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Taxation

Tax Policy and U.S. Agriculture:
A General Equilibrium Analysis

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Hertel, T.W. and M.E. Tsigas--Tax Policy and U.S. Agriculture: A General Equilibrium Analysis.

This article employs a computable general equilibrium model to analyze the effects of eliminating farm and food tax preferences in 1977. Tax differentials on capital income, labor payments, and production and sales taxes are each examined. Results indicate that these combined preferences lowered food costs by about \$4.5 billion, while enhancing after tax returns to farm land, labor, and capital. The associated general equilibrium tax expenditure is estimated to have been between \$5.5 and \$6.6 billion. American Journal of Agricultural Economics.

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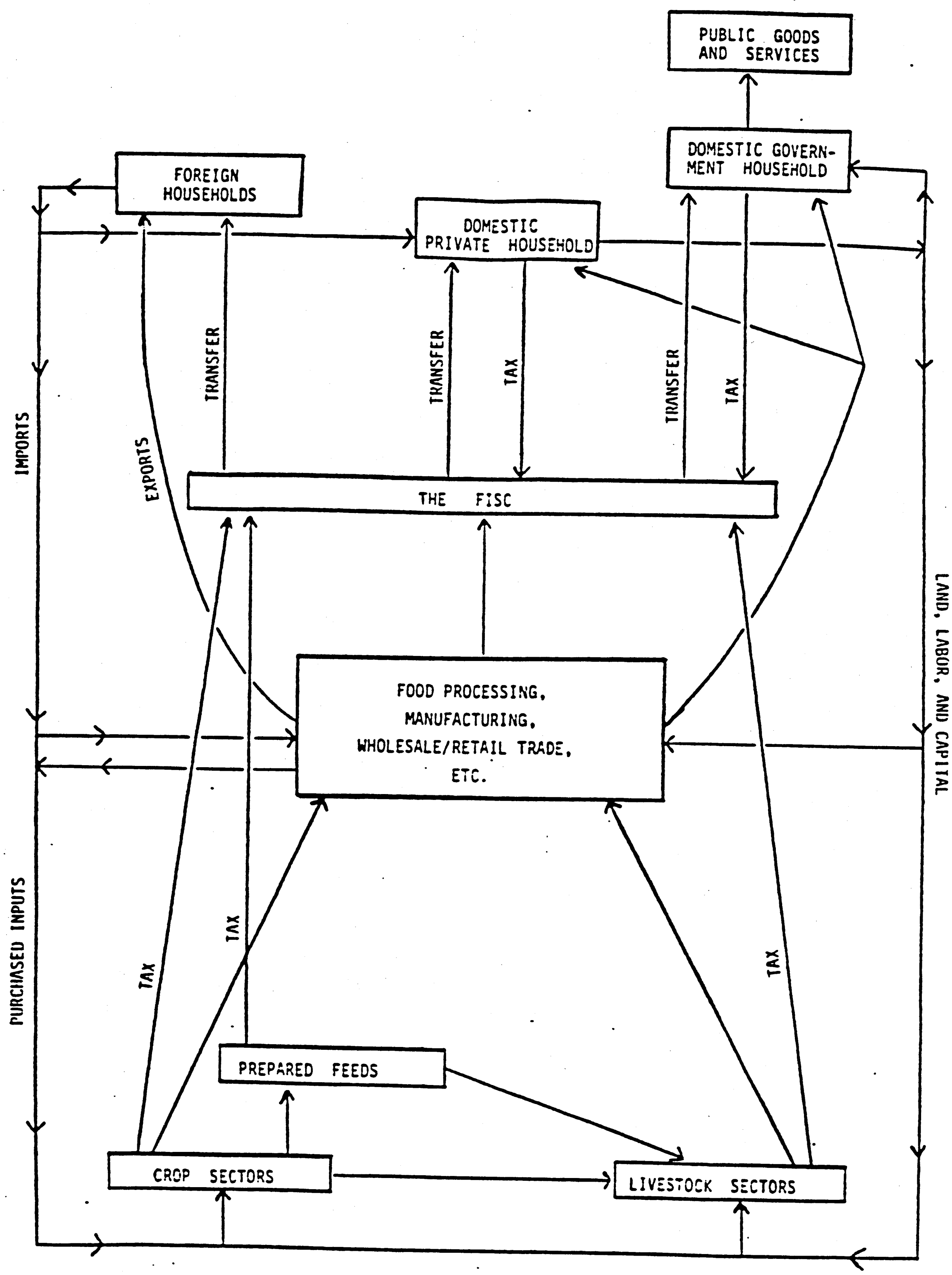
The partial equilibrium impact of income tax policy on U.S. agriculture has received considerable attention from agricultural economists (e.g., Woods, Sisson, Boehlje and Carman, Hrubovcak and LeBlanc). Research in this area was stimulated by major income tax reform legislation in 1986. The analysis in this article does not address the most recent tax reform *per se*. Rather it provides an historical analysis of the preferential tax treatment of the farm sector over the 1970's. The article's scope extends beyond the income tax to consider other taxes which differentially affect farm and food products. These include: social security contributions by employees and their employers, other social insurance payments for employees, property taxes, excise taxes, and sales taxes. A computable general equilibrium (CGE) model is employed to conduct counterfactual experiments in which these tax differentials are eliminated. The resulting impact on prices, output, government outlays, and household welfare are then examined.

