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INCOME TAXES AND PRICE VARIABILITY IN STORABLE COMMODITY MARKETS

Kevin McNew and Bruce Gardner*

Abstract: Progressive income taxes lead to distortions in economic decisions made across tax years. This is particularly important when income can be quite volatile, as in the case of agriculture. Progressive taxes, therefore, can fundamentally change economic behavior over time. This study explores how progressive income taxes influence storage decisions and the markets for storable commodities. Under a progressive tax system, commodity storage tends to be lower in the aggregate and, as a consequence, price volatility increases. These distortions could be eliminated by introducing a flat-rate tax or by changing the tax reporting system for farmers.

Introduction

Several recent federal income tax reform proposals suggest replacing the current progressive tax system by a flat tax (National Commission on Economic Growth and Tax Reform, and Senator Specter). For many advocates, a flat tax system is appealing because it would ease the burden in computing taxes and provide a level playing field in the economic production of goods and services. Duncan, Koo and Taylor (1997) recently assessed how U.S. farmers would fare from a flat tax proposal as compared to the current system of progressive taxes. Their analysis considers how farmers' tax incidence would change under the new system but not how farmers' economic behavior would change in the face of a flat tax. Recent literature on the general economics of tax reform concludes that "decisions concerning the timing of transactions are the most clearly responsive to tax considerations" (Engen, Gale and Scholz, 1996, p. 135). Auerbach and Slemrod (1997) emphasize the importance of changes in the timing of realizations of capital gains caused by the Tax Reform Act of 1986. In agriculture, there is a particularly important element of timing of commodity receipts, by shifting sales from one year to the next. But this is not just a paper transaction. It requires commodity storage.

This paper analyzes the role that tax policies have on commodity storage behavior. While the impact of taxes on firm level storage has received some attention (Tronstad (1991), Tronstad and Taylor (1991) and Taylor and Novak (1992)), the implications for aggregate storage markets have not been explored. We analyze the consequences of flat-rate and progressive income taxes on the intertemporal storage market. A simulation based on U.S. corn market parameters indicates that progressive taxes may reduce the average level of carryover stocks and increase the year-to-year variability of prices substantially, as compared to a flat tax.

Whether taxes are progressive or flat also has a distinct impact on tax receipts and farm income in aggregate storage markets. A flat-tax system leads to higher tax receipts but lower after-tax income than a progressive tax system with the same average tax rate. With a progressive tax, aggregate storage tends to be significantly reduced, leading to lower tax receipts

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and higher after-tax income. Thus, even though incomes and prices may be less volatile in a flat-tax system, average farm income may be lower making it less favorable for U.S. farmers.

The next section presents a simple model of firm storage behavior in the presence of taxes. The third section discusses the market-level model of commodity storage and taxes while the fourth section presents simulation results of the tax impacts on prices, storage and tax receipts.

Firm-level Effects of Taxes on Storage

Consider a simple, 2-period model of firm-level storage. The years are both production periods and income-tax years, and we assume that there is no uncertainty about prices or production.[1] Production (h) is the same in year 1 and year 2. After harvest in year 1, the farmer may sell part or all of the crop at the prevailing price (p_1). What is not sold in year 1 must be sold in year 2 along with the production in year 2 at the market price of p_2. Production costs (c) are the same in both years, and there is no other source of income beside this commodity.

The tax situation can be characterized by the marginal tax function, which defines the amount of tax paid for an additional dollar of taxable income. Assume that the marginal tax rate is linear in taxable income and for year k this tax function is:

(1) $\tau_k = a+bI_k$

where I_k is taxable income in year k and a and b are parameters. When needed, we will refer to the average tax rate as μ_k; the marginal linear tax rate implies that total taxes are quadratic in I_k, and the average tax rate is:

(2) $\mu_k=a+0.5bI_k.$

Under a cash accounting system such as most farmers use, income is based on the cash receipts from product sales.[2] Sales in a given year can be altered through inter-year storage. We denote as s the amount of stocks that are withheld from the market in year 1 and sold in year 2. Assuming storage and interest costs are a constant per bushel charge, k, year 1 and year 2 cash accounting incomes are:

(3) $I_1 = p_1(h - s) - c - ks$

(4) $I_2 = p_2(h + s) - c.$

The combined after-tax income for years 1 and 2 is:

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[1] A more complete model would consider an infinite horizon which incorporates production and price uncertainty and can be solved via stochastic dynamic programming methods (e.g., Tronstad and Taylor). Our interest is to illustrate the tax consequences for storage decisions so we choose a simpler approach.

[2] Farmers, unlike other businesses, may use either cash or accrual accounting methods when computing taxable income. Income under an accrual system is based on the economic performance of production and costs while a cash accounting method computes income from purchases and sales in the year. Thus, with an accrual system, taxes on outputs and inputs coincide with their production or economic use, while a cash system bases taxes on actual transactions of products sold or purchased. Most farmers prefer cash accounting methods because of the fewer demands on record keeping (IRS).

