RESEARCH REVIEW

INFLATION AND THE MONEY SUPPLY

By Alan R Bird*

To stop inflation, cut the money supply That is a traditional remedy Yet the persistence of inflation throughout the seventies implies the need for novel remedies that would discourage nonproductive specula tion and encourage resource produc- tivity Complementary efforts to remedy structural deficiencies in markets would also seem called for

Cutting the money supply through such traditional means as a higher discount rate (the interest rate the Federal Reserve System charges its member banks), higher reserve ratios (the percentage of deposits that member banks cannot loan or invest), or increased pur- chase of bonds on the open market will likely intensify inflation Why?

Chronic inflation has created a climate of expectation that infla- tion will continue The conven- tional definition of money supply thus no longer applies This defini tion includes currency and demand deposits, and several other variants, among them, successively less liquid assets, such as deposits at savings and loan institutions and certificates of deposit

The relevant definition of money supply when inflation is expected to continue will be termed the "operative money supply " It includes the conventionally defined money supply plus bank borrowings of foreign funds and an increasing array of commodities and other goods that serve as near-money and can substitute for conventional money as inflation intensifies

Obtaining goods which serve as operative money typically involves borrowing which, in turn, creates more conventional money These ac- tions inflate prices further, creating more demand for operative money As the process continues, more goods function as near money and goods already in that category become more liquid and more acceptable as a store of value for deferred pay- ments They also displace conven tional money as a unit of account so that nominal money values have less and less meaning unless converted to real terms In other words, goods, increasingly displacing conventional money, function as money while fulfilling their conventional func tions These goods include diamonds and other precious stones and metals and many agricultural and other commodities As inflation progresses, residential housing and other real estate begin to perform as money So do automobiles, refrigerators, and other consumer durables

As inflation intensifies, the effects of the snowballing supply of operative money are reinforced by its increasing velocity of circulation Goods and conventional money both change hands an increasing number of times each year

Higher interest rates encourage those with the most assets to seek ownership of more assets They expect continuing inflation to reduce the financial burden of outstanding loans and to increase their equity in owned assets, which increases their ability to borrow They thus increase inflation through the in creased prices of goods and services and increased nominal value of assets ranging from gold to real estate Those with the most assets and the most debt stand to gain most from this behavior And their poten tial for borrowing is the greatest

Business will boost prices and hire more labor Why? Because the nominal value of their current plant and equipment is now greater and the cost of replacement greater still, they have a greater incentive to use this plant and equipment to full capacity They may also extend the life of plant and equipment through increased servicing, repair, renovation, and hiring of labor and services to perform these functions They may postpone replacement even beyond the point of prudence They may increase raw material inventories both to expand produc tion and to profit from further price hikes They will also tend to mark up prices as much and as often as possi- ble, to help cover the increasing costs of labor, credit, and materials, and the anticipated snowballing costs of plant and equipment More- over, such businesses will have both increased ability and incentive to borrow to purchase further assets also expected to appreciate

When inflation is expected to continue, higher interest rates will encourage businesses to borrow more from one another and from the public by overbilling, as with utili- ties, which further expands the operative money supply This kind of borrowing, reportedly quadrupled in the last decade, now amounts to an estimated $90 billion annually An accurate estimate is difficult because new ways of borrowing surface more frequently as infla tion intensifies

Higher interest rates and reserve ratios encourage more banks to leave the Federal Reserve System so that they may loan and borrow more Banks are encouraged to increase the operative money supply by issuing credit cards with liberal limits and hedging their risks by wider geographic dispersion of accounts

Because the U S economy is open ended and because the number and size of multinational corpora

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Thus, expected continuing inflation in an open-ended economy such as ours means that intense application of such traditional measures as higher interest rates and higher discount rates to slow the money supply can, instead, exacerbate inflation

tions are growing, higher interest rates attract greater quantities of foreign money, including Euro- and petro-dollars This money expands the operative money supply further as foreigners buy money market bills, real estate, commodities, and other assets It also increases bank deposits and bank borrowing, which adds to domestic inflation because of increased dividend and interest payments to foreigners, and it inflates commodity prices, real estate, and other asset values

Such foreign investment tends to "stengthen the dollar" in a cosmetic sense Increased foreign ownership of U S assets slows the relative outflow of U S dollars just as such outflow would be slowed from increased net exports due to greater productivity and the containment of inflation This factor does not show up in the usual Federal Reserve statistics of the domestic money supply

Higher interest rates also encourage more Government lending and spending on housing When inflation is not expected to continue, the slowing of housing construction in response to mild increases in interest rates is a major signal of slowing inflation However, when inflation is expected to continue, governments will loan low-income and young families the downpayment to buy a home as an inflation hedge Thus, the money supply increases still more

Thus, expected continuing inflation in an open-ended economy such as ours means that intense application of such traditional measures as higher interest rates and higher discount rates to slow the money supply can, instead, exacerbate inflation The relevant money supply becomes open ended Asset owners and debtors are encouraged to borrow and buy more assets rather than investing in activities and processes that enhance resource productivity These asset values increasingly become part of the operative money supply This operative money supply increasingly fans further inflation since asset values generally appreciate faster than the rate of increase in wages and prices

In such a situation, individuals and businesses with the least assets and the least expertise in money management will become bankrupt Layoffs will occur Higher interest rates and related tighter conventional controls on money supply may hasten this "cosmetic" recession It can be termed cosmetic because it simply signifies a widening of income and asset distribution whereby those with the most assets become richer and those with the least become poorer There is no reason to suppose that such a recession would induce fundamental changes in the composition of investment and other economic activities to enhance resource productivity An example of such a change would be the development and marketing of lower-priced substitutes for items with an inelastic demand Meanwhile, individuals and businesses contributing most to the increase in inflation through asset purchase and negotiated wage increases gain the most and can continue to fuel inflation

