IMPACT OF CAPITAL GAINS TAXATION ON FARM ORGANIZATION: IMPLICATIONS FOR MEAT ANIMALS PRODUCTION ON DIVERSIFIED FARMS

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Agricultural economists have devoted considerable research efforts to measuring aggregate capital gains accruing to the U.S. agricultural sector and their effect on the welfare of farm families (Bhatia, Evans and Simunek, Hoover, Melichar and Sayre). A specific research issue concerning capital gains is preferential treatment under federal income taxation statutes. Carmen (1968, 1969) outlined the general tax shelters provided by capital gains taxation and explored the example of beef breeding herds in some detail. Vandeputte and Baker demonstrated that preferential capital gains taxation encourages extensive rather than intensive farm firm growth.

A relatively neglected research area is the impact of special income taxation treatment of capital gains on farm enterprise organization. This paper demonstrates that the current system of income taxation encourages meat animal production on diversified farms. In addition, this tax incentive is demonstrated to increase as farm income increases. Using linear programming methods, the theoretical reasoning is confirmed empirically for diversified farm situations which are representative of South Central Georgia.

ANALYTICAL FRAMEWORK

In farm organization studies, the typical methodology involves determination of the combination of enterprises that maximize profits before income taxes. To evaluate the impact of income taxes on farm organization the objective function must incorporate income taxes:

$$(1)\quad PAT = \sum_{i=1}^{n} P_i X_i - t \cdot TI$$

where PAT is profit after taxes

X_i are farm inputs and outputs

P_i are prices of inputs and outputs

t is the average income tax rate

TI is taxable income.

Under current tax rules, TI can be defined as follows:

$$(2)\quad TI = \sum_{i=1}^{m} P_i X_i + \tfrac{1}{2}\sum_{i=m}^{n} P_i X_i - PD$$

where $X_1, X_2, \ldots X_m$ are commodities subject to ordinary income tax

$X_{m+1}, X_{m+2}, \ldots X_n$ are commodities subject to capital gains tax

PD is the sum of personal exemptions and deductions.

To examine the tax advantages associated with income in the form of capital gains, (2) can be substituted into (1), and (1) rewritten as:

$$(3)\quad PAT = (1-t)\cdot \sum_{i=1}^{m} P_i X_i + (1-\tfrac{1}{2})\cdot \sum_{i=m}^{n} P_i X_i + t\cdot PD$$

In this formulation, capital gains clearly have a higher after-tax value than an equivalent amount of ordinary income.

The impact of this income tax effect on enterprise organization can be examined in an after-tax profit maximization model of a multiproduct firm. In this model, (3) is maximized subject to (2) and the following conditions:

$$(4)\quad F(X_1, X_2, \ldots X_n) = 0$$

and $(5)\quad t = t(TI)$.

Equation (4) is a standard multiproduct production function and equation (5) is necessary to incorporate the effects of the progressive income tax structure on the objective function.

The first order conditions for maximization of this model can be derived by taking the first differentials of the equations with the methods discussed in Allen (pp. 332-334) and setting dPAT = 0. If all inputs and all outputs except X_j, an enterprise with ordinary income, and X_k, an enterprise with all capital gains income, are held constant, the optimal marginal rate of transformation between X_j and X_k can be derived:

$$(6) \quad -\frac{\partial X_j}{X_k} = \frac{F_k}{F_j} = \frac{[1-\frac{1}{2}t-\frac{1}{2}TI\cdot t'(TI)]\ P_k}{[1-t-TI\cdot t'(TI)]\ P_j}$$

where F_k and F_j are partial derivatives of (3) and $t'(TI)$ is the first derivative of (5).

Under the standard assumption of increasing rate of transformation, the larger value of the rate of transformation on an after-tax basis specifies that more of X_k will be produced if the objective is to maximize after-tax profits rather than before-tax profits.

An interpretation of (6) is helpful in understanding the impact of capital gains taxation on enterprise organization. The price ratio with income taxes has three terms in both the numerator and denominator: the first is the gross revenue from a unit of output, the second is the amount of income taxes associated with the enterprise, and the third is the change in income taxes resulting from a change in the average tax rate due to a change in taxable income from a change in output. It can be noted that the differences in the price ratios due to consideration of income taxes results from the special treatment of capital gains. Both of the ½'s in the numerator are a result of only one-half of capital gains being subject to income taxation (Equation (2)). A corollary of this position is that income taxes would not have any effect on the relationship between two enterprises both

subject to the same tax rules - the bracketed terms in (6) would be exactly the same.