A U.S. CGE Model With an Agricultural Emphasis

Figure 1 portrays the circular commodity flows in the CGE model used in this study. Crop and livestock farms (see bottom of figure) are highlighted. They rent primary input services (land, labor, and capital) from the private domestic household. These are combined with intermediate inputs (both domestic and imported) to produce farm products. Commodities also flow from the crop sector to the livestock sector, in part via the prepared feeds industry.

Raw farm products pass through the rest of the economy, generally receiving some additional value-added, before being sold to domestic households or exported. These food products compete with non-food commodities and imports in the product markets. (See Hertel and Tsigas for a complete listing of the 40 sectors included in this model.) The agricultural sectors also compete with non-farm firms in the factor markets.

Figure 1: Real Flows in the Economy



Government functions are divided into two components. The first involves the provision of public goods and services by the government "household". Since these products are assumed "non-rival" in consumption, their demands are not explicitly modeled. (However, their supply can be measured by real government outlays on private goods and services which are endogenously determined.) Treasury activities are handled by the "fisc", which collects all tax revenues from product and factor market transactions. (Subsidies are simply negative taxes.) These revenues are then distributed to the government, private, and foreign households. Any deficit financing is handled by a lump sum tax on (negative transfer to) the relevant households.

Relative Farm and Non-farm Tax Rates

In evaluating the general equilibrium effect of taxes on the farm sector, policies that alter the cost of capital to all sectors of the economy (e.g., the investment tax credit) must be distinguished from those with differential effects on agriculture. Hughes and Adair's analysis of the 1981 federal tax cut falls into the former category. In their study increases in the cost of capital to the farm sector (due to higher interest rates and capital input prices) more than offset the cut in farm tax rates. Our study examines tax policies which affect agriculture differentially. We conduct a series of counterfactual experiments holding tax rates in the rest of the economy constant, while eliminating the differential between farm and non-farm sectors.

Using data from the 1960's, Sisson documented the differential taxation of farm and non-farm households. He attributed lower tax rates faced by farm households primarily to the special capital gains treatment of farm assets such as breeding and dairy livestock and orchards. This treatment was "preferential" because development expenses were written off immediately against current income (rather than being capitalized) while proceeds from sale of the asset qualified as capital gains. Carman documented the commodity market effects of such capital gains provisions for California orchard crops. Cash accounting has also yielded important income tax benefits for farmers (Davenport, et al.).

The basic tax rates in this study are derived from Ballard, Fullerton, Shoven, and Whalley (BFSW).[1] (As in BFSW, all taxes are approximated in an ad valorem manner.) However, those authors did not incorporate any of the income tax provisions, noted above, which are unique to the farm sector. Thus the tax rates on capital in each of the seven agricultural sectors in the model must be modified.

Factor Taxes on Capital

An attractive feature of the BFSW study is their treatment of interactions between the personal income tax (PIT) and the sectoral cost of capital. BFSW capture this effect by levying the personal income tax on capital at the firm level. This personal factor tax (PFT) is given by: $PFT_i = f_i \, CAP_i \tau$, where CAP_i is capital income received by households from sector i, and f_i is the portion of this capital income that is taxable at the marginal PIT rate τ. The fraction f_i is a weighted average of each type of capital income, where the weights correspond to the fully taxable portion. (Details are provided on pp. 67-72 of BFSW.) Capital income consists of dividends, retained earnings, interest, monetary rent, and non-corporate income. This comprises the denominator of f_i. In addition to the weighted sum of the components of CAP_i, estimated capital gains and the negative of the non-corporate investment tax credit are added into the numerator of f_i. These affect tax payments, but are not included in CAP_i. For this reason f_i can exceed one when estimated capital gains are relatively large.

In order to incorporate farm income tax preferences into the BFSW framework, the results of Hanson and Eidman (for a sample of farms over the period 1973-78) were employed to infer a relationship between federal tax expenditures and sales for four farm types: crop, hog, dairy, and feeder cattle operations. Benefits were computed for cash accounting and capital gains treatment of livestock sales.[2] Cash accounting was assumed to lower the personal tax rate (τ) faced by farm households. After applying the estimated tax expenditures, the personal tax rates are reduced from BFSW's $\tau = .278$, to the rates shown in column 1 of Table 1.[3] Capital gains treatment of livestock sales results in livestock sector income being taxed at less than the full rate. Applying these estimated tax expenditures to the dairy and red meat sectors results in a lower value of f_i.[4] The disaggregated f_i's for the seven agricultural sectors are shown in column 2 of Table 1.

Personal factor tax rates are shown in Table 1, column 3. Although all agricultural sectors benefit to some degree, the dairy sector experiences the most significant capital tax rate decline as a result of these tax expenditures. The total effective gross tax rate is computed by adding personal factor taxes to capital taxes actually levied on the firms (corporate and property taxes), and dividing the sum by gross factor payments.[5] The results are summarized in the final column of Table 1. Two points warrant special mention. First, BFSW's addition of differential personal factor tax rates tends to equalize the average tax rate on farm capital and all U.S. industry capital. [The ratio of the former over the latter increases from .2367 (column 4) to .7122 (column 5)]. This is due to the relatively large value of f_i for agriculture. Second, note that cash accounting and capital gains provisions introduce considerable variability in tax rates across farm sectors.

Other Taxes

Other taxes in the model come directly from the BFSW study. The tax on labor at the industry level includes employer contributions for social insurance and both employer and employee contributions for social security. Because many agricultural workers are not covered by these insurance programs, the effective gross labor tax rate is low (.0656) compared to the industry average (.0918) (Ballard, et al., p. 58). Sectoral variability among the non-

Table 1. Derivation of Agricultural Capital Tax Rates Used in the Study.