Thus, as stated, new approaches are needed to encourage a more productive pattern of investment and related economic activity These measures will likely extend far beyond ways to control the money supply, although its control remains a priority What can be done to control the supply? Since increasing the interest rate accelerates the increase in the money supply, a somewhat lower set of rates seems called for, such as lower spot and forward exchange rates for the U S dollar However, because the United States is an open economy, further interim provisions would be needed to prevent a flight of funds to foreign countries with greater inflation rates The need for these provisions would diminish when both U S and foreign investors perceived a lesser risk to investment for comparable rates of return in the United States This lesser risk would result from the successful application of basic anti-inflation measures such as those to enhance resource productivity and modulate monopoly power Lower interest rates could enable increased investment for these purposes Other, more specific provisions would be needed to trim the overall money supply Examples would be limiting foreign ownership in real estate and other assets, and imposing tighter credit controls

Measures to control the money supply alone, however, are unlikely to be enough to enhance resource productivity and the functioning of various economic institutions to ensure only mild continuing inflation But that is another story

In Earlier Issues

Self-appraisal—serious-appraisal—is often recommended, rarely practiced

O V Wells
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AN ANALYSIS OF THE 1979 FEED GRAIN SET-ASIDE PROGRAM*

By Lloyd D. Teigen, Thomas M Bell, and Joseph M. Roop*

INTRODUCTION

In this note we describe a short-cut method for evaluating the impact of alternative set aside and diversion decisions for the 1979 feed grains program that draws on existing models and data systems and that provides needed policy information quickly, to meet demands within USDA The models used are (1) commodity acreage equations, (2) impact multipliers from the USDA Cross Commodity Forecasting System (CCFS), which are maintained by the Food and Agricul ture Policy Branch of the National Economics Division (NED) ESCS, (3) the farm income and Consumer Price Index (CPI) processors developed by the Aggregate Forecasting Project of the National Economics Analysis Division, (NEAD) (now part of the Economic Indicators and Statistic Branch, NED), and (4) the Outlook and Situation Information System (OASIS), (*1*,*2*)[1] (now in the World Analysis Branch, International Economics Division (IED)

We measure impacts on Govern ment costs, consumers, and the agri cultural commodity and financial sectors We also analyze cash receipts for commodities, aggregate U S net farm income (and changes of relative incomes between the crop and live stock sectors), and the CPI for food

Assumption

The first of the five scenarios, referred to as the base solution, assumes a zero set-aside for feed grains and cotton with a 20-percent set-aside for wheat The other four alternatives analyzed were

A 10-percent set aside on all feed grains (except oats)

A 10-percent set aside on all feed grains (except oats) and an optional 10 percent paid diversion of acreage with payments of $2 per bushel on corn and $1 20 per bushel on barley and sorghum grain

A 15-percent set-aside on all feed grains (except oats)

A 15-percent set aside on all feed grains (except oats) and an optional 15 percent paid diversion of acreage with payments of $2 50 per bushel on corn and $1 50 per bushel on barley and sorghum grain

ACREAGE ANALYSIS

To analyze supply response, we use the regional cotton equations of Evans and Bell (*3*) and the corn equation of Gallagher (*5*) The feed grain equations revise and modify the original work by Houck, and others (*7*) The wheat equation is original with this analysis [2]

As the equations used here were not estimated with either constrained estimation or a consistent set of variables (particularly variables representing the current program), our solutions provide only one interpretation For example, a set-aside program can be viewed as reducing the price facing farmers, increasing the diversion payment, increasing the opportunity cost of the crop, or any combination of the three In our analysis, the expected effective support price overrode lagged farm prices We did not adjust the diversion payment to account for inflation as we used the nominal variable in each equation Nor did we constrain the acreage estimates to equal a fixed land base

The effective support prices for grains[3] were factored by the appropriate percentages to represent the set-aside scenarios (for example, the effective support price for sorghum for the 10 percent set-aside is 90 percent of the zero set-aside price but is not allowed to fall below the loan rate) Effects on the competing crops were estimated either by reducing farm prices facing the grower or by increasing opportunity costs or diversion payments For the scenarios with set-aside and diversion payments, the diversion payment variable (if present) or a modification of the producer price induced the acreage response The effective diversion payment is the per bushel rate times the ratio of diverted to total (planted, set-aside, and diverted) acreage

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

[2] The variables in the wheat equation are loan rate, diversion payment, wheat/sorghum price ratio, oat-plus barley acreage, and cotton acreage

[3] The effective support price is the loan rate plus the allocation factor esti mate times the difference between target and loan The allocation factor is the ratio of national program acreage to the estimated harvested acreage, and affects the level of deficiency payments received by farmers

The presence of a set-aside program alone is not enough to affect planted acreage substantially A paid diversion program is needed to appreciably reduce supply

Table 1 presents the acreage estimates for 1979 under the five policy scenarios For all feed grains plus wheat, the equation estimate for 1979 was given an additive adjustment equal to the difference between the model solution for 1978 and the actual 1978 acreage The most significant of these adjustments were -7 million acres for wheat, -4 million acres for corn, and 1 7 million acres for barley

The presence of a set-aside program alone is not enough to affect planted acreage substantially A paid diversion program is needed to appreciably reduce supply The actual 1979 program was a 10 percent set-aside/10-percent diversion program Actual 1979 planted feed grain acreage was within 3 per cent of the 10/10 scenario's estimate The overestimation of minor grains (due to an unexpected increase in sunflower acreage) slightly exceeded the underestimation of corn acreage The record soybean acreage was not forecast by the equations and its error exceeds that for all seven crops

CROSS-COMMODITY IMPACTS

This analysis used multipliers from the four-sector model of the ESCS Cross-Commodity Forecasting System (CCFS), which links together the livestock, feed grain, wheat, and soybean sectors [4] This 165-equation model links the U S consumer demand for meats and export demands for grains to U S production of crops We calculated multi-

[4] The basic equations for all except the soybean sectors are those reported in (*11*) The soybean sector results from current research in ESCS that has used the work of Houck, Ryan, and Subotnik (*8*), the specific estimates of coefficients are available from the authors The cotton model was developed by Bell and Evans, whose detailed supply side is presented in (*3*), and the impact multipliers were presented by Evans, Bell, and Remmele (*4*)