With the progressive income tax structure in the United States, the average tax rate increases as taxable income increases ($t'(TI)>0$) up through very large taxable incomes. The impact of this increase on the optimal combination of enterprises can be shown by evaluating the tax adjustment factor in equation (6) at various points on the U.S. income tax rate schedule. Using the tax table for married taxpayers filing joint returns, the factor is 1.318 for $30,000, 1.499 for $50,000, and 1.612 for $70,000 (U.S. Internal Revenue Service, 1974). Thus, increasing taxable income is associated with increasing levels of enterprises with capital gains.

The relationships expressed in the algebra in this section can be geometrically summarized in Figure 1. The tangency defined at A is the before-tax situation. After taxes are considered, the slope of the iso-revenue line becomes larger and point B is the optimal - which is associated with more X_k and a larger after tax income than A. As taxes increase more, P''/P_j'' becomes relevant and the optimal point becomes C which has even more X_k, the enterprise with capital gains income. In analysis of organization of diversified farms, selection of enterprises with consideration of after-tax profits rather than before-tax profits will result in an increase in the level of enterprises that have income in the form of capital gains. These enterprises would include livestock breeding herds, orchards, and forests. More importantly, the level of these enterprises on diversified farms would be expected to be increasing over time in the United States. Inflation, farm size expansion, and increasing off-farm income