(5) $\pi = (1-\mu_1)I_1 + (1-\mu_2)I_2$.

Optimal inter-year storage solves the first order condition for maximizing (5) which, after arranging, has the form:

(6) $$\frac{\partial \pi}{\partial s} = p_2\left[1 - \frac{\partial \mu_2}{\partial I_2} - \mu_2\right] - (p_1 + k)\left[1 - \frac{\partial \mu_1}{\partial I_1} - \mu_1\right] = 0,$$

where the term $\partial\mu/\partial I$ is the change in the average tax rate caused by a marginal change in income which occurs only by changing storage. Notice that if taxes were either flat-rate or zero, the terms in brackets would be equal and the first-order condition would reduce to a comparison of the p_2 and p_1 plus storage costs. Otherwise, the proper comparison requires an adjustment for tax rates.

Substituting equations (3) and (4) into (2), and substituting the resulting expressions for income and tax rates into equation (5), we have the 2-year after tax income as a function of carryover stocks, s, and exogenous variables. Maximizing with respect to the farmer's choice of s, subject to the restrictions that $h \geq s \geq 0$, and solving the first-order condition for s^*, the optimal level is:

(7) $$s^* = \max\left(0, \frac{(\frac{1-a}{b} + c)(p_2 - p_1 - k) + (p_1(p_1 + k) - p_2^2)h}{(p_1 + k)^2 + p_2^2}\right), \qquad b>0.$$

The second-order condition for (7) maximizing π is $-b[(p_1 - k)^2 + p_2^2] < 0$, which holds for all $b>0$. Under a flat-rate tax, $b=0$ and s^* is at one of the corner solutions: $s^*=0$, if $p_2 \leq p_1+k$; or $s^*=h$, if $p_2 > p_1+k$. As b gets closer to zero the first additive term of the numerator of equation (7) containing the no-tax criterion (p_2-p_1-k), gets larger relative to the term containing p_2^2 and $p_1(p_1+k)$.

The complexity of (7) arises from the interaction of income and the tax rate, with the square of prices entering from multiplying the linear equation (2) by I_1 and I_2 in equation (5).[3] The key analytical point is that the two numerator terms change in opposite direction as p_2 rises relative to p_1, and can differ in sign if p_2 is large enough (and will always differ in sign if k=0). Thus, an increase in p_2-p_1 will create less incentive for storage because of taxes, and may even induce less storage!

To see how optimal storage changes with prices, consider a hypothetical situation for a corn farmer. Suppose that the farmer grows 1,000 acres of corn and production each year is 120 bushels to the acre (h=120,000). Tax-deductible costs account for \$250 per acre (c=\$250,000).

Suppose the price in year 1 is \$3.00 and the price in year 2 is \$2.50, roughly the corn price in 1996 (year 1) and the futures price for the 1997 (year 2) corn crop as of harvest in 1996. If no stocks are carried, then taxable income under cash accounting will be \$110,000 in year 1 and \$50,000 in year 2. Although marginal tax rates increase in discrete steps based on the

[3] Under a more complicated tax function than (2), equation (7) would be more complicated. Qualitatively similar results would be obtained so long as τ_k increases with I_k. The most pertinent implication would be to incorporate an exemption from tax for $I_k < I^0$, a minimum taxable income. This would strengthen our finding because the difference between τ_1 and τ_2 would be even greater in cases where one of the rates is zero.

relevant local, state, federal and social security taxes, for our purposes here, it is sufficient to take the marginal tax rate as a linear function of income as in equation (1). Specifically, let a=0.04874 and b=3.15e-06, parameters which give marginal tax rates of 40 percent and 21 percent for year 1 and year 2, respectively. These rates are roughly appropriate for several states with state income taxes, in addition to the federal income tax.

Intuitively, one might expect no storage from year 1 to year 2 to be the appropriate strategy for our farmer because of the negative price spread. However, the relevant comparison is based on the change in after-tax income from storing one bushel, which should be negative if this is indeed the best strategy. Storing one bushel lowers after-tax income in year 1 by $(p_1 - k)(1 - \tau_1)$ and increases after-tax income in year 2 by $p_2(1 - \tau_2)$.

For this example, assuming storage costs, k, are 20 cents per bushel, then storing one bushel lowers after-tax net income in year 1 by \$1.92 and raises next year's after-tax income by \$1.975. Therefore, after-tax net income is improved by \$0.055 over the two years. Plugging costs, prices and production into equation (7), the optimal storage is 1,053 bushels (or 0.9 percent of total production). Despite a strong *market* incentive not to store through negative inter-year price spreads, an incentive for storage still exists because of tax effects.[4]

Even more surprising is how a lower price in year 2 may lead to more storage, as opposed to less. For example, if p_2 is \$2.30 instead of \$2.50, optimal storage is 1,460 bushels. Therefore, a *lower* price in year 2 is associated with more storage and vice versa.[5] However, increased storage costs are still associated with less holding of stocks. In this example, if storage costs were 30 cents rather than 20 cents per bushel, storage would not pay under either of the two price scenarios.

