally, a summary note is in order regarding the application of marginal cost analysis for endangered species management in general. Outlining the costs associated with the anticipated preservation of discrete biological units provides resource managers with the total cost information necessary for choices among management alternatives with various associated risks of extinction. Furthermore, marginal cost estimates determine the relative costs of preserving various potential individual habitat sites and provide a way of evaluating alternate means of meeting an exogenous preservation constraint.

Limitations do exist, however. This analysis shows the costs of providing *habitat* for the species. This may or may not result in preservation of the species or even its individual members. Preservation of the individual occurs when the individual's niche requirements are met throughout its natural lifespan. Preservation of the species requires not only preservation of the individual, but also preservation of a sufficient number of individuals such that adequate

Table 4—Marginal costs of preserving individual existing colony sites where timber management is a viable option

Case number	Species	Site index	Area	Age (years)	Discount rate and rate of price change scenarios[1]								
					r = 4 percent			r = 7 percent			r = 10 percent		
					0 0	0.015 0.0075	0.03 0.015	0 0	0.015 0.0075	0.03 0.015	0 0	0.015 0.0075	0.03 0.015
47	Longleaf	70	7	52	$ 3,264	5,218	8,374	1,598	2,346	3,363	884	1,294	1,831
16	Longleaf	70	7	59	4,434	6,355	9,545	2,739	3,482	4,434	1,930	2,410	2,983
31	Longleaf	70	7	64	5,495	7,309	10,531	3,974	4,585	5,373	3,277	3,699	4,173
52	Longleaf	80	7	52	5,566	8,405	13,187	2,812	3,979	5,561	1,583	2,226	3,070
15	Longleaf	70	7	67	6,241	7,947	11,194	4,951	5,375	6,015	4,475	4,762	5,080
49	Longleaf	70	7	69	6,791	8,403	11,670	5,726	6,008	6,478	5,498	5,627	5,780
30	Longleaf	70	15	64	11,776	15,662	22,566	8,515	9,824	11,513	7,021	9,927	8,942
6	Loblolly	100	7	52	12,906	18,770	27,785	6,816	9,350	12,761	3,896	5,311	7,170
10	Longleaf	80	15	54	12,985	19,263	29,274	6,998	9,538	12,908	4,213	5,687	7,568
8	Longleaf	80	15	56	14,130	20,360	30,347	8,116	10,662	13,975	5,215	6,769	8,697
11	Longleaf	70	15	74	15,177	18,515	25,539	13,192	13,853	14,403	13,053	13,102	13,203
12	Longleaf	70	15	74	15,177	18,515	25,539	13,192	13,853	14,403	13,053	13,102	13,203
13	Longleaf	70	15	74	15,177	18,515	25,539	13,192	13,853	14,403	13,053	13,102	13,203
50	Longleaf	70	15	74	15,177	18,515	25,539	13,192	13,853	14,403	13,053	13,102	13,203
9	Longleaf	90	15	52	19,597	28,920	43,420	10,221	14,150	19,446	5,818	8,004	10,875
46	Loblolly	110	15	57	56,529	74,452	100,862	35,798	44,762	56,025	24,015	29,823	36,912
Total cost					220,422	295,124	420,911	151,032	179,473	215,464	120,037	135,947	155,893

[1]Rate of price change: First entry for sawtimber, second entry for cordwood.

genetic diversity is maintained throughout the geographic range of the species. Uncertainty here is compounded: We know neither the specific habitat requirements of the individual nor the population level or distribution which must be sustained to provide the necessary genetic stock. These problems may be resolved with further biological research on the colony site and on the safe minimum standard for population preservation. The same marginal cost analysis demonstrated in this paper could then be applied with superior confidence.

The importance of this analysis is that (1) it provides evidence that RCW management costs society less than much of the political discussion would have us believe, and (2) it demonstrates a mechanism for arraying costs and management choices in a manner that makes resource tradeoffs clear. The low-cost result causes us to ponder whether the costs of activities to protect other endangered species may be less than often anticipated. Application of this method and these results should help focus scientific research for the RCW, and for other endangered species as well, on topics having large impacts on either management costs or species survival. The method and results beg clearer analysis of endangered species problems in general.

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The CARD Linear Programming Model of U.S. Agriculture

Thomas W. Hertel, Paul V. Preckel, and Wen-Yuan Huang

The Center for Agriculture and Rural Development (CARD) at Iowa State University, Ames, and the U.S. Department of Agriculture's (USDA) Economic Research Service have invested considerable effort in developing a national database for modeling resource use in U.S. farming. The CARD linear programming (LP) modeling system has been used to assess the Resources Conservation Act (RCA) (*8*), and to analyze the effects of enrolling acreage in the conservation reserve (*7, 9*).[1] Recently, the model was used to determine the cost of conservation compliance once enrollment in the conservation reserve was complete (*3*). This modeling system remains a primary instrument for assessing the link between land use and aggregate U.S. agricultural output. Since a typical CARD model is very large (at its most detailed level, the model has 105 producing regions, 8 land groups, 330 crop rotations, and 12 tillage alternatives), many of its underlying economic properties are difficult to assess. The purpose of this paper is to shed some light on these properties.

We focus particular attention on a CARD LP's response to changing relative input prices. The resulting derived demand elasticities provide a measure of input substitutability in the model. Possibilities for input substitution, in turn, affect the way the LP model responds to increases in output levels and changing resource endowments. The greater the potential for input substitution, the more slowly marginal costs rise as agricultural output increases.

Model Description

The model that we have chosen to analyze is a reduced version of the full CARD-RCA model of cost minimization for U.S. crop production (*4*). We reduced the size of this LP by aggregating up from 105 producing areas to the 31 market regions shown in figure 1. The number of tillage options was also reduced to the three major alternatives: conventional-, minimum-, and no-tillage. These simplifications make the construction of useful summary elasticities feasible without substantially altering the shape of the model's aggregate isoquants. Even after these reductions, over 13,000 alternative crop production activities remain in this model.

