



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

A New Approach to Estimating Agricultural Costs of Production

By George Hoffman and Cole Gustafson*

Abstract

Current concepts and procedures used by the U S Department of Agriculture (USDA) to estimate farm enterprise costs of production are inadequate for describing economic conditions of various producer groups. The 1981 Agriculture and Food Act gives USDA greater flexibility in estimating production costs. This article describes new procedures for developing estimates that deal with problems of unrealized farmland capital gains, cash flow, and returns to the resources of production.

Keywords

Costs of production, returns, land values, opportunity costs

Introduction

Substantial public debate in recent years has focused on costs-of-production (COP) statistics (4, 9, 10), especially since the Agriculture and Consumer Protection Act of 1973 required USDA to conduct COP studies.¹ Although the 1973 legislation did not tie farm program support levels directly to COP estimates, the 1977 act authorized adjustments in target prices based on changes in production costs. The Agriculture and Food Act of 1981 does not contain specific requirements for adjusting support prices (except for peanuts), however, the act does allow the Secretary of Agriculture to raise supports above established minimum levels to reflect increases in production costs.

In recent years farmers have expanded production for some commodities even when USDA estimates have shown that production costs are not being covered. If producers are rational, this suggests USDA cost estimates may have been too high, returns may

have been underestimated, or a combination of both may have occurred. A major conceptual problem with current methods could explain this situation. Current methods compare longrun costs, including full opportunity cost, with current returns for production. Thus, some returns from investment in agricultural production resources, primarily capital appreciation of farmland, are neglected when one compares total costs only with shortrun or current returns from production.

If COP figures are to be meaningful indicators for policymakers or are to be used to describe accurately the economic condition of producer groups, researchers must separate asset valuation criteria appropriate for full economic cost analysis from those appropriate for cash flow analysis. The Agriculture and Food Act of 1981 permits the modification of methods for valuing returns to operator supplied inputs, primarily land charges, labor, and management.

This article proposes new procedures for valuing and allocating the returns to resources used in production and a new format for reporting enterprise COP statistics. These new procedures separate current costs from longrun costs, thus making cash-flow analysis independent of full economic cost analysis.

*Hoffman is the Associate Administrator of ERS and Gustafson is an agricultural economist with the National Economics Division, ERS. The authors wish to thank Ken Baum, Richard Crom, Milton Ericksen, Henry Gilham, Verner Grise, David Harrington, Jim Johnson, Ronald Krenz, Gene Mathia, Thomas A. Miller, Robert E. Olson, and Hosein Shapouri for their contributions.

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

Problems in the Current Methods

Section 808 of the 1973 act specified that COP studies must include "a return on fixed costs equal to the existing interest rates charged by the Federal Land Bank (FLB)" and a "return for management comparable to the normal management fees charged by other comparable industries." These two provisions create major conceptual and estimation problems when the costs of production for selected commodities are computed.

Costs of labor, management, and equity in land and equipment are major components of total costs under current procedures, but they are implicitly estimated as opportunity costs. For example, about half the total cost of producing corn accrues from implicitly estimated opportunity costs. Consequently, small differences in assumptions concerning these imputed budget items can cause estimates of total costs to differ substantially. Because of the high proportion of opportunity cost imputations in the budgets, current production cost estimates may not accurately reflect economic conditions of the subsector.

Total returns may differ considerably from current ones when anticipated future returns are neglected. Future returns may be in the form of an increasing current income stream or (unrealized) appreciation of assets. Through the seventies, the capital gain on farmland was the primary future return associated with farming.

Use of the nominal FLB interest rate and current land prices to calculate opportunity costs for land overestimates land charges and total unit costs relative to observed commodity prices because this procedure ignores the effects of inflation. Current interest rates include an inflation component. Inflation also creates capital gains on land. Thus, if one uses nominal interest rates to estimate annual land costs, one should also include capital gains on land as a return—in addition to current returns from product sales.