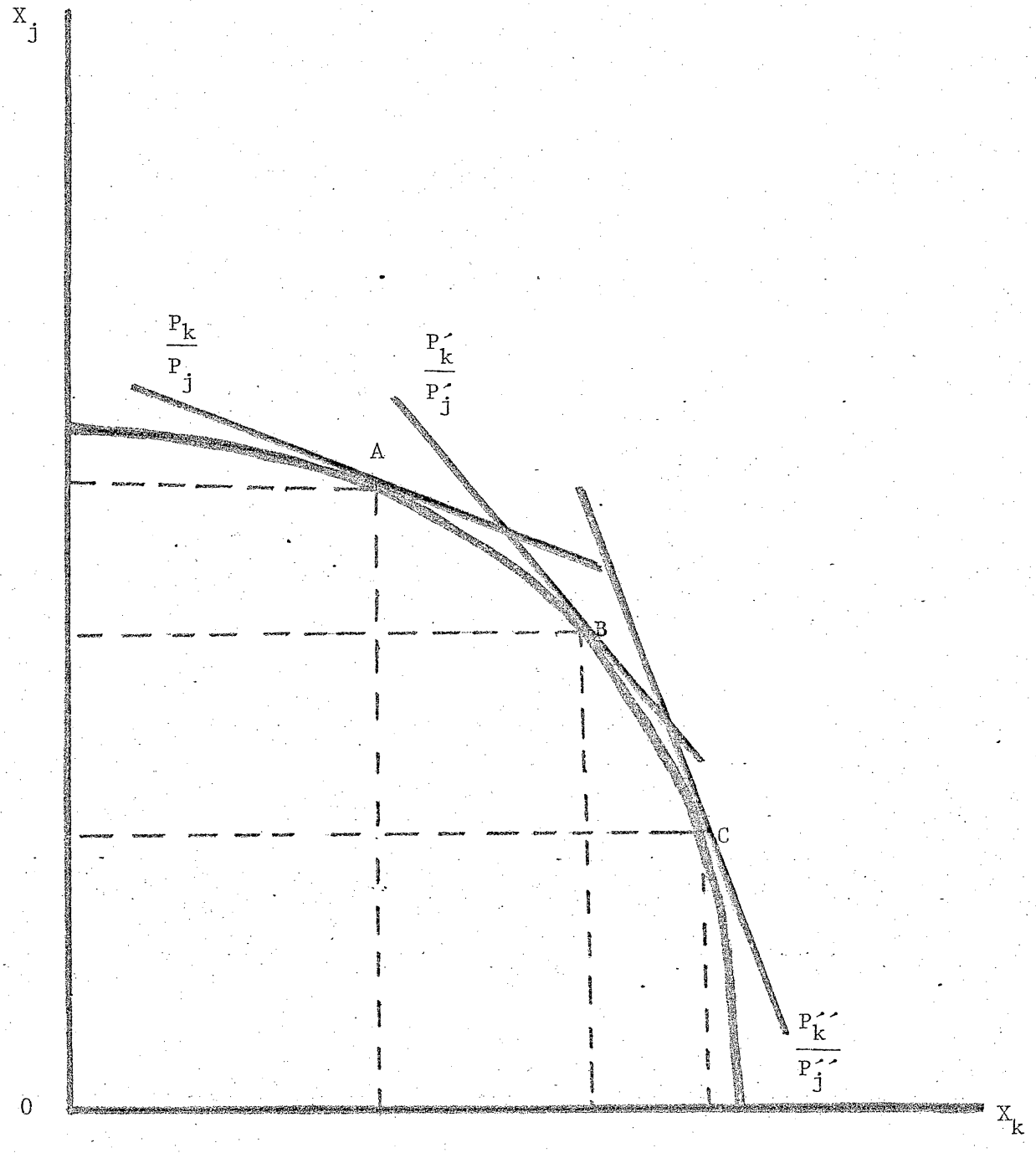

Figure 1. The Impact of Capital Gains Taxation on Optimum Farm Organization

are combining to increase the level of family income and therefore the incentives to include enterprises with capital gains.

METHODOLOGY

The theoretical propositions developed in the previous section were tested with a linear programming model of representative farm firms. Westberry developed the basic model which was used in this study to reflect technology and prices in the early 1970's. Two farm sizes were used in the study to examine the effect of increasing income tax rates on farm organization: one farm had 400 acres of land and one full-time resident worker while the other had 600 acres and two full-time workers. The possible enterprises included row crops, livestock, and forestry activities representative of South Central Georgia. The major enterprises and their budgeted net incomes are reported in Table 1.

The net income from the enterprises was divided into ordinary farm income and capital gains according to 1972 federal income tax regulations (U.S. Internal Revenue Service, 1973). As shown in Table 1, all income from crops was ordinary income, that from pine trees was all capital gains, and that from livestock was both ordinary income and capital gains. On the livestock enterprises, gross revenue from sale of cull cows and sows were considered capital gains while the difference between gross revenues from sales of calves or market hogs and the respective enterprise expenses were ordinary income. In the case of the beef cow-calf enterprise, capital gains were more than net income so that an ordinary loss exists which illustrates the familiar tax advantage of beef cow herds. In the hog enterprises, capital gains and positive ordinary income existed for both enterprises. System B involved heavier culling and smaller production per

Table 1. Distribution of Net Income Between Ordinary Income and Capital Gains for Enterprise Alternatives on Analytical Farms

Enterprise	Unit	Net Income		
		Total	Ordinary	Capital Gain
			(Dollars)	
Tobacco	acre	1035.42	1035.42	-
Peanuts	acre	230.00	230.00	-
Cotton	acre	199.50	199.50	-
Soybeans:				
First crop	acre	50.09	50.09	-
Second crop	acre	35.42	35.42	-
Wheat	acre	31.33	31.33	-
Oats	acre	6.31	6.31	-
Corn	acre	52.52	52.52	-
Grain sorghum	acre	3.17	3.17	-
Hay	acre	106.65	106.65	-
Hogs:				
System A[a/]	12 sows	2732.12	2150.86	581.26
System B[b/]	12 sows	2664.75	1502.23	1162.52
Beef cow-calf[c/]	30 sows	164.39	(475.81)	640.20
Pine trees	acre	8.45	-	8.45

a/ Sow is culled after 4 litters (2 years), 10 pigs born alive per litter, 8% death loss prior to weaning, and 1 pig in 4 litters held for replacement.

b/ Sow is culled after 2 litters (1 year), 9 pigs born alive per litter, 9% death loss prior to weaning, 1 pig in 2 litters held for replacement.

c/ Cow is culled after 10 calving seasons, 9 calves weaned per 10 cows, 1 heifer per 5 weaned calves held for replacement, and 1 heifer per 2 held for replacements sold as a yearling.

litter compared to System A. System B had lower net income but a larger proportion of capital gains than System A.[1]

The empirical research had two steps. First, a standard profit maximization solution was derived for both farm sizes to determine the before-tax enterprise combination. Then, the methods of Vandeputte and Baker were utilized to augment the matrix to include income tax activities. Again, 1972 tax regulations were utilized to derive the tax activities. It was assumed that the farm income was taxed under married filing jointly rates with four exemptions and a standard personal deduction. With a further assumption of no off-farm income, the first $5,000 of income was tax-free (U.S. Internal Revenue Service, 1974). After-tax profit maximization solutions were derived to reflect this tax situation.