Table 1—Acreage response for 1979 to five policy scenarios

Crop	0 pct set aside 0 pct diversion	10 pct set aside	10 pct set aside 10 diversion	15 pct	15 pct set aside 15 pct diversion	Actual
	Million acres					
Corn	85 3	82 82	78 3	82 1	76 28	80 0
Sorghum	18 2	17 3	16 5	16 9	15 9	15 4
Barley	9 9	9 3	8 9	8 9	8 5	8 1
Oats	17 4	17 3*	17 2	17 2*	17 1	14 1
Total	130 8	126 72	120 9	126 1	117 7	117 6
Wheat[1]	70 7[2]	70 4*	70 1[2]	70 1[2]	70 1[2]	71 2
Soybeans	68 0	68 0	65 5	68 0	65 4	71 5
Cotton	13 5[1]	13 5[3]	13 5[3]	13 5[3]	13 3[3]	14 1
Total	283 9	278 57	269 5	277 55	266 5	274 4

[1] Assumes a constant participation rate
[2] 20 percent wheat set-aside
[3] 10 percent set-aside, 10 percent paid diversion
* Interpolated solution

The acreage response equations suggest the set aside without a paid diversion program induces little response to reduce acreage

pliers (*12*) of corn, soybean, wheat, sorghum, and cotton production on both the crop and the livestock sectors using the CCFS [5]

For the livestock sector, ESCS analysts tabulated the impacts on production, the market price of live animals, and the index of retail meat prices They also calculated crop sector impacts on farm price, domestic use, exports, and stock levels To capture the dynamic response of these changes, they tabulated both the immediate and induced impact on subsequent production, consumption, and price The cotton sector is virtually independent of the food sectors

We estimated the overall free market effects of each of the set-aside options on commodity production, consumption, and prices using the CCFS impact multipliers The crop acreage equations with corresponding yield estimates determined supply [6] The difference between these estimates and the supply under the zero set aside option, together with the CCFS multipliers, determined free market results We integrated these results with minimum commodity prices (the loan rates) and maximum commodity prices[7] and inserted these results into the CCFS, with commodity prices simultaneously exogenized, to determine the results shown in table 2

AGGREGATE INDICATORS

These set-aside programs influence retail meat prices Concentration in the cereal, baking, and other grain-processing industries, together with the large fraction of nonagricultural value added, has caused retail prices for these products to be relatively independent of farm grain prices The 1979 set aside plus diversion scenarios will increase retail meat prices between 2 and 3 percent in 1980 and 1981, while the set-aside-only scenarios would have a smaller impact on meat prices Meat prices represent about half of total food costs, which make up about one-fifth (18 percent) of the consumer's total budget

We translated the above prices and quantities into effects on cash receipts and farm sector income using algorithms developed by NEAD and documented in (*1*) and (*2*)

Table 3 estimates the effect of different programs relative to the zero set aside baseline (the 10- and 15-percent set-aside-only scenarios only fractionally affected farm income) Expense reductions almost offset reduced receipts both from marketings and Government payments When paid diversion is considered with set-aside, the income effects are substantial—$1 billion to $5 billion on a base of $28 billion

RESULTS

We selected five scenarios to indicate the wide range of options open to decisionmakers The acreage response equations suggest the set-aside without a paid diversion program induces little response to reduce acreage For example, a 10-percent feed grain set aside decreases total acreage by about 5 million acres, and the 15-percent set-aside idles slightly less than 8 million acres of land Consequently, aggregate impacts on farm income and retail prices (table 3) are negligible This results from (1) the narrow spread between the target and loan (or market prices) that induces the acreage response, (2) the stock action generally required to maintain the

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In Earlier Issues

Economic forecasting has always been a hazardous pursuit we employ a combination of qualitative judgment and statistical estimation, which doubtless involves too much intuition to satisfy the econometricians and too much statistical manipulation for those who believe that predominantly judgmental appraisals are likely to yield the best predictions

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[5] The following reservations regarding the specific estimates of the multipliers should be noted The corn and soybean demand equations may be slightly too inelastic (*13*) Pork supply and beef demand may also be too inelastic (*6*) while pork demand seems too elastic (*6*) The cross-commodity price impacts on the wheat sector may be too "hot," over estimating the wheat price effect of nonwheat-sector changes

[6] Actually the acreage is converted to production by harvested acreage and yield equations

[7] After looking at stock impacts and consulting with commodity specialists, the authors reached the conclusion that the maximum commodity price is generally less than commodity release prices under reserve programs and sometimes less than the free market price plus the change from free market levels using impact multipliers

price at loan, or higher, and (3) the requirement of participation in Government programs for program benefits, which decreases U S Treasury outlays due to relatively low program participation

However, the 10-percent set-aside plus 10-percent paid diversion removes enough acreage from production (16 4 million acres) to maintain aggregate U S farm income near 1978 levels [8] Treasury outlays are increased less than $500 million, and the consumer pays approximately 1 percent more money for 1 percent less meat The total CPI increases less than 0 1 percent Crop producers gain income increases, averaging more than $1 billion, in 1979, 1980, and 1981 Total cash receipts for crops, which decrease negligibly are more than offset by decreased production expenses of approximately $1 billion The livestock sector suffers small losses as increased cash receipts of approximately $1 billion in 1980 and 1981 are more than offset by the $1 3 billion cost increase in feed

Relative to the 10/10 scenario, the 15-percent set-aside, plus 15-percent paid diversion, increases farm income about $2 billion and $5 billion for 1979 and 1980 This increase results from slightly increasing crop cash receipts (over the base) rather than the no change or slight decrease in total cash receipts for the 10/10 scenario U S Treasury outlays are approximately $400 million over the 10/10 scenario, and feed costs increase about $300 million Farm production expenses decline approximately $300 million, and little change occurs in aggregate cash receipts for livestock There is a slight increase in consumer purchases and prices over the 10/10 scenario