Imputed charges for management and labor also pose conceptual and estimation problems when enterprise costs are established. Under current procedures, one includes the management fee in crop budgets by charging 10 percent of variable,

machinery ownership, and general farm overhead costs and in livestock budgets by charging 7 percent of the same components excluding livestock purchased. These rates are intended to approximate the fees professional farm-management firms charge for managing farms. However, it is unrealistic to assume that these flat rates approximate opportunity costs for all farm operators or that they should be applied equally for all commodities in all regions.

The requirements of the 1973 act concerning management charges could not be literally fulfilled. Industries directly comparable to agriculture and observable management fees comparable to those of business owners in other industries are not readily available. Furthermore, imputing comparable management returns by approximating a professional fee is inappropriate because the management component in a national average is supplied primarily by farm operators, not by professional farm managers. Basing management returns on an arbitrary percentage of costs may also incorrectly escalate the estimated management return when other costs rise. The likelihood that the percentage method will distort production costs greatly increases during periods when rapid inflation increases input prices.

New Methods

The economic principle guiding our proposed method for calculating and presenting COP estimates is to compare current returns with the value of inputs used in current production and to distinguish this comparison from investment costs which generate future returns.

In particular, the treatment of farmland must recognize implied investment and noncash returns flowing from investment in land. If future returns to assets are excluded (for example, realized after-tax capital appreciation of assets), then cost items should not include that portion of expenditures made for the express purpose of gaining future returns to assets. Rather, cost items should include only those costs necessary for generating current returns. If the farm enterprise budget costs are to be comparable with income from produced output, then the appropriate opportunity cost for land should be based only on the contribution of land to the current year's production.

This procedure requires some measure other than nominal interest rates (as previously required by law) as the basis for calculating the current year's land charges. Unfortunately, the appropriate method of valuing anticipated capital gains has yet to be settled (1, 2, 6, 7, 8)

Revised Format with the New Methods

Table 1 presents corn production costs for 1979 through 1981 under current procedures. Table 2 uses new methods for allocating returns to operator-supplied factors to estimate costs and returns for producing corn in the United States for the same 3-year period. Table 2 contains three major sections: (1) cash receipts, (2) cash expenses and returns, and (3) economic costs and returns to owned inputs, management, and risk.

Cash Receipts

Under the revised format, cash receipts include the current year's returns from primary or secondary products, excluding Government payments (table 2). Program payments are made when policymakers determine that market returns are either insufficient to provide adequate income in the short run or to elicit the desired level of production in the long run. Furthermore, program payments are often made in conjunction with production adjustments which affect costs. Because policymakers need to assess conditions without programs, to evaluate the need for and benefits of programs, cost information should exclude payment and cost adjustments.

In 1981, total returns were \$268.03 per acre, reflecting a national season average corn price of \$2.45 per bushel and an average yield per planted acre of 109.4 bushels.

Cash Expenses and Returns

The revised format breaks cash expenses into variable expenses and fixed expenses. Variable expenses are those incurred only if production takes place. Items in this category include seed, fertilizer, lime, chemicals, custom operations, fuel, repairs, irrigation, and drying—all of which are identified in the current format.