National commodity demands for wheat, feed grains, cotton, soybeans, corn silage, sorghum silage, legume hay, and nonlegume hay, as well as resource endowments, are fixed in this problem.[2] Resource endowments are expressed in terms of dryland and irrigated acreage (by land class). Water supplies for existing irrigated acreage may be purchased at an exogenously determined price.[3] The remaining variable inputs include: labor, machinery, nitrogen, pesticides, and "other."[4]

To illustrate why it is important to analyze the role of input prices in this model, we increased a selected price, in this case machinery, by 25 percent (holding all other prices and outputs constant). Table 1 shows the resulting reallocation of soybean, wheat, and corn outputs. A total of 88 million bushels of soybeans and 91 million bushels of wheat shifted among regions. Corn production rose by 241 million bushels. Because the geographic location of production is an important determinant of resource depletion, the postulated change in machinery price can be expected to affect both regional and national projections of such target variables as erosion.

Analysis of Aggregate Demands

We used the summary function algorithm in (*5*) to analyze the response of the LP model to input price changes. This algorithm involves two steps. First, we obtained the optimal LP response surface (as a function of prices) for the CARD model in a prespecified set of price directions. The sample design was orthogonal,

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[1]Italicized numbers in parentheses cite sources listed in the References section at the end of this article.

[2]Quantities demanded and resource endowments represent estimates for the year 2000. These were developed for use in USDA's recent RCA analysis (*2*).

[3]Base prices represent 1978 estimates. Additional detail on their construction is provided in (*2*).

[4]Throughout this article, the prices of inputs in this residual category will always be moved together, legitimizing their aggregation into a single group.

Figure 1
The 31 market regions in the CARD LP model

with each price varying independently over the 75-125 percent range of the base value for each of the six input groups. Using a dynamic sampling procedure that takes account of the unique properties of a linear program, we derived an acceptable piecewise linear approximation after 53 solutions of the model. In the second step of the algorithm, we fit a translog cost function to the piecewise linear summary. (Actually, it was the system of cost share equations which were fitted.) This step allowed for computation of derived demand elasticities at the base point, which is also the point of approximation for the translog summary function.

Table 2 presents the national, output-constant price elasticities of input demand produced by this algorithm. All of the on-diagonal elements are negative, as expected, and there is only one complementary relationship, that between labor and machinery. However, with the exception of water, national input use in this model is highly price-inelastic, particularly when compared with the evidence based on econometric cost functions for U.S. agriculture (*1, 6*).[5]

The relatively small elasticities in table 2 indicate that, despite the large number of activities in the model, factor intensities vary little. (Water is an exception because both dryland and irrigation alternatives exist in the model.) Figure 2 depicts the situation for the case of two inputs, X_1 and X_2. The rays A,

[5]This absence of substitutability is even more striking when one notes that these aggregate elasticities include both intraregional and interregional substitution possibilities.

Table 1—Regional shifts in the production of corn, soybeans, and wheat in response to a 25-percent increase in the price of machinery

Crop and market region	Change in output
	Million bushels
Soybeans:	
8 (Louisville)	15
9 (Montgomery)	37
11 (Milwaukee)	8
13 (Cape Girardeau)	28
14 (New Orleans)	-11
15 (St. Joseph)	-44
17 (North Platte)	-33
Net change in production	0
Wheat:	
5 (Miami)	1
9 (Montgomery)	-43
11 (Milwaukee)	-7
12 (Davenport)	17
13 (Cape Girardeau)	-32
15 (St. Joseph)	-9
17 (North Platte)	34
22 (Billings)	34
25 (Missoula)	4
26 (Boise)	1
Net change in production	0
Corn:	
11 (Milwaukee)	25
14 (New Orleans)	33
15 (St. Joseph)	-22
16 (Pierre)	112
17 (North Platte)	93
Net change in production[1]	241

[1]Since the national demand constraint is specified in terms of total feed grains output, there can be changes in the mix of feed grains produced. In this case, corn production increases slightly at the expense of other feed grains. This added flexibility leads us to overstate the model's true output-constant input demand elastiticites.

Table 2—National derived demand elasticities (output constant)[1]

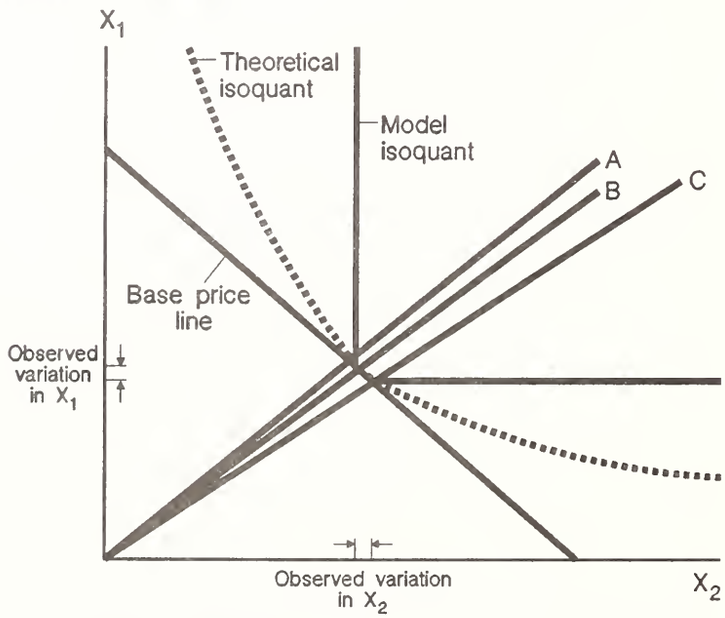
Inputs	Labor	Machinery	Nitrogen	Pesticides	Water	Other
Labor	-0.04	-0.04	0	0.02	0.02	0.03
Machinery	-.01	-.04	.01	.03	.01	.01
Nitrogen	0	.02	-.06	0	.01	.03
Pesticides	.02	.08	.00	-.12	.01	.01
Water	.11	.32	.11	.11	-.82	.17
Other	.01	.01	.01	.01	.01	-.04

[1]Since the national demand constraint is specified in terms of total feed grains output, there can be changes in the mix of feed grains produced. This added flexibility leads us to overstate the model's true output-constant input demand elasticities.

B, and C represent alternative activities in the production of a given crop. These alternatives might involve different regions, different land types, or different rotation/tillage practices. When combined, they produce the model isoquant (fig. 2). As long as relative prices remain on the base price line, the description of what we believe to be the true underlying technology (theoretical isoquant) will be reasonably accurate. As a result, the model should reproduce the actual outcomes fairly well. This model, however, does not appear to be capable of capturing the effect of input price changes which might induce substantially different factor intensities.