The inclusion of federal income taxes in the linear programming tableau is illustrated in Table 2. Adjustment of the solution to an after-tax basis requires two additional rows and a series of tax activities. The Taxable Income Constraint has entries from all activities which generate costs or returns applicable to income taxation. The entries for activities subject to ordinary income, such as Sell Soybeans and Produce Hogs duplicate the entries in the objective functions. For activities subject to capital gains taxation, such as Sell Cull Sows, only one-half of the objective function value is entered in the Taxable Income Constraint. Since this constraint must equal zero, the solution must include a positive level of income tax activities to exactly balance the taxable income from

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[1]Van Arsdall's hog budgets were used to adapt Westberry's analysis in deriving the hog systems for this research.

Table 2. Partition of Linear Programming Matrix Illustrating Income Taxation in a Farm Organization Model

	Produce Soybeans	Sell Soybeans	Produce Hogs	Sell Market Hogs	Sell Cull Sows	Income Tax Activities				Constraint Levels
						45,000	49,000	57,000		
	($/Ac.)	($/Bu.)	($/12 Sows)	($/Lb.)	($/Head)	($)	($)	($)		
Objective Function	-54	2.97	-3020	.27	99.36	-12,140	-14,060	-18,060	=	Max
Taxable Income Constraint	-54	2.97	-3020	.27	49.68	-45,000	-49,000	-57,000	=	0
Progressive Tax Constraint						1.0	1.0	1.0	=	1.0

production activities. The income tax activities reflect all income levels at which the marginal tax rate changes. In addition, these activities reflect tax-free income; for example, the tax bill of $14,060 at $49,000 income is the tax liability in the tax tables for $44,000 taxable income. The final feature of this matrix is the Progressive Tax Constraint which guarantees that a combination of tax activities consistent with actual taxable income are included in the constrained solution.

The number of tax activities included in the model depends on prior knowledge of the relevant level of taxable income for the farm situation. At the extreme, a tax activity could be included for every income level with a change in the marginal tax rate. However, some reasonable limits typically exist. For example a before-tax solution can define the maximum taxable income and several lower brackets can also be included.

EMPIRICAL RESULTS

The optimum enterprise levels and alternative income levels from the empirical analysis are summarized in Table 3. The beef cattle enterprise was not competitive in this model on either farm size in both the before and after tax solution. However, hog enterprises were in all solutions along with crop and pine tree enterprises. As expected, net income was lower in after tax solutions than in before tax solutions while after-tax income and capital gains were higher in the after-tax solutions.

The most dramatic differences between the before-tax and after-tax solutions were in the hog enterprises. On both sizes, the number of sow units increases. In addition, System B was included in the after-tax solution while System A was included in the before-tax solution. Another measure of increase in hog activity was the increase in liveweight produced

Table 3. Effect of Capital Gains Taxation on Enterprise Organization for Analytical Farms