Table 1—Corn production costs, United States, current methodology

Item	1979	1980	1981
	<i>Dollars per planted acre</i>		
Variable			
Seed	12.41	14.23	16.26
Fertilizer	37.55	47.28	52.58
Lime	1.18	1.38	1.53
Chemicals	13.27	14.24	15.49
Custom operations	4.44	4.77	5.52
Labor	12.03	12.98	14.92
Fuel and lubrication	12.53	17.12	20.26
Repairs	8.99	10.25	11.82
Drying	6.36	6.62	8.60
Purchased irrigation water	.08	.09	.10
Interest	4.27	6.28	7.96
Total	113.11	135.24	155.04
Machinery ownership			
Replacement	23.00	25.29	28.73
Interest	14.29	19.61	25.11
Taxes and insurance	3.36	3.73	4.24
Total	40.65	48.63	58.08
Farm overhead	8.62	8.87	9.83
Management	16.24	19.27	22.29
Total, excluding land	178.62	212.01	245.24
Land allocation			
Composite, current value	107.91	133.73	138.84
Composite, acquisition value	59.32	65.58	64.03
	<i>Bushels</i>		
Yield per planted acre	109.6	90.1	109.4
	<i>Dollars per bushel</i>		
Variable	1.03	1.50	1.42
Total, excluding land	1.63	2.35	2.24
Total, to a renter			
Share renter	2.43	3.67	3.40
Cash renter	2.18	2.93	2.83
Average renter	2.30	3.27	3.10
Total, including land			
Composite, current value	2.65	3.93	3.71
Composite, acquisition value	2.13	3.05	2.90

Note: Composites include land allocation at average of share rent, cash rent, and charge based on current or acquisition value of owner-operated land.

The interest on operating capital (table 2) is the actual cash amount the operator and landlord pay. We explain a return to the equity capital used to purchase operating inputs in the following section on economic costs. For 1981, we assume that 32 percent of the annual capital needed to purchase inputs was financed at the Production Credit Association's (PCA) annual interest rate of 14.6 percent.

Table 2—Corn production costs and returns, United States, revised methodology

Item	1979	1980	1981
	<i>Dollars per planted acre</i>		
Cash receipts			
Corn	276 19	283 81	268 03
Cornstalks	0	0	0
Total	276 19	283 81	268 03
Cash expenses			
Seed	12 41	14 23	16 26
Fertilizer	37 55	47 28	52 58
Lime	1 18	1 38	1 53
Chemicals	13 27	14 24	15 49
Custom operations	4 44	4 77	5 52
Hired labor	0	0	0
Fuel and lubrication	12 53	17 12	20 26
Repairs	8 99	10 25	11 82
Drying	6 36	6 62	8 60
Purchased irrigation water	08	09	10
Management fees	0	0	0
Storage	14 62	11 94	14 50
Interest on operating capital	1 28	1 88	2 55
Total variable expenses	112 71	129 80	149 21
Taxes and insurance	8 11	9 25	9 70
General overhead	8 62	8 87	9 83
Interest	20 25	27 42	32 29
Total fixed expenses	36 98	45 54	51 82
Total cash expenses	149 69	175 34	201 03
Receipts less cash expenses	126 50	108 46	67 00
Capital replacement	23 00	25 29	28 73
Receipts less cash expenses and replacement	103 50	83 18	38 27
Economic costs			
Variable expenses	112 71	129 80	149 21
Taxes and insurance	8 11	9 25	9 70
General overhead	8 62	8 87	9 83
Capital replacement allowance	23 00	25 29	28 73
Total	152 44	173 21	197 41
Returns to owned inputs			
Operating capital (equity)	2 99	4 40	5 33
Other nonland capital	5 34	6 13	6 88
Land	59 07	71 27	70 92
Unpaid labor	12 03	12 98	14 92
Residual to management and risk	44 32	15 82	-27 39
Net returns to owned inputs	123 75	110 60	70 56
Prices for corn (dollars/bushel)	2 52	3 15	2 45
Yield per planted acre (bushels)	109 60	90 10	109 40

Hired labor and paid management fees represent two new cash expense items included in the variable expenses section. A return to operator-supplied labor and management is included in the economic cost section. Although both hired labor and management fees are zero in this example, future surveys will provide actual cash payments.

Cash storage expenses are included to the extent that farmers must store grain after harvest to realize the season average price used in determining returns. Information on the method and type of equipment used to store grain on farms is not currently available, but will also be provided by future surveys. As with unpaid labor above, the noncash costs of storage will be included in the economic cost section. The cost shown in table 2 is based on the annual Government storage payment rate of \$0.265 per bushel. We assume the corn must be stored 6 months to realize the season average price.