Alternative technologies, some of which are not employed at current prices, would have to be introduced into the CARD model to broaden the range of input intensities. Increased factor substitution would reduce the rate of increase in production costs resulting from a given input price increase, reducing production shifts among regions in response to a given factor price change. By omitting these alternative technologies, the CARD model tends to overstate the amount of regional shifting when a new configuration of output and input prices is specified. Whether this leads to an exaggeration or understatement of, say, total erosion is unclear. That depends on the model's cost-minimizing response to a particular scenario. What is clear is that the allocation of production, and hence erosion, among the various regions will not be correctly predicted, if regional production shifting is not correctly restricted.

Figure 2
Substitutability of nonwater inputs in the model



X_1 and X_2 are two agricultural inputs, and A, B, and C represent linear activities in the LP model.

Conclusions

The CARD LP model has the attribute of yielding very detailed geographical information on the use of resources in U.S. agriculture. This explains its popularity in policy analysis of land use problems. National factor demands (except water) in this model, however, are very unresponsive to relative input price changes, probably because the LP activities associated with alternative production locations, rotations, and tillage options tend to provide only a small range of input-output ratios. These ratios, which reflect base period intensities, permit the model to replicate patterns of production and input use in that period. However, when confronted by changes in relative input prices, the model fails to account for alternative activities that would permit anticipated input substitution.

Yet, the model as a whole is not unresponsive to changes in relative factor prices. A 25-percent change in the relative price of machinery induces many inter-regional production shifts. This is a direct consequence of the limited potential for substitution among inputs in any given region. Farmers in a marginal region will actually substitute other inputs for the more costly machinery. This enables them to keep cost increases down, thus limiting the amount of displaced production. Our analysis shows that by limiting the potential for such input substitution, and allowing unrestricted regional production shift, the model overstates the magnitude of regional shifts in production. This limitation reduces the model's potential for projecting input and output levels at both the regional and national levels.

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Book Reviews

A Message to Rekindle an Agriculturalist's Zeal

Toward a Well-Fed World. By Don Paarlberg. Ames: Iowa State University Press, 270 pages, $24.95.

Reviewed by James Hite

Most of the human beings who have ever lived have been hungry. Perhaps most human beings alive today are hungry a large part of the time. But little by little, hunger is being conquered. This conquest, seen through the work of agricultural scientists, religious leaders, government officials and politicians, is the theme of Don Paarlberg's newest book.

Paarlberg's book at first seems simply a collection of 30 or so vignettes, hardly the sort of serious book one would read systematically cover to cover. Readers who do not know that the author is a distinguished agricultural economist, widely respected in both academics and government, might leaf quickly through the book and miss its significance. But, agriculturalists curious as to what Don Paarlberg might have to say about such diverse personalities as Jethro Tull, Margaret Sanger, Henry Wallace, and Hubert Humphrey will find time invested in reading this book richly rewarding.

> ***Some ancient issues were illuminated by the Watson-Crick discovery. The continuity of life was affirmed. The life material is split with each generation from the beginning to the present and forward for as long as our offspring continue to reproduce. To a reflective person, this gives what Wordsworth called 'intimations of immortality.' (p. 128)***

Paarlberg's reputation is that of a conservative agricultural economist who was called to Washington to mold farm policy in Republican administrations. This book will do nothing to change that reputation. He sees the fight against hunger, whether waged by scientists like Watson and Crick, by economists like T.W. Schultz or China's Ma Yen Chu, or by public administrators like Herbert Hoover and Hugh Hammond Bennett, as an epic moral struggle. And, he takes his moral bearings unashamedly from the mainstream traditions of western Christianity. Yet, unlike some conservatives, Paarlberg is unequivocal in asserting a need for active government involvement in food aid programs. In assessing the successful food relief programs of the Mormons, Paarlberg concludes such strategies will not work nationwide because:

> The interdependence of individual and group envisioned by Joseph Smith and his followers has shown its merit. But most citizens lack the necessary charitable commitment. Government food aid programs may be second best but when the first best is inadequate the second best must move up. (p. 173)

Conservative ideologues will find things to disagree with in what Paarlberg has to say but will approve of his point of view, which is deeply conservative, reaffirming religious conviction as the source of sound moral values.

The history of the fight against hunger will be told in a more systematic and better documented way by someone else in some other book. Paarlberg's book's significance lies in its ability to draw together the major issues facing world hunger. The book contains no new economic theory or new techniques of analysis. Rather, it brings the reader into contact with a first-rate mind reflecting upon the larger significance of science, politics, economics, and religion, and doing so from the perspective of traditional values rooted in fundamentally conservative premises. Paarlberg gives us a very personal book of commentary, full of wisdom and grace, that goes to the heart of the philosophical and social meaning of what those of us do who work in agriculture and why we do it. The book is fundamentally a work of philosophy.

> ***If we interfere massively in the processes associated with death we are compelled to interfere also in matters related to birth. (p. 221)***

There is a missionary's zeal that comes through in this book, and not all of us will be able to share that zeal. Yet, Paarlberg's is a positive message that can reinspire professional agriculturalists whose enthusiasms may have been eroded by the petty day-to-day battles of life in the bureaucracies or the universities.

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Paarlberg never seems to preach, being far too subtle to do that. We know that Paarlberg is a sound, practical agricultural economist, but the discovery that he is also a graceful wordsmith is one of the unexpected delights of this book. Like a good novel, this deceptively beautiful book does more than inform. It moves and changes the reader.

> ***Almost all the agricultural colleges added graduate schools. Several of the original attributes, however, were in large measure kept: their predominantly tax-supported status and their preference for what is relevant over what is merely reputable . . . By the time these land grant colleges . . . reached the hundredth anniversary of the Morrill Act, they enrolled one-fifth of all the undergraduate students in the nation. Of the thirty-six then-living Nobel Prize winners in the United States, eighteen had earned land grant college degrees. (p. 63)***

Paarlberg's book should be high on the reading list of all professional agriculturalists, a book to be purchased for reading not just once, but over and over, whenever internal doubts stir about the value of what we do and when there is the danger that we may let the moral value of our work slip from our conscious mind and surrender ourselves to numbing routine.

> ***Some people believe that life is a zero-sum game, that what one party wins another loses. There are some zero-sum games, and even some negative-sum games, but agricultural science is not one of them. (p. 164)***

> ***To one taught to love the appearance of a deep-tilled field with all the crop residue buried, a conservation-tilled field is, for a month or more after planting, an ugly sight indeed. But to one who loves the thought of soil kept in place, such a field is wonderfully pleasing. (p. 156)***

First the Profit

First the Seed. By Jack Ralph Kloppenburg, Jr. Cambridge University Press, 1988, 349 pages, $37.50.