Sector	(1) Personal Tax Rate	(2) f_i	(3) Personal Factor Tax Rate (1) x (2)	(4) Industry Tax Rate	(5) Total Effective Tax Rate
Dairy	.203	.527	.107	.078	.177
		(1.089)[a]	(.221)[a]		(.282)[a]
Poultry	.256	1.096	.280	.093	.347
Red Meat	.256	.841	.215	.074	.273
		(1.074)[a]	(.275)[a]		(.328)[a]
Food Grains	.254	1.009	.256	.065	.304
Feed Grains	.254	.963	.244	.068	.296
Oil Crops	.254	1.076	.273	.094	.341
Other Agriculture	.248	1.070	.266	.088	.330
BFSW estimates:					
Agriculture	.278	1.053	.2929	.0817	.3507
All Industries	.278	.816	.2268	.3451	.4924

[a] These rates abstract from the effect of livestock capital gains treatment, reflecting only the cash accounting effect.

agricultural sectors is due to differential insurance coverage, the income cap on social security taxes, and differential unemployment insurance payments.

Output taxes include federal excise taxes and custom duties, public utility taxes, severance taxes, occupation and business taxes, license and inspection fees, and other miscellaneous items. These taxes are relatively small for most sectors (Ballard, et al., pp. 84-85).[6] Sales taxes are treated as consumer expenditure taxes, as are the excise taxes on alcoholic beverages and tobacco. The absence of sales taxes on food in many states results in a lower than average gross tax rate on consumption (.0409 vs. .0640 for all industries combined, Ballard, et al., pp. 96-97).

The final tax required by the model falls on labor income. Since private households are aggregated and labor is inelastically supplied, this tax has no allocative effects in the model. Rather than use BFSW's average of marginal rates across households (τ), the labor income tax is selected to provide enough revenue to cover government expenditures, less the amount of the federal deficit, for the 1977 benchmark data set. The latter is further discussed below.

Model Specification

In Keller's CGE model the structure of the economy is approximated in the neighborhood of a particular point of interest, with a set of log-linear equations. This concept of a local approximation is compatible with recent work on consumer and producer behavior (e.g., Fuss and McFadden). Most of this research is conducted with flexible functional forms designed to provide a local, second-order approximation to the true, but unknown production/utility structure (Diewert). Since these unrestricted elasticities are only valid in the neighborhood of the approximation, the results from this CGE model, which employs estimates from several flexible demand systems, will only be locally valid as well.

Two types of information are required by the Keller model. Information concerning net expenditures by all agents in the initial equilibrium situation generates the (locally constant) expenditure shares in the behavioral equations for firms and households. Based on initial prices (which will differ among firms and households in the presence of taxes), equilibrium quantities may be extracted from the equilibrium expenditures. These quantities generate the share-weights which are used to aggregate the behavioral equations of firms and households to the market level where the general equilibrium solution is obtained. The second type of information describes marginal responses to changes in prices, output, and income.

Expenditures in Initial Equilibrium

The economy-wide set of accounts developed for this study builds primarily on the 1977 input-output table and the national income and product accounts (Hertel and Tsigas). A condensed version of this benchmark equilibrium data set is reported in Table 2, which reports net expenditures by industries and households on goods and services. The first row of Table 2 describes the sales and purchases of aggregate net output of the 40 producing sectors. This totals $1.87 trillion. Final demands for these products include: investment of $373 billion, private consumption of $1.28 trillion, government purchases of $187 billion and exports of $140 billion. Because of output and consumption taxes, consumers pay more than producers receive. Since outlays are positive and receipts are negative, this gives rise to a positive row total (tax revenue).

We follow Johansen and Keller by introducing a "dummy" capital goods sector to collect and distribute investment goods. Replacement investment equals purchases of scrap and depreciation, and is entered in the capital goods row for the 37 non-livestock sectors. (Livestock sectors are assumed to generate their replacement investment internally.) The remaining portion of capital

Table 2. Net Expenditures at Net Prices: 1977 (Million $). (Receipts are indicated by negative expenditures).

	40 Industries	Capital Goods	Domestic Households Private	Domestic Households Government	Foreign Household	Row Total (Taxes)
40 Industries	-1,873,031	373,490	1,284,635	187,357	140,346	112,797
Capital Goods	218,102	-349,275	251,031	847	1,560	122,265
Imports	161,496	53	1,551	4,135	-167,235	0
Labor Services:						
• Farm	20,957	0	-18,796	0	0	2,161
• Non-Farm	1,015,690	0	-1,063,521	203,674	-29	155,814
Capital Services						
• Crops	1,399	0	-957	0	0	442
• Dairy	941	0	-774	0	0	167
• Poultry	616	0	-402	0	0	214
• Red Meats	2,425	0	-1,763	0	0	662
• Non-Farm	435,876	-24,268	-206,876	-446	23,511	227,797
Land Services	15,529	0	-10,544	0	0	4,985
Column Total (Transfers)	0	0	233,584	395,567	-1,847	627,304

goods output (net investment) is allocated to the domestic household as savings.