The budget does not include any cash premiums paid for crop insurance. This omission is consistent with the fact that indemnity payments do not appear as a return in the value of production section.

Fixed cash expenses include general farm overhead, taxes, insurance, and interest. These cash expenses are incurred whether or not production occurs. Taxes and insurance include personal property tax and insurance on machinery and equipment and real estate taxes paid on the land. Interest on non-land and land debt includes cash interest payments made by owner-operators and landlords. Principal payments are not included because they reflect a change in equity.

In 1981, average machinery investment per acre of corn planted totaled \$171.99. Here, we also assumed that 32 percent of the \$171.99 machinery investment per acre was financed at the nominal PCS annual interest rate of 14.6 percent.

We estimated cash interest paid on land debt in the example using the current 1981 land value of \$1,733 per acre. Because 88 percent of the land is owned debt free by owner-operators and landlords and the remaining 12 percent of owned land is encumbered (11), we arrived at the total interest per acre by first multiplying \$1,773 per acre by 12 percent and then by the average FLB interest rate of 11.4 per-

cent. Future surveys will provide cash interest paid on machinery and land debt

Subtracting the variable and fixed cash expenses from cash receipts leaves net cash income before replacement of depreciable assets. Excluding income taxes, this amount is the discretionary income that can be used for debt retirement, family living expenses, depreciable asset replacement, or other investments. It represents a short-run financial indicator of the operator's cash flow position for the average acre (for example, an acre of corn)

The capital replacement allowance is estimated just as in the current budget. As mentioned earlier, even though operators can postpone replacement of machinery and equipment in some years, over the long run they must replace both as each wears out. Net cash income after capital replacement leaves an amount that indicates long-run liquidity.

Economic Costs and Returns

The economic cost section of the revised enterprise budget attempts to place a value on inputs and resources required to produce the current year's crop without regard for ownership of the resource. If a resource is held with the expectation of receiving income from an additional source (for example, urban development rights), the calculated residual return will only cover that portion of the resource's value directly attributable to the production process. Any costs incurred for the express purpose of gaining an additional future return to the resource will be excluded.

The costs for variable inputs, taxes and insurance, general overhead, and capital replacement are the same in the economic cost and the cash expense sections. These expenses are incurred in the production process regardless of resource ownership. However, cash interest payments on debt are not included as economic costs because these payments vary according to the equity position of the resource owner. The cash expenditures of an owner with all assets debt free are significantly less than under situations with large amounts of debt, even though production takes place with similar technology. The economic cost section of the budget will allow comparisons of returns to the various enterprises with-

out regard to the equity owners have invested in land and operating capital.

Subtracting variable expenses, taxes and insurance, overhead, and capital replacement allowances from cash receipts leaves the net returns to owned inputs—land, labor, and capital. We used the opportunity cost principle to allocate total net returns to these factors with residual returns to management and risk being the balancing factor.

We assumed that farmland and operating capital are solely committed to agricultural uses. Because ours is an enterprise analysis, the alternative use for these fixed assets, derived from the opportunity cost framework, is a different enterprise. Therefore, to allocate total net returns to owned factors, we used a 4-percent real rate of return for owned land and operating capital—a rate approximating the observed long-run return to production assets in agriculture for the past 30 years (3, 5, 12).

The average current per-acre value of land used in corn-producing areas in 1981 was \$1,773. Multiplying this value by the 4-percent expected rate of return gives an annual resource cost of land of \$70.92. Likewise, the average 1981 machinery investment per acre of corn planted totaled \$171.99. If one uses the 4-percent return, the allocated cost was \$6.88.