Reviewed by Mary K. Knudson

Many people believe that achievements in plant breeding have benefited the farmer and consumer by increasing yields. Jack Kloppenburg attempts to refute this notion. But, without a background in Marxist theory, the reader may find this book a difficult read.

Kloppenburg argues that profit maximization motives behind the plant breeding programs of the seed industry have been detrimental to the farmer. The farmer has become more dependent on the input industry, with seed now being an input the farmer must buy. Kloppenburg calls this the "commodification" of seed. He examines this transformation in the means of agricultural production by providing a rich historical discussion supplemented with detailed statistical information and interprets this transformation using a Marxian economic framework. Kloppenburg hopes we can apply information from his study to regulate the seed industry, which is becoming more corporate and focused on biotechnology. However, his analysis is sometimes tenuous, and his conclusions too simplified.

This book is unique in the perspective it takes and its scholarship. Neoclassical economists typically look at ways to correct for market failure. Kloppenburg's perspective is that correcting for a market failure, or even having a market, is not always desirable for society overall.

Kloppenburg has done a scholarly job in detailing and documenting the historical development of the seed industry. He begins with the germplasm Columbus picked up on his 1492 voyage and takes us to the present day with the emergence of biotechnology and its role in seed development. Kloppenburg informs us what events took place in the industry's development, who the players were, and what incentives were involved. Kloppenburg's bibliography includes a healthy distribution of proceedings from professional meetings, popular and professional journals, professional association and corporate reports, government publications, and interviews. He cites neoclassical economists such as Zvi Griliches, Willard Cochrane, and Vernon W. Ruttan, breeders such as Peter Day and Donald Duvick, Marxian economists such as Jean-Paul Berlan, geneticists such as Arnel R. Hallauer, biologists such as Richard Lewontin, and popular writers such as Rachel Carson (*Silent Spring*) and Dan Morgan (*Merchants of Grain*).

It is possible to read each chapter separately without any trouble, and some chapters are particularly useful to economists. Those readers interested in international development should read chapter 7, in which Kloppenburg discusses the issue of germplasm transfer between countries of the North and the South. Readers interested in public finance and returns to research should read chapters 6 and 8, in which Kloppenburg discusses the impact of the Plant Variety Protection Act on the private sector and the current research and funding relationship between the universities and private sector.

In his final chapter, Kloppenburg presents his solution to the problems he foresees with the growing corporate sector in seed development. He writes:

> "Research priorities . . . . . are too important to be left to research directors, management types, or scientists. The public has a right to demand not just accountability from the scientific community but also a voice in determining the goals and purposes to which science and technology are directed." (p. 278)

However, Kloppenburg does not discuss how a relatively uninformed public can acquire the knowledge necessary to direct the course of plant breeding research. Indeed, if Kloppenburg's analysis is correct, one might suppose that the same forces that the private sector used to sway public breeding programs may also sway an ignorant and uninterested public. Having expended considerable energy in detailing the significance of the problems in the U.S. seed industry, Kloppenburg should have devoted more attention to formulating and discussing possible solutions.

The reader will find a knowledge of Marxist theory useful. Readers unfamiliar with Marxist terminology may balk at such convoluted sentences as:

> "Where the immediate and complete expropriation of the independent producer is constrained, capital seeks to establish the hegemony of

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exchange-value as opposed to use-value by binding the autonomous producers inextricably to the commodity form, to bring them ultimately under capitalist relations of production." (p. 26)

For those who are not familiar with Marx, Kloppenburg fittingly limits the number of obscure terms and defines the difficult ones he does use.

Kloppenburg has done an admirable job in analyzing the emergence of the seed industry even though his analysis can be weak at times. This book is an excellent choice for people who are interested in neo-Marxist theory, the seed industry, or biotechnology. It is comprehensive and addresses some important issues facing the seed industry.

Restructuring Banks May Soften Deregulation's Impact

What Should Banks Do? By Robert E. Litan. Washington, DC: Brookings Institution, 1987, 207 pages, $9.95.

Reviewed by Stephen W. Hiemstra

A recent U.S. Supreme Court ruling upheld the right of several large commercial banks to underwrite commercial paper, municipal revenue bonds, and mortgage-backed securities, provided the activity involves less than 5 percent of their assets. This ruling prompted the House Banking Committee in 1988 to reverse its opposition to bank reform legislation, which the Senate has proposed periodically over the past several years. The legislation proposed in 1988 would have amended or repealed the Glass-Steagall Act of 1933, which separated commercial banking from investment banking by prohibiting commercial banks from underwriting most classes of securities. The bank product deregulation discussion has, therefore, graduated from the philosophical to the legislative level.

Litan, a senior fellow of the Brookings Institution, is one of a number of authors who has attempted to frame the bank deregulation discussion. The book describes and analyzes deregulation issues to evaluate the efficiency benefits of permitting commercial banks to enter investment banking. Permitting commercial banks to underwrite common stock, mortgage-backed securities, corporate bonds, and other securities currently forbidden will presumably allow banks to lower portfolio risk and to distribute overhead costs over more output.

Litan sees deregulation as a response to two economic trends: high inflation and technological change, particularly changes in information management. Inflation led Congress to deregulate interest rate controls on banks and thrifts and led many financial services firms to adopt new products and other innovations for less costly managing, storing, and analyzing of financial data. These changes strengthened the ability of nonbanking firms to enter traditional banking activities, while banking firms have been legislatively restricted from entering nonbanking financial services, such as securities and insurance underwriting. This disparity in new opportunities, according to Litan, provides an incentive for banks to seek product deregulation legislation.

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In his review of the history of the U.S. financial system, Litan develops several themes. One is that the role of banking regulation, going back to the 1930's, has been to ensure the safety and soundness of the banking and monetary system, promote fair and honest credit allocation, and limit the political and economic power of banking enterprises. A second theme emanates from the "Real Bills" interpretation of the business of banking first expounded by Adam Smith. Banking is the taking of deposits and the making of loans. Advocates of the Real Bills doctrine emphasize the making of loans to cover the operating expenses of business (their real bills), arguing that by sticking to short-term loans banks will be able to maintain their liquidity during financial crises. Demand deposits are extremely short-term liabilities and even short-term loans can leave a bank illiquid in the event of a bank run. Following this theme, Litan suggests that reforms encourage banks to offer more mutual fund-type instruments and to offset deposit accounts with extremely safe, liquid assets, such as government securities.