Imports of foreign goods are treated as augmenting the domestic availability of output from the 40 producing sectors. They total $167 billion and are supplied by the aggregate of foreign households. The succeeding rows of Table 2 document the flows of primary factor service payments to private domestic households. Labor is disaggregated into farm and non-farm components. Similarly capital stocks generating capital service flows to the private households are disaggregated into crop capital (e.g., tractors and combines), three types of livestock capital, and all other (non-farm) capital. Payments to land are included as well. Each of these factor service flows generates tax revenue, yielding a total of $627 billion in taxes collected by the fisc (sum of row totals) which must equal the sum of transfers to households.

The household column sums in Table 2 equal the excess of expenditures over receipts. This excess must equal government transfers according to the household budget constraint. The negative transfer from the foreign household balances the observed 1977 trade deficit. The 1977 federal budget deficit of $44.6 billion is "financed" by negative transfers from the other two households. The private household's contribution to deficit financing is more than offset by public transfers to private individuals. The resulting column total of $233 billion is the difference between these two flows.

In general, deficiency payments and other aspects of farm price and income supports are part of the system of taxes and transfers handled by the fisc. However, in 1977 agricultural prices were quite high and government intervention was minimal. As a result, (in this study) farm programs are not generally reflected in Table 2. The one exception is the demand for stocks by the Commodity Credit Corporation. These net purchases are part of the government activities and are further considered below.

Marginal Behavior of Firms and Households

Keller and most other CGE modelers (e.g., Ballard, et al., Dervis, et al.) employ nested CES relationships to describe production and utility structures in their CGE models. This study departs from a strict adherence to convenient functional forms to incorporate more flexible demand systems in the model. Thus specification of the domestic household's demand for food builds on the recent work of Huang and Haidacher. The derived demand for inputs by crop and livestock farms is based on an aggregate translog cost function for U.S. agriculture.

Firm Behavior: Since factor tax rates differ across agricultural commodities, the production of each commodity must be treated as an independent activity facing a distinct vector of factor prices. In the absence of commodity-specific time series data on input use, an aggregate multiproduct cost function was estimated based on the data of Ball. Seven farm outputs were defined to match sectoral disaggregation in the CGE model. Assuming a translog cost function, a system of share equations was derived for seven inputs, including: crop capital (durable equipment), land, livestock capital (herd and structures), labor, feed, fertilizer, and other inputs. A time trend was also included in each share equation to represent technical change over the sample period (1948-79). The estimated partial elasticities of substitution, evaluated at the fitted 1977 shares, are presented in Table 3.

The same (7x7) matrix of Allen partials was assigned to each individual farm sector in order to utilize the estimated matrix of substitution effects, while permitting each sector to face a different vector of factor prices. The sectoral demand elasticities will differ across commodities since they are equal to the Allen partials weighted by the cost share of the relevant price. For example, the demand elasticity for feed in the crops sectors will be zero due to a zero cost share for feed in those activities. However, the shape of

Table 3: Estimated Allen Partial Elasticities of Substitution for U.S. Agriculture (Evaluated at Fitted 1977 Shares)[1]

	Crop Capital[3]	Land	Livestock Capital[4]	Labor	Feed	Ferti-lizer	Other Inputs[2]
Crop Capital	-4.147 (0.762)	0.500 (0.564)	0.318 (0.393)	-1.279 (0.504)	0.941 (0.344)	0.659 (0.768)	
Land		-5.304 (2.525)	0.299 (0.443)	0.224 (0.414)	0.662 (0.296)	0.394 (0.644)	
Livestock Capital			-2.875 (0.414)	0.498 (0.371)	0.662 (0.215)	1.054 (0.500)	
Labor				-0.230 (0.925)	0.152 (0.308)	1.836 (0.948)	
Feed					-0.995 (0.282)	-0.303 (0.475)	
Fertilizer						-5.239 (2.145)	
Other Inputs							

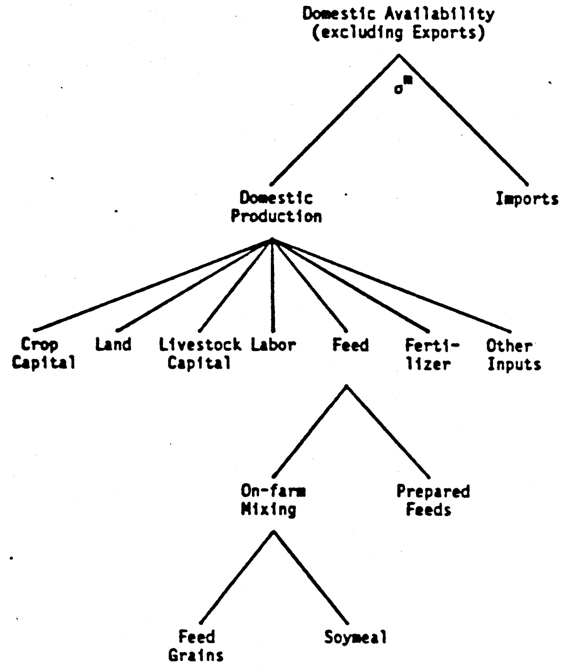
1 The matrix of Allen partial elasticities is symmetric (approximate standard errors are presented in parentheses)