[8] The current estimate of 1979 net farm income is about $31 7 billion

Table 2—Final impacts of set aside/diversion scenarios

Commodity	Unit	Calendar year							
		10 percent set aside		10/10 diversion		15 percent set aside		15/15 diversion	
		1980	1981	1980	1981	1980	1981	1980	1981
CPI, meats	1967=100	+0 19	-0 65	+3 75	+5 30	+0 29	-0 36	+4 07	+5 82
Beef									
Production	Mil lbs	- 3	+24	-106	-138	-12	+14	-119	-157
Price, Omaha, slaughter steer	$/cwt	+ 03	- 27	+1 09	+1 17	+ 12	- 20	1 22	+1 33
Price, Kansas City feeder steer	$/cwt	- 03	+ 54	- 62	- 25	- 05	+ 57	- 72	- 31
Retail price index	1967=100	+ 009	- 095	+3 26	4 07	36	- 68	6 59	2 84
Pork									
Production	Mil lbs	+0	+32	-69	-101	+1	+28	-68	-107
Price 7-market borrows and gilts	$/cwt	+ 01	- 52	1 16	1 39	04	- 47	1 20	1 51
Retail price index	1967=100		-1 65	3 66	4 63	16	-1 44	3 85	5 05
Broilers									
Production	Mil lbs	+0	+37	-69	-22	4	38	-63	-16
Price, 9 city wholesale	¢/lb	+ 02	-88	1 88	1 96	09	- 79	1 98	2 15
Retail price index broilers	1967=100	07	-2 94	6 33	6 85	34	-2 64	6 75	7 56
Milk									
Production	bil lbs	- 07	1 11	-2 28	-1 78	- 23	1 04	-2 51	-2 02
Farm price	$/cwt	+ 022	- 036	0 73	057	007	- 033	0 80	065
Retail price index, dairy	1967=100	+ 02	- 34	71	55	07	- 32	78	63

Table 2—Final impacts of set-aside diversion scenarios

Crop	Unit	10 pct set aside		10/10 diversion		15 pct set aside		15/15 diversion	
		Crop year							
		1979	1980	1979	1980	1979	1980	1979	1980
		Number							
Corn									
Price	$/bu	0	-0 10	+0 20	$0 10	0	-0 10	+0 20	+0 20
Feed use	Mil bu	-2	-37	36	84	+10	-32	4[illegible]	112
Commercial exports	Mil bu	0	-51	1 02	6	15	-44	122	154
Sorghum									
Price	$/bu	0	05	0	+ 17	0	- 05	07	+ 17
Feed use	Mil bu	0	+6	-2	-17	-1	+7	-20	-16
Commercial exports	Mil bu	-0	-9	22	14	2	-8	20	18
Barley									
Price	$/bu	12	+ 17	20	25	20	25	28	33
Feed use	Mil bu	-18	-28	-45	-42	-31	-37	-53	-68
Total exports	Mil bu	0	0	0	0	0	0	0	0
Oats									
Price	$/bu	01	01	01	01	01	01	02	02
Feed use	Mil bu	-4	-11	+14	+6	-4	-11	+10	+3
Total exports	Mil bu	0	0	0	0	0	0	0	0
Wheat									
Price	$/bu	0	0	0	0	0	0	0	0
Feed use	Mil bu	-0	-4	-1	+12	-0	-4	+4	+12
Commercial exports	Mil bu	6	-13	46	43	10	-11	+60	+49
Soybeans									
Price	$/bu	06	10	1 00	1 55	0 09	14	1 22	1 72
Commercial exports	Mil bu	-0	+20	-37	-41	-4	+18	-42	-49
Soybean meal									
Price	$/bu	- 033	- 910	+1 883	+1 708	+ 165	- 841	+2 107	2 015
Feed use	Thous S T	-6	+501	-859	-9 55	-79	+457	-955	-1 114
Commercial exports	Thous S T	+1	+285	-594	-579	-61	+260	-676	-692

Set-aside-only options have little impact unless the set-aside and paid diversion scenarios maintain or increase farm income over 1978 levels Increased livestock receipts fail to offset increased feed costs The consumer eats slightly less meat at slightly higher prices

CONCLUSION

For farm income to be maintained at approximately 1978 levels, some form of acreage diversion program would have been required for the feed grains for 1979 Set-aside-only options have little impact unless the set-aside percentages are higher than those analyzed here Combination set-aside and paid diversion scenarios maintain or increase farm income over 1978 levels The increase occurring entirely in the crop sector results from slightly higher Government payments and decreased crop production expenses Increased livestock receipts fail to offset increased feed costs The consumer eats slightly less meat at slightly higher prices

The models were shown to be an efficient means of obtaining a comprehensive quick-response evaluation of a major policy question In concert with the judgments of economists with both institutional and analytical backgrounds, the models provide a consistent framework for analysis The analyst's judgments are still needed because not all of our economic knowledge is precise enough to express in explicit mathematical language

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In Earlier Issues

Economic forecasting is still exceedingly unsatisfactory, and some economists regard it as a vice from which the virtuous should resolutely abstain But so long as individuals, commercial enterprises, and governments must make decisions on the basis of judgment as to the course of economic events in the future, economic forecasts must necessarily be made and acted upon

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U.S. AGRICULTURE IN AN INTERDEPENDENT WORLD: CLOSING THE GAP BETWEEN ANALYTICAL SYSTEMS AND ECONOMIC REALITY

Leroy Quance and Mihajlo Mesarovic*

Institutions that provide information about food and agriculture to private and public decisionmakers are developing more realistic analytical systems Their models are becoming globally oriented and more interdisciplinary They are directed more at longrun planning, better balanced in terms of man/machine components, more explicit as to policy and management decision options, and thereby more useful

We can no longer analyze significant issues in U S food and agriculture apart from the global system to which they are related Comprehensive, computerized simulation models together with professional subject-matter expertise are essential

CURRENT USDA MODELS

For the past 6 to 10 years, most long-range projection activities in ESCS and its predecessor, the Economic Research Service (ERS), have depended on formal models Projections of U S agricultural exports and analyses of the world food situation depend heavily on the Grains, Oilseeds, and Livestock (GOL) world trade model (*4*) [1] For long-range analyses of U S domestic food and agricultural issues, we use the National-Interregional Agricultural Projections (NIRAP) system (*3*)