Item	Unit	Optimum Farm Organization: 400 acre farm: Before tax	400 acre farm: After tax	400 acre farm: Change Units	400 acre farm: Change Percent	600 acre farm: Before tax	600 acre farm: After tax	600 acre farm: Change Units	600 acre farm: Change Percent
Peanuts	acre	31.2	31.2	-	-	46.8	46.8	-	-
Cotton	acre	25.7	25.7	-	-	38.6	38.6	-	-
Tobacco:									
Produce	acre	3.7	3.6	-.1	-3.	8.7	7.9	-.8	-9.
Lease out	acre	6.6	6.7	+.1	+2.	6.7	7.6	+.9	+13.
Soybeans/second crop	acre	61.6	62.9	+1.2	+2.	62.5	67.9	+5.4	+9.
Wheat	acre	61.6	62.9	+1.2	+2.	62.5	67.9	+5.4	+9.
Hay	acre	33.9	30.0	-3.9	-12.	50.9	36.7	-14.2	-28.
Pine trees	acre	91.9	94.8	+2.9	+3.	135.5	145.9	+10.4	+8.
Hog production:									
System A	sow	24.5	-	+6.2	+25.	51.0	-	+23.1	+45.
System B	sow	-	30.7			-	74.1		
Liveweight produced	cwt.	948.5	1,113.8	+165.3	+17.	1,974.5	2,688.6	+714.1	+36.
Net income	dol.	34,978.0	34,860.2	-117.8	a/	54,927.0	54,599.2	-327.8	-1.
Capital gains	dol.	1,957.0	3,762.3	+1,805.3	+92.	3,602.0	8,398.8	+4,796.8	+133
Adjusted gross income	dol.	33,999.5	32,979.0	-1,020.5	-3.	53,126.0	50,399.8	-2,726.2	-5.
Taxable income	dol.	28,999.5	27,979.0	-1,020.5	-4.	48,126.0	45,399.8	-2,726.2	-6.
Tax	dol.	7,490.0	7,092.4	-397.6	-5.	16,123.0	14,759.9	-1,363.1	-8.
After tax income	dol.	27,488.0	27,767.8	+279.8	+1.	38,804.0	39,839.3	+1,035.3	+3.

a/ Less than a 1 percent change.

under both farm systems. The labor resources to produce the extra hogs was obtained from reduction in tobacco production which has heavy seasonal labor requirements. A shift in crop organization from hay production, which is highly seasonal in labor requirements, to double-crop soybeans and wheat, which are fairly even in seasonal labor requirements, also aided in meeting the hog labor requirement. Adjustments also occurred in other crop enterprises.

While the shift to hog production with consideration of income taxes occurred on both farm sizes, the effect was greater on the larger farm with a higher tax bracket. Number of sows increased 6.2 units or 25 percent on the 400 acre farm compared to 23.1 units or 45 percent on the 600 acre farm. Similar results hold for liveweight pork production - a 17 percent increase on the 400 acre farm compared to a 36 percent increase on the 600 acre farm. The differential reallocation of resources to the swine enterprises with consideration of income taxes is also apparent in the response of capital gains which increased 133 percent on the large unit and 92 percent on the smaller unit.

CONCLUSIONS AND IMPLICATIONS

The research in this paper demonstrated theoretically and empirically that the existence of differential income taxation of capital gains provides incentives to increase meat animals production on diversified farms relative to crop production. While the tax advantages were greatest for beef breeding herds, they were not sufficient to make beef herds competitive on the representative diversified farm considered in this research. However, consideration of income taxes did increase hog production, with the response being greater on the larger farm. Furthermore, consideration

of capital gains resulted in a switch in organization of the swine enterprise to a heavier culling of sows and a higher proportion of capital gains to ordinary income from the swine enterprise. While capital gains taxation has potentially more impact in land and beef cattle management, this paper indicates that an impact exists in hog production which has been ignored in the literature.

The increased importance of capital gains in farm organization as average tax rates increase has some important implications for agricultural production research and policy. As the income of farm families increases with increases in farm size, inflation, and increases in off-farm income, the potential impact of income taxes on farm organization increases. Farm organization studies of commercial farms should therefore consider adopting after-tax profits as the firm objective. In terms of aggregate agricultural production, present income tax laws generate a supply response in meat animal animals as farm income increases. Furthermore, elimination of special capital gains classification of income for taxation, which is a common tax reform proposal, would be expected to decrease production of meat animals.

A few comments on the efficiency implications of capital gains taxation of livestock breeding herds are appropriate. The increased production of livestock in response to preferential capital gains taxation violates the marginal conditions for Pareto efficiency which result in inefficient organization of agricultural production. However, second-best theory is appropriate in this consideration. In 1972, all the crops in the model except soybeans were subject to various government programs which distorted the gross income from these enterprises from competitive levels. It is

possible that the income tax advantages of livestock in combination with historical crop income support programs were closer to a welfare optimum than without capital gains taxation. These efficiency implications warrant further research efforts.

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