Litan sees three potential benefits of bank product deregulation. It may enhance competition in financial service and reduce excess profit margins, particularly in investment banking. It could lead to economies of scope, that is, cost savings due to the production of services with common and underused inputs. It may allow banks to diversify their portfolios, reducing the combined risk of the assets they hold.

Litan notes some risks of deregulation as well. Instead of taking advantage of new opportunities to diversify, banks could use their new powers to take on greater risk, thereby compromising the soundness of the banking system. He sees the potential for large banks and other financial institutions to accumulate too much economic and political power. Banks might also abuse their greater freedom to offer new products to engage in noncompetitive practices.

The challenge to lawmakers, from Litan's point of view, is to channel the energies released in deregulation toward achieving the benefits of deregulation while avoiding the risks. He sees two approaches to accomplishing this objective. One is to maintain the current institutional structure outlined in the Bank Holding Company Act of 1956 and to enact piecemeal regulation to deal with problems as they arise. The second approach is to restructure banks so as to separate their deposit-taking and loan-making activities,

creating finance holding companies to replace the bank holding companies. The deposit companies would essentially become money market funds which could invest only in low-risk assets, such as government securities. Their lending counterparts would acquire loanable funds through the commercial paper and other security market transactions. By separating deposits from lending, regulation would be simpler. Problems arising because the maturities of assets and liabilities were poorly matched (disintermediation) would be reduced. Federally insured deposits would no longer provide a competitive advantage to one financial institution over another. Litan views this second approach as the preferred route to take in legislating bank product deregulation.

It is difficult to capture the richness of Litan's writing in a brief review. His book reads quite well and yet provides a high level of technical detail throughout. I found the references he cited interesting and have requested many of them for my own use and study.

Although the general public has a lot at stake in questions involving bank regulation and reform, many of the topics raised in this discussion may be too technical for the average reader. Graduate students in economics and economists should have no problem following Litan's arguments. The book's availability in paperback should attract a wider readership than many other texts on bank deregulation.

Limit Price Setting, Invest More—Government's Responsibility to Agriculture

Agricultural Price Policy for Developing Countries. Edited by John W. Mellor and Raisuddin Ahmed. Baltimore: Johns Hopkins University Press, 1988, 327 pages, $35.

Reviewed by Ray W. Nightingale

The focus of this book can be summed up in one quote:

> "Price policy is not the basic engine of economic development, but it is of great political importance and can be a major drag on development if not properly articulated." (p. 291)

This book is based on a set of International Food Policy Research Institute (IFPRI) reports presented at a 1984 Swiss Development Cooperation-sponsored seminar. The book is based primarily on the work of IFPRI, but it also draws on the contribution of 13 economic policy experts from abroad and reflects Mellor's years of price policy research experience. Emphasis is not on abstraction of economic relationships and measurement but on applied problems. As Mellor says, the book "stops the action" to provide readers with a snapshot of the implications of IFPRI agricultural price policy research. The objective is "to focus explicitly on agricultural price policy in the context of economic growth and, more specifically, of technological change."

It is improbable that at one time a set of researchers would have in hand a collection of papers neatly falling into chapters of a book. Researchers just are not like that, particularly good researchers in a good research environment. IFPRI's great advantage is precisely its ability to attract exceptionally knowledgeable people from around the world, giving them respite from their professional duties to research subjects of interest to them.

The introductory and concluding papers by Mellor and Ahmed provide a systematic treatment of agricultural price policy for accelerating growth and a framework to which readers can relate. Other papers are grouped under: international environment; domestic market intervention; production response, technology, and commercialization; and consumer welfare. The result is an excellent set of thorough and professional research papers. The 26-page concluding paper contains the conceptual framework, richly leavened with the findings of policy research.

The preponderance of western economic literature tells us that economies perform best if buyers and sellers in private enterprises set the terms of exchange among themselves. While we commonly characterize this as market pricing, abstract markets do not set prices, decisonmakers in enterprises set prices. While agricultural markets are among the most atomistic, it is in these markets that the dictum of the superiority of private decisions is frequently violated. For reasons both technical and political, the people who set prices for many agricultural commodities around the world have been the employees of governmental agencies. The basic instruction of *Agricultural Price Policy for Developing Countries* is that government cannot avoid pricing agriculture, but that the activity should be viewed as an essential responsibility of government, not as an opportunity.

With the relative advantages of market pricing conveyed, Mellor and Ahmed identify two particular problems which occur when relying on the market alone to solve agricultural price troubles. First, the market "may equate the wrong side of the supply-demand equation" (that is, market prices may bring demand into line with supply when the policy intent is greater agricultural output). Second, the lag between an action and its effect may be too long to be acceptable. The task of agricultural price policy is more than that of determining appropriate prices in the short run. Policymakers must be able to predict prices that would prevail without market intervention and then develop appropriate long-term policies.

To support accelerated technological change, government expenditures in agriculture must grow immensely. Each chapter on technology and the commercialization of agriculture announces public costs. Public expenditure is required for the fostering of technological change, support of agricultural prices, subsidy for inputs or the distribution channel for inputs, and encouragement of growth in employment. Mellor and Ahmed recommend that the structural requisites of growth in food production and employment take priority over input subsidies and price support, especially if public resources are scarce.

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Five difficulties confront technological change: public resource scarcity, instability in agricultural prices, downward price trends, the increased use of purchased inputs, and equity in rural regions.

In the concluding paper, Mellor and Ahmed give an incisive review of theory and practice, drawing on broad experience. They describe the pitfalls that several decades of struggling policymakers have experienced. They do not treat policymakers of developing countries unsympathetically. Their experiences are, after all, not very different from those of developed countries.

The 1984 seminar does not date this book. The observations on policy pitfalls are today's news and communicate strong warnings on the dangers of poor price policy, particularly pertaining to the growth agenda seen as a way out for low-income countries. Farmers and consumers in developing countries will benefit most from a government that focuses on promoting growth in agriculture. An agenda for growth, combined with concern for equity and stability in agriculture, is the best type of policy for developing countries to follow. But Ahmed and Mellor remind us of the "intensely political nature of price policy, even in countries where agriculture is a minor sector." Both farmers and consumers have an uncommon claim on the hearts and minds of politicians. In developing countries, farmers make up a large share of the population, and food supply shortfalls are borne by low-income people "through drastic reduction in their intake of basic nutrients."