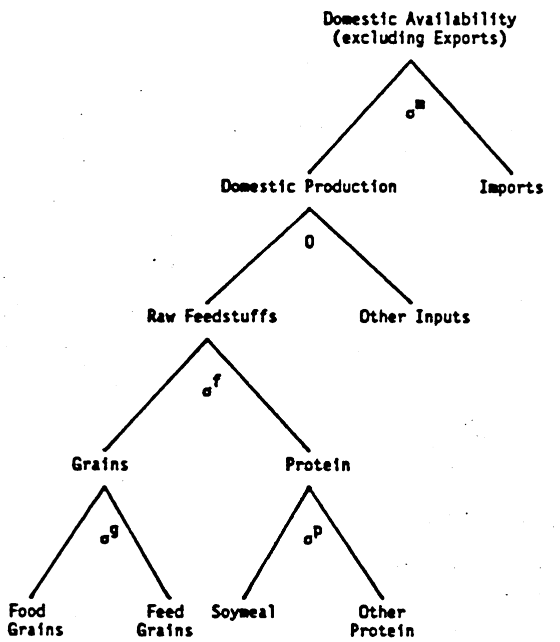
2 Elasticities related with Other Inputs are derived via homogeneity

3 Crop Capital includes autos, trucks, tractors, and other durable equipment

4 Livestock Capital includes livestock herds and structures

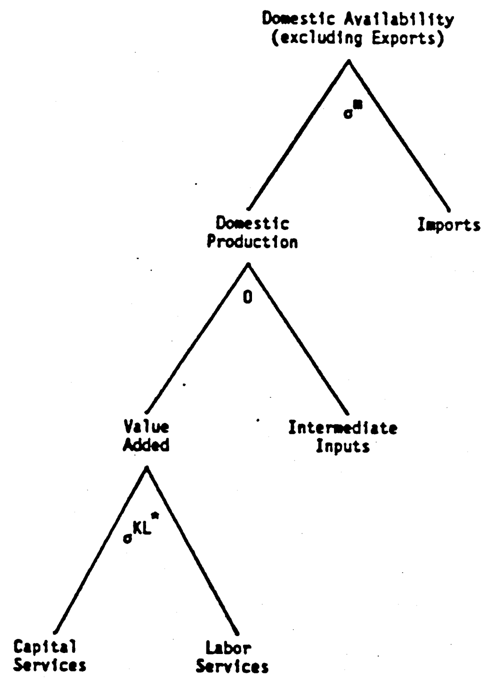
Figure 2: Production Structure in the Farm Sectors





Sector	Base Parameter Values		
	σ^g	σ^p	σ^f
Dairy P.F	3.06	4.29	1.25
Poultry P.F.	1.60	4.29	1.09
(Beef)	(3.06)	(4.29)	(1.14)
(Hogs)	(1.52)	(2.38)	(1.70)
Red Meat P.F.	2.32	3.72	1.41

Figure 3: Production Structure in the Prepared Feeds Sector



* σ^{KL} taken from BFSW, pp. 132-34.

Figure 4: Production Structure in the Non-farm Sectors

the aggregate farm sector isoquants will reflect the substitutability implied by the multiproduct cost function.

From the substitution matrix in Table 3 it can be seen that labor and crop capital are net complements, while substituting for the other inputs. This relationship is statistically significant and confirms the findings of Shoemaker who estimates a single output model using the same U.S. data. Both models attribute the decline in labor's share of output, over the postwar period, to labor-saving technical change rather than capital-labor substitution.

Figure 2 provides the overall structure of domestic production in the agricultural sectors. Total supply is modeled as a CES aggregation of foreign and domestic production which, following Armington, are treated as imperfect substitutes. The ease of substitution, as measured by σ^m, varies by commodity and is a function of product homogeneity. It is set at 4.0 for crops and 0.5 for livestock products. Figure 2 also shows the feed input as a nested CES aggregate of the on-farm feed mix and purchases from the prepared feeds sectors. The on-farm mix is a combination of feedgrains and soymeal. Substitution between these inputs varies across livestock types and is identical to the grain-protein substitution parameter used for prepared feeds.

While the availability of agricultural land is fixed in this model, acreage supplied to individual crops responds to changes in relative rental rates. A CET function "transforms" one type of land into another. The land groups include: foodgrain, feedgrain, oilseeds, and other agricultural land. Other agricultural land is employed in the production of both other crops and livestock. A constant elasticity of transformation among land types of 0.2 gives the model partial equilibrium (commodity price) acreage response elasticities of .25 for oil crops, .78 for feedgrains, and .91 for foodgrains.

Production technology in the prepared feeds sectors is summarized in Figure 3. Here the Armington elasticity is set at four, reflecting easy substitution between imported and domestic feeds. Domestic output consists of a nested CES technology with separability between protein sources and grains.[7] The protein aggregate combines soymeal with other protein sources, while foodgrains may substitute for feedgrains in the grain aggregate. These two elasticities of substitution, as well as the substitutability of grains for proteins, depend on the type of feed. For example, the dairy and beef industries can substitute more easily between grains than can poultry producers.

The production structure in the non-farm sectors is treated in less detail (Figure 4). Following BFSW, capital and labor are combined with a constant elasticity of substitution to produce a value-added aggregate. These substitution parameters are taken from Ballard, et al., pp. 132-34. Value-added is then combined with intermediate inputs using the Leontief assumption of fixed coefficients. The Armington elasticity for each of these rather aggregate sectors is set at two.

Households: Substitution in private household consumption is characterized by a 9x9 matrix of unrestricted demand elasticities which disaggregates food into 8 groups and treats all non-food consumption as a single aggregate. These elasticities were obtained by re-estimating the model reported in Huang and Haidacher using a slightly more aggregate data set and imposing symmetry, homogeneity, and Engel aggregation at the budget shares used in the CGE model. (See Hertel, Ball, Huang, and Tsigas for more details.) These commodity demands are the only source of price responsiveness for the domestic household since the demands for leisure and savings are fixed in this model.