GOL, a longrun equilibrium model of world grains, oilseeds, and livestock production, consumption, and trade, relates grain-oriented food economics of developing regions to livestock-oriented economies of developed regions

NIRAP, an annual supply-demand equilibrium model of U S farm production, provides linkages to the general economy, farm inputs, natural resource use, the environment, food prices, total and per capita food consumption and expenditures, and world agricultural trade It relates equilibrium production and prices to scenario-determined shifts in commodity and aggregate demand and supply functions

Collaboration between the groups responsible for GOL and NIRAP has generally resulted in consistent projections of U S agricultural exports However, such consistency is achieved offline and is time-consuming, furthermore, the real-world feedback loops or the interactions between world demands for U S agricultural exports, as represented in GOL and U S domestic demand and supply representations in NIRAP, have been dealt with inadequately

Largely due to increasing exports, the demand for U S farm output is projected to increase faster than supply, resulting in real commodity price increases U S supply and demand details in the GOL model are inadequate to realistically project the real price increases Agricultural exports derived from the GOL model are generally higher than projections generated by NIRAP In NIRAP, real price increases generally lower quantities demanded for export more than the GOL model Such phenomena generally occur when two sectors or markets are simulated independently The lack of adequate feedback loops causes projections to approach simple trend projections and rates of change to be projected too high

Our recent experience with the Global 2000 Study, directed by the U S Council on Environmental Quality (CEQ), provides an excellent example of the problem of inadequate feedback loops The CEQ study, requested in President Carter's 1977 environmental message, assesses worldwide trends in population, environment, and resources In coordinating the study, CEQ analysts asked several U S Government agencies to provide projections in their respective areas of important variables under three scenarios differing in U S Bureau of the Census population projections and in World Bank GNP projections Projections were also generated for food, fisheries, energy, water, and minerals

The CEQ staff discovered that, although most projections and analyses had been made with great care and considerable subject-matter expertise, they were not consistent This inconsistency resulted from considering each major sector independently of other sectors Impacts of other variables, such as population, energy, and agriculture, had been inadequately treated For example, an assumption of high economic growth for a specific region may not have been consistent with high oil imports and high balance of payment deficits

WORLD INTEGRATED MODEL

To assess the importance of these inconsistencies, the Global 2000

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

The GOL and NIRAP models need linkages not only between agricultural export demand and domestic supply and demand but also to general economic growth, energy, and population

Study director asked Case Western Reserve University and Systems Applications, Incorporated, to analyze the impact of closing such feedback loops using their World Integrated Model (WIM) WIM has 7 sectors and 13 geographic regions with 27 possible subsectors It is supported by five submodels population, food, energy, raw materials, and international trade WIM analysts initially cut the feedback loops to validate the Global 2000 projections To assess the impact, they closed the loops linking the various sectors They analyzed some important feedback loops (1) balance of payment restrictions on imports, (2) the impact of energy deficits on economic growth, (3) fertility as a function of income, and (4) the impact of calorie and protein availability on mortality (*1*)

In the WIM open-loop analysis, the global economy grows from $6 1 trillion in 1975 to $14 8 trillion in 2000—a 3 5-percent growth rate, that is, slightly below the average for the sixties but almost identical to the Global 2000 Study projection of $14 7 trillion for 2000 (generated by the World Bank's SIMLINK model) This compares with an $11 7 trillion world economy in 2000 under the WIM closed-loop analysis—a difference of 21 percent The lower economic growth projected by the open-loop analysis occurs primarily because energy shortages materialize by the late eighties and early nineties and because high levels of foreign debt occur, particularly in the less developed countries In the closed-loop analysis, the lack of adequate new capital leads to reduced imports, including energy and capital goods, and to slower economic growth

World grain production increases 107 percent from 1975 to 2000 in the WIM open-loop analysis, compared with a 96-percent growth in the median Global 2000 projections generated by the GOL model This difference is caused largely by differences between the initial values of grain production for GOL and WIM The calculations of the U N Food and Agriculture Organization (FAO) for 1975 production used in the WIM analysis involve a slightly different accounting system than those used by USDA In the WIM closed-loop analysis, there is less capital for agricultural investments and production inputs as indicated by the WIM closed-loop scenario's lower fertilizer projections This causes world grain production to fall considerably short of the growth rate projected in either the WIM open-loop scenario or the Global 2000 median projection (an 85-percent increase by 2000)

The Global 2000 Study projects a 40-percent increase in real grain prices by 2000, compared with a 100-percent increase in the WIM open-loop projections WIM accounts for the impact of increasing input prices whereas the Global 2000 Study does not However, the WIM closed-loop scenario does not result in higher food prices than the open-loop scenario because, in the former, less income is spent on food and fewer people buy it

This comparison makes a strong case for an integrated global analytical system for studying food and agricultural issues The GOL and NIRAP models need linkages not only between agricultural export demand and domestic supply and demand but also to general economic growth, energy, and population

AGRICULTURE IN THE WORLD INTEGRATED MODEL (AGWIM)

While ESCS analysts were initially discussing integration of GOL and NIRAP, Mesarovic approached ESCS about the possibility of integrating GOL, NIRAP, and WIM Whereas GOL and NIRAP lack WIM's general economic and nonagricultural world detail, WIM lacks the agricultural detail of GOL and NIRAP to analyze emerging U S and world food and agricultural issues fully

The cooperative project that followed has resulted in a first-generation combined GOL, NIRAP, and WIM model — Agriculture in the World Integrated Model (AGWIM) Linkages have been effected among the three major submodels for population and GNP growth and for agricultural production and trade That is, WIM provides population and GNP projections for GOL and NIRAP GOL and NIRAP then project U S and world agricultural production, prices, trade, and utilization

These agricultural projections provide the value added for agriculture in the economic submodel and food availability for the population submodel in the next WIM iteration The WIM food submodel provides world agricultural production and trade projections for some commodities, such as tubers, coffee, and sugar, which GOL lacks Thus, the agricultural projections capability originating in GOL and NIRAP is internally consistent and has linkages with, and feedback loops to, the population and GNP projections generated in WIM Furthermore, *We cannot expect any modeling system to analyze effectively all issues regarding food and agriculture But we think AGWIM points in the direction of future modeling developments, that will help in analyzing complex issues*