Policy advisers who venture abroad should check this book out. It is a very good reference for lecturers on farm policy because it conveys, with substance, the varied international landscape of agricultural policymaking.

The reports include: (1) "Agricultural Price Policy—the Context and the Approach" by Raisuddin Ahmed and John W. Mellor; (2) "Trends in Cereal Supply, Demand, Trade, and Stocks" by Leonardo A. Paulino; (3) "Changing Patterns of Variability in Cereal Prices and Production" by Peter B.R. Hazell; (4) "Pricing Principles and Public Intervention in Domestic Markets" by Raisuddin Ahmed; (5) "Public Stock Management" by Ammar Siamwalla; (6) "Risk and Uncertainty in Domestic Production and Prices" by Peter B.R. Hazell; (7) "Foreign Trade Regime, Exchange Rate Policy, and the Structure of Incentives" by Alberto Valdes and Ammar Siamwalla; (8) "Relative Prices in the People's Republic of China; Rural Taxation through Public Monopsony" by Bruce Stone; (9) "Determination of Administered Prices of Food Grains in India" by J.S. Sarma; (10) "Capital Accumulation, the Choice of Techniques, and Agricultural Output" by Yiar Mundlak; (11) "Technological Change, Production Costs, and Supply Response" by C.G. Ranade, Dayanatha Jha, and Christopher L. Delgado; (12) "Policy for Rapid Growth in the Use of Modern Agricultural Inputs" by Gunvant M. Desai; (13) "Government Credit Programs: Justification, Benefits, and Costs" by Mark W. Rosegrant and Ammar Siamwalla; (14) "Good Subsidies: Consumer Welfare and Producer Incentives" by Per Pinstrup-Anderson; (15) "Implications of Food Aid for Price Policy in Recipient Countries" by Joachim von Braun and Barbara Huddleston; (16) "Agricultural Price Policy for Accelerating Growth" by John W. Mellor and Raisuddin Ahmed.

Linking Trade and Resources Policy—It's About Time

Agricultural Trade and Natural Resources—Discovering the Critical Linkages. Edited by John D. Sutton. Boulder, CO: Lynne Reinner Publishers, 1988, 245 pages, $30.

Reviewed by Alan Randall

In the 1950's and 1960's, agricultural policy was largely a matter of figuring out how to dispose of surplus commodities. A highly productive agriculture, a strong dollar, and United States dominance of world financial markets kept the policy issues simple, if not especially tractable. But, things changed about 1970, never to be the same again. The United States, accustomed to making things happen on the world scene, was convulsed by a series of events it could no longer control.

The 1970's were the decade of flexible exchange rates, OPEC and the oil price shocks, rising inflation, fencerow-to-fencerow cultivation, buoyant farmland prices, concerns about fertilizer and pesticide residues, prohibition of some first-generation pesticides in the United States with subsequent suspicions that agricultural imports may have been produced using these same pesticides, and the charge that the United States was balancing its international accounts by trading soil for oil. The 1980's have seen the internationalization of financial markets, enormous third-world debt, falling but still-high inflation in the United States, the emergence of many former food-importing nations (rich and poor) as self-sufficient or net exporters, huge U.S. grain surpluses, plunging farmland prices and crises for heavily leveraged farmers and their creditor institutions alike, persistent U.S. trade and fiscal deficits, increasing protectionism at home and abroad, and renewed reliance on old policy instruments (set-asides) and even older ones (land retirement, refurbished as the Conservation Reserve Program) to reduce commodity surpluses. When things seem really desperate, as they did in the 1930's and the 1980's, agricultural interests are prepared to offer some really serious-sounding soil conservation, if that's what it takes to bring in more public dollars.

Ever alert for new, hot issues, it seems that a small group of leading agricultural economists came up with: "Shoot, maybe we ought to hold a workshop on agricultural trade and natural resources linkages, say, sometime in 1987." Shoot, why not? Having made this commitment, an informal group of analysts based in USDA's Economic Research Service and Resources for the Future's National Center for Food and Agricultural Policy organized a workshop to study the factors that link agricultural trade and natural resources.

I missed the workshop, but to judge from John Sutton's edited volume of essays generated for or by that gathering, it must have been better focused than most efforts of its kind. The standard complaint about edited volumes concerns disjointedness and uneven quality among the individual papers. However, this volume is coherent and polished. Most of the chapters reflect serious effort: the organizers must have chosen authors who had substantial work in progress or were willing to make major efforts for this workshop. Style and level of treatment is fairly consistent, with most essays using diagrammatic analyses familiar to anyone who has studied commerce. Papers that present formal mathematical models and results are not unusually forbidding. Most pleasing, and not especially common in works of this kind, are some of the essays, which show clear signs that final drafts were significantly influenced by ideas developed at the workshop. In all of these respects, this book is better than many similar collections of conference papers.

The book's goal is to "advance our ability to construct a conceptual framework describing economic relations between trade and resources and to conduct research needed to clarify linkages that may be particularly important for policy and economic analysis." (p. 1) The book should appeal to advanced students, teachers, researchers, and policy analysts who have a special interest in agricultural trade and natural resources. Three major sections deal with theoretical framework, implications of natural resource policies for agricultural trade, and implications of trade policy for natural resources. Theoretical analyses dot all three sections, while the second and third sections also present some data and simple empirical analyses. Comprehensive empirical analysis of major issues is beyond the scope established by the workshop organizers and the editor. The reader forms the impression that such analyses are generally unavailable, and a major purpose of this volume is to stimulate their production.

Several of the authors lament that trade economics and resource economics developed independently, with little communication among the principals. Bruce

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Gardner notes that explicit consideration of welfare economics is largely absent from the papers in this collection. At first glance, the claim that the economics of trade, welfare, and resources are practiced in mutual isolation seems surprising. Yet, it raises a question worth thinking about. The basic theories of all three areas are quite closely related. Welfare economics is central to resource economics, while its core concepts of exchange theory and the identification and measurement of gains from trade, economic surpluses, and the welfare impacts of trade distortions were developed and clarified with considerable input from economists who focused on trade questions. Ricardo is a founding father of both trade economics and resource economics, and his trade theory was founded on differential production costs emanating from differences in resource quality. While subsequent trade theorists have vacillated on the substitutability of land (natural resources) and capital, that has been symptomatic of neoclassical economists in general rather than peculiar to the trade people. In fact, the uniqueness of natural resources has received a more sympathetic hearing from trade economists than from the general run of neoclassicals. Trade economists have displayed an interest in the trade impacts of environmental regulation, resource economists have been concerned with transboundary pollution, and both groups have contributed to the discussion about the viability of international natural resources cartels.