The public household is assumed unresponsive to price changes, with the mix of demands determined legislatively. Moreover, any change in overall governmental purchasing power is allocated proportionately across all demands.

The most important behavioral parameters for the foreign household are the border demand elasticities for major export crops. These are taken from Seeley (Tables 5, 9, and 13) and represent 2-year responses. The implications of increasing these to their longer run (4-year) levels are also explored. The own-price elasticities follow (4-year responses in parentheses): wheat -1.49 (-2.15), feedgrains -1.70 (-2.65), and protein feed (used for soybeans and other prepared feeds as well) -1.52 (-1.78). Seeley's cross-price elasticities are also included in the model. Due to their smaller market share, other agricultural products are assigned a larger elasticity of -2.0 (-3.0). Non-agricultural products are assumed to face a unitary elasticity in the "short run" and an export demand elasticity of -1.5 over the longer run (4 years).

Counterfactual Experiments

In this section we consider first the impact of eliminating the farm/non-farm disparity in each of the tax categories. Their cumulative effect on agriculture and the general economy is then considered. Since all of these experiments tend to boost farm prices, the interaction between the tax changes and price and income support programs is not considered. For example, in 1977 the market price for corn ($2.02/bu.) exceeded the target price ($2.00/bu.). Thus an increase in corn prices would not have affected deficiency payments. Commodity stock accumulation is limited to that actually observed in 1977 (government purchases in Table 2).

Price Effects of Tax Equalization

Solving the model for the general equilibrium impact of removing all farm income tax preferences gives the results in the first column of Table 3. The increase in capital taxation drives an added wedge between the price the firm pays to employ more capital services and land and the price received by factor owners. For example, in the case of dairy capital services, the firm price rises by 1.14% while the market price declines by 25.55%. The difference between these two percentages [1.14 - (-25.55) = 26.69%] equals the percentage change in the *ad valorem* tax rate, $\hat{t}$. Mathematically, since $p^F = tp^M$, $dt/t = \hat{t} = \hat{p}^F - \hat{p}^M$. Because each type of livestock capital is distinct, with no intersectoral mobility, the owners of livestock assets bear almost all the burden of eliminating tax preferences for livestock capital. Crop capital is assumed mobile across crops sectors, but not mobile out of agriculture. It tends to move from grains into the oilseeds and other crops sectors where the percentage tax increase is less. This movement lowers the cost of capital services in the recipient sectors, while raising it for food and feedgrains. A similar phenomenon occurs for land, where the tax inclusive price of land in oilseed production (p^F) drops slightly. Per acre land rents paid to households (p^M) drop across the board, with the market price of feedgrain land experiencing the largest decline.

Because labor is complementary with capital, the relatively higher price of capital depresses the demand for farm labor which is not mobile out of agriculture. As a result, farm wages drop by 4.07%. Since non-farm labor is the numeraire good in these simulations, its price never changes.

The bottom portion of Table 3 reports commodity price responses to eliminating the capital tax preferences. Prices increase for the most preferred sectors. However, due to the fixity of land, labor, and capital in agriculture, if some sectors release these factors, other farm sectors must absorb them. Since their rental rate has dropped, this tends to lower production costs for poultry, red meats, oilseeds, and other crops.

The next column in Table 3 reports the impact of eliminating the farm/non-farm differential in labor taxation. Since farm labor has a fixed and immobile supply, all of the tax increase is borne by the farm workers (a 2.8% cut in after-tax wages).

Table 3. Price Effects of Tax Equalization.[a] (Percentage Change)

	Capital		+ Labor		+ Sales & Production			= All Taxes[b]		
	$\hat{p}^M$	$\hat{p}^F$	$\hat{p}^M$	$\hat{p}^F$	$\hat{p}^M$	$\hat{p}^H$	$\hat{p}^F$	$\hat{p}^M$	$\hat{p}^H$	$\hat{p}^F$
<u>Primary Factors</u>										
Capital Services										
Crops	-4.74	(see below)	0.00		1.15			-3.59		(see below)
Dairy	-25.55	1.14	-0.00		-2.26			-27.82		-1.12
Poultry	-0.23	0.26	-0.00		-1.49			-1.72		-1.22
Red Meats	-11.50	0.39	-0.00		-3.59			-15.10		-3.20
Non-farm	0.03		-0.00		0.05			0.09		
Land	-4.17		-0.00		-0.65			-4.82		
Foodgrains	-6.31	0.88	-0.00		-0.41			-6.73		0.46
Oilseeds	-1.44	-0.04	-0.00		-0.26			-1.71		-0.31
Feedgrains	-8.07	0.43	-0.00		-1.05			-9.12		-0.62
Other Ag.	-3.11	(see below)	-0.00		-0.81			-3.92		(see below)
Labor										
Farm	-4.07		-2.80	-0.00	-5.06			-11.94		-9.14
Non-farm (numeraire)	0.00		0.00		0.00			0.00		
<u>Commodities</u>										
Dairy	0.34		-0.00		0.71	2.31	-0.74	1.05	2.65	-0.40
Poultry	-0.27		-0.00		0.87	2.47	-0.58	0.59	2.19	-0.86
Red Meats	-0.21		-0.00		0.41	2.01	-1.04	0.20	1.80	-1.26
Foodgrains	0.99		-0.00		0.61	2.21	-0.84	1.61	3.21	0.15
Feedgrains	1.66		-0.00		0.79	2.39	-0.66	2.45	4.05	0.99
Oilseeds	-0.33		-0.00		0.78	2.38	-0.67	0.45	2.05	-1.01
Other Crops	-1.22		-0.00		-0.48	1.11	-1.94	-1.71	-0.11	-3.17
Capital Services (Crops)										
Foodgrains		2.45								3.60
Feedgrains		3.75								4.90
Oilseeds		-3.34								-2.19
Other Crops		-1.64								-0.49
Land, Other Ag.										
Dairy		7.38								6.57
Poultry		-2.61								-3.42
Red Meats		0.28								-0.52
Other Crops		-0.01								-0.82