Determining the opportunity cost of operating capital is conceptually more difficult, as the capital set aside to purchase variable inputs is not fixed in the short run. Each year farmers decide either to pay cash for variable inputs of production or to leave available money in an interest-bearing account. Of the total annual operating capital required in 1981, 32 percent was borrowed, and the associated cash interest cost is included in the cash expense section under interest on operating capital. In the economic cost section, the remaining 68 percent of annual operating capital is multiplied by the annual average 3-month Treasury bill yield of 14.1 percent to obtain the opportunity cost of equity operating capital.

To calculate the allocation for unpaid labor, one must first ascertain the total amount of labor required (as determined by the old methodology) less the hours of hired labor. The implied amount of un-

paid labor provided by the operator, family member, or other individuals is then charged as a cost by use of a hired-labor wage rate

After all the above costs and returns to owned inputs are subtracted from cash receipts, the return to management and risk remains as a residual. Although the return to risk over time would be expected to average close to zero, the return to combined management and risk should have a positive value over time, reflecting the managerial input needed to make operating decisions

Conclusion

The proposed methods convey substantially more information about the financial situation of the enterprise. The difference between cash costs and economic costs is clearly distinguished. Different measures of net returns are also presented, each with its own distinctive use in describing various aspects of financial conditions in the farm sector. The new methods permit comparisons among enterprises. The difference between income received and the total cost of purchased inputs is the residual return to owner-supplied factors—land, labor, and management. Over time, this residual indicates returns to these operator-supplied factors on an enterprise-by-enterprise basis. This residual return is a good way to compare the profitability of enterprises and to understand shifts in enterprise levels.

This method allows us to more easily develop whole farm budgets, develop more useful information about the distinction of cash cost and returns, and develop comparisons of cash costs and returns by farm size, type, tenure, region, and commodity produced.

References

- (1) Dunford, Richard W. "The Value of Unrealized Farm Land Capital Gains Comment," *American Journal of Agricultural Economics*, Vol 62, 1980, pp 260-62
- (2) Drynan, Ross G, and Ian D Hodge "The Value of Unrealized Farmland Capital Gains Comment" *American Journal of Agricultural Economics*, Vol 63, 1981, pp 281-82
- (3) Great Plains Agricultural Council "Developing and Using Farm and Ranch Cost of Production and Returns Data—An Appraisal" Report No 104 University of Nebraska, 1980
- (4) Gustafson, Cole "Costs of Producing Crops, Livestock, and Milk in the United States—1975-1981" ERS Staff Report No AGES830128 U S Dept Agr, Econ Res Serv, 1983
- (5) Melichar, Emmanuel "Capital Gains Versus Current Income in the Farming Sector," *American Journal of Agricultural Economics*, Vol 61, 1979, pp 1085-92
- (6) Plaxico, James S, and Darrel D Kletke "The Value of Unrealized Farmland Capital Gains," *American Journal of Agricultural Economics*, Vol 61, 1979, pp 327-30
- (7) _____ "The Value of Unrealized Farmland Capital Gains Reply" *American Journal of Agricultural Economics*, Vol 62, 1980, pp 263-64
- (8) _____ "The Value of Unrealized Farmland Capital Gains Reply," *American Journal of Agricultural Economics*, Vol 62, 1981, pp 283-84
- (9) U S Department of Agriculture, Economic Research Service "Costs of Producing Livestock in the United States—Final 1979, Preliminary 1980, and Projections for 1981" U S Senate Committee on Agriculture, Nutrition, and Forestry Committee Print 72-550, 1981
- (10) _____ "Costs of Producing Selected Crops in the United States—Final, 1979, 1980, and Preliminary for 1981" U S Senate Committee on Agriculture, Nutrition, and Forestry Committee Print 93-848, 1982
- (11) _____ "Economic Indicators of the Farm Sector Income and Balance Sheet Statistics, 1981" ECIFS.1-1 1982, p 120
- (12) Watts, Myles J, and Glenn A Helmers "Inflation and Machinery Cost Budgeting," *Southern Journal of Agricultural Economics*, Vol 11, No 2, 1979, pp 83-88