The core theories of welfare economics, international trade, and resource economics clearly emerged after substantial cross-fertilization. Analysts who worried about excessive compartmentalization must have had something else in mind. I speculate that their concern relates not so much to core theories as to the models and empirical analyses that elaborate those theories. If I am right, then the problem is a more general issue, the tension between abstraction and elaboration in economic theories, models, and analyses. Power and generality seem to require a considerable degree of abstraction. A highly abstract model, however, cannot capture simultaneously the subtleties of trade and resources issues. Answers applicable to specific problems require detailed models, with all that entails for specificity, data needs, difficulties in estimation and computation, and the possibility of virtually untraceable error. Faced with this dilemma, we seek simple yet powerful models that address real-world problems, so successes come grudgingly.

Several of the essays in this book nevertheless take us part way down the road. John Antle and Richard Howitt introduce a hybrid resources-and-trade model that identifies some key linkages and suggests empirical hypotheses. Andrew Schmitz, G.C. van Kooten and Hartley Furtan, and John Sutton and Alan Webb present some highly probing yet simple comparative static analyses of trade-resources policy interactions. Robert Chambers and Katherine Reichelderfer start with a Ricardo-Viner model (that is, a trade model that assumes that at least some factors, such as farmland, are immobile across production sectors) extended to permit one input to grow or be depleted. This setup allows them to generate some interesting comparative dynamics results.

These efforts at elaboration of models represent a first step toward specifying and estimating empirical relationships and performing empirically-based policy simulations. Agricultural economists, our editor and authors readily admit, have a long way to go before these tasks can be completed routinely and reliably. Like most books intended to stimulate a budding research program, this one contains a mixture of exhortation and leading by example. But, to the credit of the participants, it offers more of the latter than do many such books. As the Nation seeks a high quality of life and high export earnings, and with agriculture rather central to both concerns, one wishes every success to the enterprise this book is intended to encourage.

The essays include: "Introduction" by John D. Sutton; "Natural Resource Concepts in Trade Analysis" by Kathleen Segerson; "International Trade Theory and Natural Resource Concepts" by Philip C. Abbott and Stephen Haley; "Economic Analysis of Agricultural Resources in Open Economy: A Hybrid Model" by John M. Antle and Richard E. Howitt; "Implications of Environmental Regulations for Competitiveness in Agricultural Trade" by C. Ford Runge, James P. Houck, and Daniel W. Halback; "Discussion: Linkages Between Soil Conservation Policy and Trade Policy" by Clayton W. Ogg and John D. Sutton; "Effects of Natural Resource Policies on Agricultural Trade" by Robert G. Chambers and Katherine Reichelderfer; "Discussion: Developing a Framework for Analyzing Effects of Resource Policies on Trade" by Nancy E. Schwartz and George E. Rossmiller; "Trade Policies and the Use and Value of Natural Resources" by John D. Sutton and Alan J. Webb; "Issues in Commodity Trade: Implications for Natural Resources" by Andrew Schmitz, G.C. van Kooten, and W. Hartley Furtan; "Discussion: Policy Issues and Research Questions Relating to the Trade-Resources Interface" by Jerry Sharples, Lyle P. Schertz, and Eduardo Segarra; "Technology, Natural Resources, and Commodity Trade" by John M. Reilly and Tim T. Phipps; and "Bringing Together International and Resource Economists: Comment" by Bruce Gardner.

A Thought-Provoking Foray into Family Farming

Family Farming: A New Economic Vision. By Marty Strange. University of Nebraska Press, Lincoln and London, and Institute for Food and Development Policy, San Francisco, 1988, 311 pages, $18.95.

Reviewed by Robert F. Boxley

The Center for Rural Affairs in Walthill, NE, has produced a number of investigative reports with such provocative titles as *Wheels of Fortune* (a study of central pivot irrigation) and *Who Will Sit With The Corporate Sow.* Readers familiar with these works will want at least to skim this book by Marty Strange, co-director of the center. Readers interested in farm structure will want to give it serious consideration, although they may be disappointed with the "new economic vision" that Strange describes.

I approached the book with some apprehension, fearing yet another paean to some earlier time, but Strange writes with refreshing candor. He concedes, for example, that the yeoman farmer of agrarian mythology was not necessarily a paragon of virtue, and that the bucolic image of agriculture contains its dark sides:

> No tradition is more glorious in its acclamation of egalitarian values than the agrarian tradition, yet none tolerates and even admires the accumulation of wealth more. No tradition proclaims more loudly the value of neighborhood and community, yet few have tolerated and rewarded predatory behavior more. Most disappointingly, no system of agriculture brags more that it respects the soil, yet none has respected it less.

Despite his obvious admiration for the family farm, even with its faults, Strange ultimately is less than fully successful in dealing with the complexities inherent in U.S. agriculture and in devising a coherent perspective for a farm policy that fosters structural goals.

The first challenge in writing about farm structure is to define terms. Strange attempts to sidestep the definition problem, arguing that we can likely agree on the cultural meanings of characteristics of farming systems, even if we might never agree on whether a particular farm fits a system or not. He broadly caricatures two farming systems: family and industrial. While useful, this approach does not solve the definitional problem since readers must still impose their perceptions of contemporary reality in order to give context to the caricatures. Thus, Strange leaves significant questions about the extent and current health of the present-day family farm system unanswered. If, for example, a farm must be diversified to qualify as a member of the system, as his caricatures implies, then my perception of midwestern agriculture would suggest that the cause is already lost. Urban readers conditioned to dealing with attorneys, accountants, doctors, and dentists as "personal corporations" may need more explanation than Strange offers as to why the corporate business form should be inimical to a family farm system. These are not trivial issues since Strange proposes a farm structure policy that would require society, rather than the market, to distribute access to farming opportunities. Such a policy will require rigorous definitions.