[a] $\hat{p}^M$, $\hat{p}^F$, $\hat{p}^H$ denote percentage changes in market, firm, and household prices, respectively. $\hat{p}^F$ and $\hat{p}^H$ are reported only when they differ from $\hat{p}^M$.

[b] Due to the inherently (log-) linear structure of this CGE model, the effects of these tax perturbations are additive. Thus the cumulative effect of capital, labor, sales, and output tax equalizations reported above is the sum across individual columns.

Elimination of the sales and production tax differentials raises the market prices (p^M) of all farm commodities except for other crops. As a result, part of the burden is passed forward to domestic consumers. Some of the tax is also passed back to factor owners in the form of lower payments to farm factors of production.

The final column of Table 3 reports the cumulative price effects of eliminating farm/non-farm tax differentials. Consumer prices for livestock and cereal products increase, with farm level commodity prices dropping for most products. The biggest decline in rents occurs in the dairy sector, where capital service payments decline by almost 28%. Red meat capital and grain land owners also suffer considerably, while farm wages drop by about 12%. All other price changes are less than 10% in absolute value, suggesting that the model's local approximation should be quite accurate (Keller, p. 5).

Welfare Effects of Tax Equalization

Table 4 reports the household burdens for each tax experiment. Following Keller (p. 117), these burdens represent a first order approximation to the true compensating variation required to return a household to its pre-experiment level of utility. Column totals in Table 4 provide the total burden for a particular household.

Consider first the private domestic household (column heading P). Increasing all taxes on agriculture raises farm and food expenditures, thus lowering welfare by $2,300 million. Non-food prices also increase modestly. Further declines in welfare are experienced by the private domestic household in its role as the supplier of quasi-fixed farm assets and labor. A small increase in the price of non-farm capital does little to offset these losses. However, the added tax revenue must also be considered. In these experiments, the added tax revenue is returned in a lump-sum to the private domestic household. When all taxes increase, this amounts to a transfer of $5,595 million. The net welfare change for the aggregate, private domestic household is

Table 4. The Welfare Effects of Tax Equalization: Compensating Variations Measured in Millions of Dollars (Positive Numbers Indicate Welfare Loss).

	Farm Labor and Capital Immobile												Full Mobility		
	All Taxes[b]			Sales and Production			Labor			Capital			All Taxes		
Commodities	P[a]	G	F	P	G	F	P	G	F	P	G	F	P	G	F
Food	2300	60	129	2433	27	85	-2	0	0	-130	34	44	4572	206	502
Non-Food	197	18	6	192	15	9	-14	-1	-1	19	3	-2	1350	131	106
Imports	-1	-3	129	-1	-2	65	0	0	2	-1	-1	62	4	11	-449
Primary Factors															
Labor															
Farm	2244	0	0	952	0	0	527	0	0	765	0	0	0	0	0
Nonfarm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital Services															
Crops	34	0	0	-11	0	0	0	0	0	45	0	0	-1	0	0
Dairy	215	0	0	17	0	0	0	0	0	198	0	0	-1	0	0
Poultry	7	0	0	6	0	0	0	0	0	1	0	0	0	0	0
Red Meats	266	0	0	63	0	0	0	0	0	203	0	0	-2	0	0
Nonfarm	-186	0	21	-111	0	13	6	0	-1	-81	0	9	-225	0	25
Land	509	0	0	69	0	0	0	0	0	440	0	0	545	0	0
Transfer	-5595	0	0	-3740	0	0	-492	0	0	-1363	0	0	-6637	0	0
Total Burden	-10	75	285	-131	40	172	25	-1	0	96	36	113	-395	348	184

[a] P = private domestic household, G = government, and F = foreign household.

[b] Numbers do not add up exactly across experiments due to rounding inaccuracies.

reflected in the column total which indicates an insignificant increase in welfare. Thus the aggregate value of the increased tax receipts offsets the effect of higher commodity prices and lower returns to farm factors.

The government household (G) suffers in its role as a purchaser of commodities. In particular, net purchases by the CCC are constrained to equal those in the benchmark equilibrium data set; but they now are acquired at higher prices. Foreign households are also worse off as a result of this experiment, due to higher farm export prices and a real exchange rate effect.

These welfare effects are further decomposed in the middle columns of Table 4. Note that the increase in sales and production taxes contributes virtually all of the increased food expenditures, while the capital tax has the greatest impact on farm wages and rents to quasi-fixed farm assets. The transfer row indicates the sources of increased tax revenue. This is largest for sales and production tax equalization ($3,740 million).