AGWIM provides a global analytical framework with emphasis on food and agriculture in which future developments can simulate interactions between emerging agricultural issues and population growth, economic development, energy, and the environment

To test AGWIM, we developed two extreme U S energy policy scenarios First, we assumed a successful energy policy combining conservation, additional investment in domestic energy production, and substitution of other energy sources for oil imports Then we simulated a pessimistic scenario in which we assumed that the United States does not develop an energy conservation policy and relies as much as possible on oil imports We then analyzed the implications of these two energy scenarios for U S agricultural exports In particular, assuming a vigorous agricultural export policy in both cases, what portion of the U S oil import bill will be covered by agricultural exports?

The results suggest that the AGWIM model performs well The tentative answer to the policy question posed is that, under the successful energy scenario, agricultural exports will cover 40 percent of the U S bill for oil imports in the year 2000 Under the second scenario in which the United States does not develop a successful energy conservation program and past trends continue, U S agricultural exports will offset only 14 percent of the bill for oil imports

The AGWIM model is new Only basic linkages are operational as opposed to the complete integration of its three component models We cannot expect any modeling system to analyze effectively all issues regarding food and agriculture But we think AGWIM points in the direction of future modeling developments that will help in analyzing complex issues Such models can be used to develop and test new theories about food and agriculture in an interdependent world

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In Earlier Issues

farmers were indoctrinated in antimonopolism, in the physiocratic faith that agriculture was the basic industry in the economy, and in the belief that they had not been receiving a fair share of the national income They were devoted, moreover, to the use of government power to protect their interests Farmers were pictured as small capitalists, determined to protect their investments and anxious to have a fair return from their labor

Everett E Edwards
AER, Vol IV, No 3, p 96
July 1952

SCARCITY AND GROWTH RECONSIDERED

V Kerry Smith, Editor Published for Resources for the Future, Inc by the Johns Hopkins University Press, 1979, $18 95 hardcover, $6 95 paperback

*Reviewed by Karl Gertel**

The stated objective of this volume of conference papers is to "reconsider the long-run importance and availability of natural resources for economic growth and material well-being " The focus is on nonrenewable extractive resources, although some data are presented for agriculture, forestry, and fisheries The interrelationship between resource extraction and quality of environment is emphasized The title derives from the influential book by Barnett and Morse who found that economic growth need not be restrained by resource shortages [1]

Scarcity and Growth Reconsidered covers three areas (1) the role of natural resources in economic modeling, or to be more accurate, the role of natural resources in the economy, (2) the availability of natural resources as viewed by physical scientists, and (3) empirical measures of the economic scarcity of resources V K Smith and J V Krutilla provide an interpretive introduction and a summary and discussion of research issues They integrate the papers within the relevant literature and suggest areas for further inquiry However, they are perhaps too wide ranging to delineate sharply the issues and priorities, nor could any overview substitute for the background and detail developed in the papers

J E Stiglitz in the lead paper, "A Neo-classical Analysis of the Economics of Natural Resources," briefly, but systematically, explores the significance of natural resources in an aggregate production function and makes a series of judgments on such issues as the effects of monopoly, government policies and interventions, and a drastic oversimplification of optimal intertemporal use rates of exhaustible resources One need not be comfortable with all of Stiglitz's conclusions to find this a perceptive and stimulating paper

"Entropy, Growth, and the Political Economy of Scarcity" by H E Daly eloquently presents the moral perspective of "the continuation of life, the survival of the biosphere and its evolving processes " Daly proceeds from the concept of entropy, which, as I understand it, derives from the laws of thermodynamics and the ultimate state of degradation of matter and energy in the universe, a state to be avoided by a "steady state economy " Daly proposes depletion quotas sold at auction as the principal means to achieve the steady state The steady state would also include a constant population and maximum use of renewable resources Whereas Stiglitz states that his paper addresses "the more immediate future," Daly's spectrum seems timeless

N Georgescu-Roegen, who is in sympathy with Daly, discusses both papers Nonetheless, Georgescu-Roegen points out that a steady state economy may not be achievable, and Daly himself recognizes that ecological and full employment equilibria may not coincide S V Ciriacy-Wantrup's "A Safe Minimum Standard as an Objective of Conservation Policy," may be relevant [2] Recognizing uncertainty, he calls for modest or minimal standards of conservation Although developed for renewable resources with a "critical zone" of rate of use, this principle might be adaptable to nonrenewable resources policy

The papers on availability of natural resources by D A Brobst and H E Goeller will most help readers with limited background in areas such as the distribution of depletable resources over the earth and the meaning of "reserves " The two papers and the discussion by B M Hannon evaluate future adequacy Brobst and Goeller both conclude that the next few decades are critical Ample supplies and low-cost energy to process the relatively plentiful materials with very low concentrations of metals and minerals represent the key to future abundance Brobst and Goeller's differences in outlook stem largely from estimates of the amount of energy required to process low-grade sources They agree substantially on appropriate public policies and the important role of the political economy

The final section on empirical measures of resource scarcity is introduced by H J Barnett who recapitulates the findings of *Scarcity and Growth* and supplements them with more recent statistics for the United States and selected countries The principal measures of resource scarcity are output per unit of input of extractive industries, agriculture, forestry, and fishing and trends in

*The reviewer is an agricultural economist with the Natural Resource Economics Division, ESCS

[1] Barnett, Harold J , and Chandler Morse "Scarcity and Growth, the Economics of Natural Resource Availability " Published for Resources for the Future, Inc , by the Johns Hopkins University Press, 1963

[2] Ciriacy-Wantrup, S V "Resource Conservation, Economics, and Policies," University of California Press, 1952

productivity Barnett concludes that most of the more recent tests confirm his earlier conclusion for 1870-1957, which rejected the hypothesis of general resource scarcity He considers monetary costs for mitigating environmental degradation as tolerable