Agricultural economists especially will want to consider chapters 4 and 5. Strange argues that conventional analyses of farm structure suffer from a static, one-dimensional measurement of farms by sales volume (chap. 4) and that this mismeasurement leads to erroneous conclusions about economies of size and efficiency in agriculture (chap. 5). On economies of size, Strange concludes that, rather than declining monotonically with increasing volume of sales, the size function more likely follows a shallow, elongated "u" shape, with most efficiencies realized at relatively low sales volumes. But, if Strange is correct in large farms having no inherent advantages of scale and in fact being *less* efficient than moderately-sized family farms, then why should the survival of family farms be in doubt? Strange identifies a number of culprits, including the U.S. Internal Revenue Code, the go-go expansion mentality of the 1970's, and the technology treadmill.

Some of Strange's arguments are victimized by timing. He presents an excellent critique of how the pre-1986 Internal Revenue Code rewarded bigness and attracted outside investors into agriculture. The 1986 tax revisions, however, eliminated the more egregious provisions of the code. Strange identifies some remaining provisions that are possibly hostile to agriculture, but their consequences are relatively modest and they are good candidates for elimination in future tax simplification efforts. The irony of arguing that Congress helped farmers by eliminating laws ostensibly passed on their behalf is not lost on Strange, but it is not clear that he has applied the larger lesson to his subsequent policy recommendations.

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Strange's critique of the expansion mentality of the 1970's is also on target, but, again, I am not convinced he has drawn the most significant conclusions from the debacle of the 1980's. In his policy chapter, Strange defines a "new mandate" for farm policy based on the propositions that farmers 1) should have no motives for owning farmland other than to make a living from it, 2) should have to pay for land from farm income, and 3) should have incentives to farm it in environmentally sensitive ways. These conditions came to be violated in the 1970's because owning land was its own reward. The post-1981 crash in land prices has arguably gone at least part way toward restoring conditions for the mandate. Strange, however, does not speculate about the longer term consequences of lower asset values and, in fact, advocates some policy measures (such as shared appreciation loans) that will work only if escalating land values are a permanent feature of U.S. agriculture.

Strange concludes with the obligatory policy chapter, although he downplays its significance because "what has been missing in American farm politics is not legislative initiatives, but clarity of purpose." Despite his appeal for clarity, substantial logical gaps exist between Strange's critique of failed policies and his recommendations for new ones. Strange draws extensively from USDA's "Structures Project" of the Bergland tenure. (See titles at the end of this article.) But, the procedure used in those projects was to list and analyze all factors that might be expected to affect structure. Of the 31 chapters in the 1979 report, 27 dealt with causative factors, ranging from credit availability to transportation policy. I submit that it is nearly impossible to design a coherent, consistent program when everything, directly or indirectly, affects everything else. Strange's chapter on tax policy is a perfect case of this difficulty, but there are many examples of unintended second- and third-order effects from well-meaning programs and policies. Yet, Strange proposes further social intervention into credit, land, and commodity markets. With enough tinkering, a foolproof structural program could possibly be designed, but the track record is not good.

Although Strange argues that the family farming system is the most robust and resilient system extant, he frequently betrays that confidence in his analysis of policy options. Take the "public policy dilemma" of when government should intervene in falling land markets:

> [If] land prices are buoyed intentionally to prevent further deterioration in the financial conditions of farmers, people trying to buy their first piece of land to start farming, or trying to reenter farming may be denied that chance. On the other hand, if land prices fall to rock bottom, wealthy investors will probably snap up most of the bargains.

This reasoning suggests that the trick for program managers must be to intervene in land markets with precisely the right amount and at precisely the right moment. I submit that this is an impossible standard. If the family farm system is as sensitive to timing or price levels as Strange suggests, then perhaps it it too much of a hothouse flower to be worth the effort.

The true public policy dilemma to me is the contentious political choices that must be made if a specific farm structure is to be preserved. One of the book's more telling passages revolves around a short discussion of inheritance and estate taxes. Strange poses the dilemma: Do you tax inheritances in order to break up large landholdings and prevent the accumulation of landed wealth, or do you allow wealth accumulation and transfer in the interest of intergenerational continuity? Strange discusses the pros and cons of both positions without taking sides. Although the passage is matter-of-fact, its poignance grows from the revelation of the social conflicts inherent in the choice (in a subsequent discussion, Strange opts for progressive estate taxes). In truth, there simply is no objective way of deciding on a "correct" level of estate taxation.

The subjectiveness of so much of the debate about farm structure is crystallized in Strange's central policy recommendation for a "two-price" system tied to marketing quotas. Marketings within quotas would qualify for guaranteed prices. Quotas would be assigned to individuals according to various social criteria and would be non-negotiable. When a quota holder dies or retires, the quota would return to a pool to be reallocated by some (not specified) political process. If society is to maintain a specific number and distribution of farms, it clearly must regulate entry in some way. Strange's proposal would accomplish this, but at what cost to the social psyche?

If the test of a book is its thought-provoking quotient, Strange's must be given high marks. I offer two examples:

Education—The Great Depression indelibly marked a generation or more of farmers as financial conservatives. Although the 1981 farm crisis was not accompanied by an economywide depression as in the 1930's, the loss of asset values within the farm sector was proportionately greater than in the 1930's. Thus, there should be a window now open for educators, extension advisers, and financial consultants to reinforce upon the next generation of farmers the merits

of fiscal conservatism. To date, however, much of the attention to asset markets seems focused on questions of whether a market "bottom" has occurred, or speculation on optimum entry strategies for new investors. Even Strange implicitly assumes that farmers, landowners, and would-be land speculators learned little from the loss of over $220 billion in asset values this decade. Agricultural economists, many of whom were cheerleaders for leveraged growth and expansion strategies during the boom years, are hardly in position to say "I told you so," as Strange points out. But, even if we have to eat some crow, we need to make sure messages are not lost in the haste to return to how things were.

Why Federal Agricultural Programs?—I finished the book asking "Why any farm programs"—not, I hope, from a lack of empathy with the family farm concept or a conviction that an unregulated market is demonstrably better, but one of an unwillingness to embrace obviously flawed alternatives. Strange does not directly address the prospects for the family farm system under a free market alternative. He only briefly discusses the need for commodity programs, noting that there may be a role for public actions to reduce commodity price instability, and suggesting that stable prices tend to favor large-scale farms. Ideology largely drives our faith in, or distrust of, markets. Even so, I think the first step in assessing the need for a structural policy would be to determine the need for any market intervention in the sector. It would be useful, for example, to refresh our collective memories of why the Nation decided to intercede with the first Agricultural Adjustment Act and to ask whether those conditions or similar conditions still hold. The answers would be useful for establishing not only a rationale for structural policies but for other contemporary issues as well, such as trade liberalization and GATT negotiations.

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