Introducing Full Factor Mobility

To this point the experiments have assumed that labor and capital were fixed in agriculture. In the longer run this assumption is untenable. Factors of production will move to employment alternatives yielding the higher after tax return. The final column in Table 4 reports the welfare effects of eliminating farm and food tax preferences under full factor mobility. In addition, export demand elasticities are raised to their longer run (4-year) levels in order to reflect more complete adjustment in the rest of the world.

Labor and capital that leave agriculture avoid virtually all of the tax increase. (The reader should keep in mind that this model does not capture the adjustment costs which are associated with this factor movement.) Only land owners experience lower returns in the long run. Most of the added tax burden is passed forward to consumers. The compensating variation associated with private households' food expenditures doubles. Since labor and capital move from relatively low to high tax sectors when they leave agriculture, tax receipts increase by even more ($6.63 billion). As a result, the private domestic household is now better off (as a whole) after the tax equalization.

The government and foreign households must also pay more for food and non-food items in the long run. However, larger (4-year) export demand elasticities in the face of sharp increases in domestic farm prices (which also attract competing imports) cause the real exchange rate effect to reverse itself in the longer run.

Concluding Comments

This article has outlined a Keller-type computable general equilibrium model for the U.S. economy which emphasizes the farm and food system. Building on the work of Ballard, Fullerton, Shoven, and Whalley, sector-specific tax rates are developed for a full complement of factor and commodity taxes. The results indicate that tax rates on food and agriculture were consistently below comparable levels for the non-agricultural economy. This tax situation likely has attracted additional resources into the farm sector, hence depressing farm prices. This study estimates the magnitude of these effects through a series of counterfactual tax equalization experiments.

The results indicate that farm and food tax preferences benefitted consumers by about $4.5 billion in lower food costs in 1977. These tax benefits also raise after-tax returns to labor and capital in agriculture, at least in the short to medium run. In the longer run land values continue to be supported at higher levels by these policies. However, these preferences result in lower tax receipts. Our results indicate that in 1977 (admittedly a low year for farm program expenditures) the tax expenditure associated with farm and food tax preferences ($5.5-$6.6 billion) considerably exceeded the level of agricultural price and income support payments ($3.8 billion). While the 1986 Tax Reform Act eliminated part of the differential capital tax treatment, the other tax preferences remain in place. Thus the tax system plays a major role in determining the size and composition of the U.S. farm and food system.

Footnotes

1 BFSW's computations reflect a 1973 data base, but this study assumes the same rates applied in 1977. This is a plausible assumption since the results of this study hinge on relative rather than absolute tax rates. The intervening Tax Reduction Act of 1975 reduced the small business corporate tax rate, slightly reduced corporate tax rate from 50% to 48%, and increased the investment tax credit from 7% to 10%. These changes tended to lower tax rates for all sectors. The Tax Reform Act of 1976 introduced an "at risk" provision for some farms. It also implemented changes affecting a subset of farm syndicates. These measures did not affect most farms.

2 Since no information was available for poultry operations, cash accounting benefits were assumed equal to the average for red meat farm types (hogs and beef). No capital gains benefits were allowed for poultry operations since chickens and turkeys were not regarded as being capital inputs for tax purposes.

3 BFSW's τ of .278 (call this τ^A) was reduced by the product of tax expenditures/sales and sales/income ratios. This procedure follows from defining tax expenditures as the product of income and the difference between tax rates with and without the preferential treatment. Thus, tax expenditures equal $I(\tau^A - \tau^C)$, where I is pre-tax income, and τ^A and τ^C are tax rates under accrual and cash accounting, respectively. If tax expenditures/I = (tax expenditures/sales) x (sales/income), then the revised τ is given by:

$$\tau^C = .278 - (\text{tax expenditures/sales}) \times (\text{sales/income}).$$

The cash accounting tax expenditures/sales ratio was 1.72% and 1.35% for dairy and crop farm types, respectively, and 0.5% for red meat. The sales/income ratio was approximated by output/profit-type income as provided in the 1977 accounts presented below in Table 2. This yields the personal tax rates reported in column (1) of Table 1.

4 The percent of capital income not subject to personal taxes is the product of the tax expenditures/sales and sales/income tax ratios. (The ratio of capital gains tax expenditures/sales was 1.72% and 0.79% for dairy and red meat farm types, respectively.) This procedure follows from assuming that only 50% of livestock capital income is subject to personal taxes. If g_{NC} is the portion of capital income that is subject to personal taxes, then $g_{NC} = 1 - (LNCI/NCI) \times 0.50$, with NCI denoting all income from capital, and LNCI denoting income from livestock capital. Furthermore, tax expenditures $= LNCI \times 0.50 \times \tau$. If LNCI/NCI = (LNCI/sales) x (sales/income) then:

$$g_{NC} = 1 - (\text{tax expenditures/sales}) \times (\text{sales/income}) \times (1/\tau).$$

Once again, the sales/income ratio is set equal to the ratio of output to profit-type income in the base accounts. This results in values of g_{NC} of to .18 for dairy and .63 for red meat.

5 BFSW's estimates of corporate and property taxes for agriculture were distributed across sectors according to their share in profit-type income. The total effective tax rate in Table 1 is based on the previous columns as follows: col. 5 = (one - col. 4) * col. 3 + col. 4.

6 This study does not consider motor vehicle taxes, which BFSW divide among industries according to their use of motor vehicles.

7 The authors acknowledge John Zeitsch who first proposed this structure for the U.S. feed industry in an unpublished memorandum written for the OECD. With a few exceptions, the substitution parameters in Figure 3 are also drawn from his work.

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