Two papers complete the third section G M Brown, Jr , and B Field's "The Adequacy of Measures for Signaling the Scarcity of Natural Resources" and A C Fisher's "Measures of Natural Resource Scarcity " Both offer penetrating analysis of conventional measures unit cost of extraction, price of extracted resources, and rent, the cost of discovery of new resources as a proxy for rent, and elasticity of substitution among resources, capital, and labor They generally prefer price to extraction cost and rent, although all measures can be misleading under certain specified conditions The logical next step, in this reviewer's opinion, is to move from theoretical analysis to the more difficult task of deciding empirically how prevalent conditions are under which measures of resource scarcity give wrong signals

These conference papers rate high in technical quality and clarity The authors discuss mathematical formulations in a way that makes them meaningful to most non mathematical readers Optimists and pessimists can find evidence to support their positions The book accomplishes its stated purpose of summarizing the state of knowledge in three areas—the role of resources in the economy, availability of resources, and measures of resource scarcity It brings to the reader's attention gaps in existing knowledge and makes recommendations for further research Although the priorities of an integrated research program do not fall easily into place, *Scarcity and Growth Revisited* is a good source for developing such a program

In Earlier Issues

Policy sciences draw upon all the sciences that can be useful in policy development In this context, knowledge is for practical application to policy needs at a given period During the war we needed to know, for example, the harbor installations at Casablanca, or the attitudes of the population of Pacific Islanders toward the Japanese, or the maximum range of a fixed artillery piece These were questions for geographers, anthropologists, or physicists economists were extensively used during World War II to estimate the facilities, manpower, and resources necessary to produce the munitions required by the armed forces and to supply men and materiel where needed The economic scientists who made the greatest direct contribution employed mathematics and statistics

Charles E Rogers
AER, Vol IV, No 3, p 99-100
July 1952

AGRARIAN STRUCTURE AND PRODUCTIVITY IN DEVELOPING COUNTRIES

Albert R Berry and William R Cline,
The Johns Hopkins University Press,
Baltimore, 248 pp

*Reviewed by Donald Baron**

Berry and Cline present a refreshingly staightforward criterion for determining the need for land reform programs in developing countries They propose that if output per unit of constant-quality land is substantially higher on small than on large farms, redistributing land from large to small farms will increase both aggregate agricultural output and employment opportunities Berry and Cline offer several hypotheses for why such an inverse relationship can be expected in most labor-surplus developing countries They support these hypotheses by establishing the existence of this inverse relationship derived from an analysis of input-output ratios and the intensity of land use characterizing farms in Latin American and Asian countries

Chapter two presents the main theoretical framework for their hypotheses Land productivity declines as farm size increases, primarily because labor-market dualism creates an effective price of labor that is substantially lower on small than on large farms Both the rate of land cultivation and the amount of labor employed per acre of cultivated land are, therefore, higher on small farms Land and capital market imperfec tions make the effective price of these factors lower on large farms than on small ones Land price differences "reinforce the difference in effective labor costs in leading to higher labor/land ratios on small farms than on large and, as a result, higher output per hectare available on the small farms" (p 10) Lower capital costs induce greater capital use on larger farms However, in most developing countries, lower capital costs also encourage replacement of labor with machinery in existing production Therefore, any increase in output/land ratios is likely to be small, while differences between small and large farm labor/land ratios are certainly greatly exacerbated

Chapter three reviews 1960 U N Food and Agriculture Organization (FAO) agricultural census data from 30 developing countries

> In practically all of these countries, the large farm sector (with the top 40 percent of land area) uses its land less intensively than the small farm sector (with the bottom 20 percent of area), based on the percent of farm area under cultivation (pp 41-43)

The clear implication is that output/land ratios are also much smaller in the large farm sector

This chapter also presents statistical tests suggesting that differences between small-farm and large-farm sector output/land ratios should generally decline slightly as land endowment per population declines across countries The inverse relation ship between land productivity and farm size should therefore be less pronounced in land-scarce countries than in land-abundant countries

Chapter four presents much more detailed analyses of productivity/farm size relationships in six countries Brazil, Colombia, the Philippines, Pakistan, India, and Malaysia Data sources include sample farm surveys conducted during the mid-sixties to early seventies, and, for some countries, 1960 or 1970 FAO agricultural censuses The following hypotheses are tested

(1) Output per unit of constant-quality land declines as farm size increases
(2) Between the early sixties and early seventies, this inverse relationship between land productivity and farm size weakened slightly, if at all
(3) Total social factor productivity, defined as the ratio of value added to total factor costs measured at social prices, also declines as farm size increases
(4) For any given farm size, land productivity is generally the same on land cultivated under sharecropping arrangements as on land cultivated by owners

Data from all six countries confirm the first hypothesis Tests of the second hypothesis are less conclusive Differences between small-farm and large farm output/land ratios appear to have remained fairly constant during the sixties in Brazil (at least in the northeast) In India and Pakistan, the differences appear to have lessened somewhat, apparently because large farms have benefited more from green revolution technology than have small farms However, the productivity differences were still substantial as of the early seventies Estimates of total social factor productivity for Brazil, Colombia, India, and Malaysia confirm the third hypothesis while estimates of land productivity on sharecropped and owner-cultivated land in Brazil, India, and the Philippines confirm the fourth hypothesis

Chapter five presents the obvious policy implications Redistribution of land from large farms to small

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If output per unit of constant-quality land is substantially higher on small than on large farms, redistributing land from large to small farms will increase both aggregate agricultural output and employment opportunities

family farms is clearly justified, not only in land-abundant countries such as Brazil and Colombia, but also in land-scarce countries such as India, Pakistan, Malaysia, and the Philippines However, where redistribution is not feasible politically, governments should consider alternative measures to assist small farms Facilities providing small farmers with "improved seeds, fertilizer, and other modern inputs" plus agricultural credit could be expanded Governments could also expand credit for land purchases by small farmers, or implement progressive land taxation to encourage voluntary land redistribution (p 137) However, the absence of any evidence that sharecroppers are less productive than owner-cultivators argues against laws limiting or prohibiting sharecropping

The apparent strong support given to land redistribution policies by Berry and Cline's statistical tests is weakened somewhat by the age of the productivity data The census data are now at least 10 years old, and even the latest sample surveys—conducted in 1973—are becoming outdated The possibility exists that the estimates of small farm/large farm productivity differences may no longer be valid today, especially for countries such as India and Pakistan where a trend towards reduction of these differences began as early as the midsixties If greater rates of adoption of green revolution technology by large farmers during the seventies have reduced these differences further, they may now be so small that land redistribution will have little effect on aggregate agricultural output

Berry and Cline's analysis is, therefore, most valuable to policymakers today not as direct input in policymaking but as a guide to the types of data that must be collected and the productivity/farm size relationships that must be estimated if correct decisions on land reform are to be made Policymakers who read this book should recognize that the most difficult land reform issue today is not that of analyzing land-related data but that of obtaining the data in the first place Berry and Cline underscore the need for much more effort to be directed toward solving the data gathering problem

In the past, data requirements for land reform studies have been met by farm surveys and by the much less frequent agricultural censuses Data bases usually vary considerably, which make intertemporal data comparisons and trend analyzes often difficult, as Berry and Cline point out Moreover, productivity statistics soon become outdated unless surveys and censuses are repeated more frequently than cost constraints generally allow Part of the cost problem is that sample farm surveys, such as the ones cited by Berry and Cline, usually generate data relevant only to a limited range of land-related issues Data relevant to other issues must come from additional surveys

In Earlier Issues

Too many agricultural economists are frightened by the word econometrics ... An unfortunate and erroneous impression appears to be current that econometrics is a particularly abstract branch of mathematics, and that only a chosen few can understand it

Frederick V Waugh
AER, Vol IV, No 3, pp 100-101
July 1952

The obvious method of reducing the costs of data collection is, therefore, the implementation of a single comprehensive land data system, or cadastre, which will maintain all land-related data needed for policymakers to formulate and administer the entire range of government-sponsored economic development programs, not just land reform For a given planning region, this data system could maintain separate records for all private ownership units For each record, data on location, size, ownership, and economic characteristics (land values, existing and potential uses, soil quality, and water availability) could then be maintained Thus, information relevant to productivity/farm size questions would be one of a variety of data items that would be routinely available Simple estimates of relative land productivity could be derived through a determination of the percentage of available farmland actually cultivated on each farm which contains land recorded in the land data system

With the assistance of the U S Agency for International Development, a number of developing countries—most notably the Dominican Republic and Honduras—have recently instituted cadastral programs to support land reform efforts These programs should be monitored closely to ensure that they provide sufficient data for policymakers to determine if output/land ratios actually are significantly lower on large farms than on small farms, the location of areas where productivity differences are most severe, and the location of large ownership units which have the lowest output/land ratios and which are, therefore, prime candidates for land redistribution

ECONOMICS AND DESIGN OF SMALL-FARMER TECHNOLOGY

Alberto Valdes, Grant M Scobie, and John L Dillon, editors The Iowa State University Press, Ames, 1979, 211 pp , $15 00

*Reviewed by Donald K Larson**

A message to the research community comes through clearly in this collection of papers by a distinguished group of scientists For new technology to be an attractive improvement on current technology, the subjective, ecological, and institutional constraints confronting the small farmer must be incorporated into an evaluation of such technology rather than recognized afterward This view is reflected throughout 10 papers presented at an International Conference on Economic Analysis in the Design of New Technology for Small Farmers held at the Centro Internacional De Agricultura Tropical (CIAT), November 26-28, 1975 The authors focused on the role of technological design at the farm level and the role of technology change in a context of small-farmer welfare and rural development

The foreword and introductory chapter set the stage for why prior evaluation needs attention The small farmer is an important client for new technology, which can increase food production and improve human well being in the less developed countries of the world However, technological benefits have not been shared equitably among agricultural producers, and new technologies have not always been readily accepted by small farmers New technologies must take into account the economic, social, and physical realities faced by small farmers These realities, interrelated and complex, have often been isolated for study by each appropriate discipline CIAT has recognized that multidisciplinary teams, involving biological and social scientists, are needed to develop technology that fits these realities

Authors of these papers examine alternative approaches to technology design and appraisal for small farmers and expose gaps in the existing concepts and techniques Culture, tradition, and environment, plus mechanisms of choice and available choices, introduce considerable heterogeneity that greatly complicates this task

The heterogeneity of small farmers is a widely recognized phenomenon that many researchers have faced while attempting to define and focus on the many issues important to small farmers Unless we have a full quantitative understanding of how small farmers react to and behave in the face of uncertainty, "it is most unlikely that ex ante appraisal can adequately reflect small-farmer reasoning on technology choice "

This book is well written and a valuable reference for economists and other professionals concerned with technology design in agriculture The papers are a refreshing mixture of economic theory and applied case studies along with some policy implications Although 9 of the 10 papers focus on Latin America, the analytical approaches can apply wherever technological design involving small farmers is considered Valuable comments by conference participants follow each article In addition, the book has a good reference section

However, this book goes beyond being useful only as a reference For full benefit, it must be read carefully and its many ideas compared The editors, in chapter 1, review the problems identified by the papers and discussions and pose a series of related questions that they feel need further, indepth study Chief among these are questions on priority of technology research and the welfare gain of consumers (including small farmers), the role of agricultural policy if small farmers are to capture benefits of new technology, changes needed in existing institutional structures before improved technology can benefit small farmers, and the lack of information about resources and psychological attributes of small farmers If these issues can stimulate the world research community, understanding the technology problems faced by small farmers will be advanced appreciably

In Earlier Issues

the subject of experimental design has grown to impressive, not to say formidable, proportions The average agricultural scientist must sometimes long for the good days, not too long past, when conducting an experiment was a simpler matter than it is today Whatever his feelings may be, he has come to accept the fact that he must learn to live with this thing that has beset him He should not be blamed too severely for seeking to make the process as painless as possible

Walter A Hendricks
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