This inverse relationship between storage and the year 2 price can be explained by looking closely at how p_2 impacts storage decisions. There are two effects on storage from changes in p_2. First, a lower price in year 2 induces less storage because the inter-year price spread declines. However, a lower p_2 will cause income and the tax rate to be lower in year 2. This gives rise to the second impact: a lower tax-rate increases the after-tax price for year 2 inducing more storage. For the problem presented here, the latter effect outweighs the former, making it profitable to store more in response to the different inter-year tax rates.

If the tax structure is less progressive, we do not always get the perverse effect that taxes cause storage when the future price is less than the current price. For example, if equation (1) had a=0.2167 and b=1.67e-06, which gives marginal tax rates of 0.40 and 0.30 in years 1 and 2, respectively, equation (7) gives zero as the optimal storage for the case when p_1=\$3.00 and p_2=\$2.50. But we always get the result that when storage is positive in the absence of tax considerations, a progressive tax structure reduces the quantity stored.[6] Note also that this finding

[4] If the situations are reversed so that the year 1 price is \$2.50 (with tax rate of 21 percent) and the year 2 price is \$3.00 (40 percent) then it is optimal not to store.

[5] To be more precise, the amount stored is concave in p_2 and nearly quadratic for the example used here. When p_2<\$2.30, the amount stored declines as p_2 falls.

[6] A simple proof is as follows: under our assumption of equal production in each year storage takes place in the absence of taxes only when taxable income is higher in year 2. Introducing progressive taxes therefore provides an

generalizes from the 2-period to the many-period planning horizon. The reason is that the optimum storage criterion for the many-period dynamic programming problem reduces to the 2-period criterion of equation (6) for t and t+1 (see Williams and Wright, Ch. 2).

If there were no differences between inter-year tax rates, as in the case of a flat tax, clearly these distortions would disappear. Faced with the same marginal tax rate from one year to the next, the farmer would store only if the inter-year price spread is positive and covers storage costs.

Another way that the tax distortions would disappear is if an accrual accounting method were used as opposed to the conventional cash accounting method. Even with progressive taxes, the requirement of accrual accounting would eliminate any distortions in storage decisions. This is because accrual income is based on the value of production in a given year and not on the value of sales. Therefore, faced with unusually high income in year 1, for example, a farmer utilizing accrual methods would have to claim all of that income in year 1 and would be unable to defer some of it to year 2, even if storage were used.

The problem with the progressive tax outcome from society's viewpoint is that we get storage from high-price into low-price years as opposed to the usual carrying of stocks from low-price to high-price years. Thus, storage has the perverse effect of increasing rather than reducing price instability if the tax incentives prevail on a market-wide basis. We now turn to the market-level consequences.

Market-level Implications

The social welfare effects of grain storage decisions stem from effects on intertemporal grain price variability. If all or many farmers in high-income years postpone sales for tax reasons, their actions will cause market prices to be higher in high-price years than they would be in the absence of tax considerations. Similarly, the tax incentive to sell in low-income years will tend to reduce prices in those years. If the tax rate is low in low-price years, the incentive to store rather than sell in low-price years is reduced. Similarly, the incentive to store rather than sell in high-price years is increased. Both responses to taxes contribute to increased price instability, since stability is promoted by storing more in low-price years and selling more in high-price years.[7]

Is it likely that the tax effect on market-level price instability is important? We approach this issue by considering the effects of progressive income taxes in the context of the competitive commodity storage model. The market model we use follows much of the recent research in the area of rational expectations models of competitive storage e.g., Williams and Wright (1991),

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incentive to realize more income in year 1. Realizing more income can only be accomplished by storing less from year 1 to year 2.

[7] In the extreme case where the tax effect is strong enough to reverse the normal price effect, we would have an unstable equilibrium if the individual response carried over to the market level. In a high-price year, action to withhold grain from the market would cause the price to rise, which would induce more grain to be withheld and prices to rise still further.

Miranda and Glauber (1993; 1995), Gardner and Lopez (1996), Makki, Tweeten and Miranda (1996).

The market model differs from the firm model in the previous section by treating price as endogenous. In addition, production is random and, therefore, price expectations are used to make storage decisions. Like most of the literature on storage, we assume that agents form rational expectations based on the underlying distribution of production and the structural characteristics of the market.

This stochastic dynamic market model can be solved given values for demand elasticities, supply elasticities, yield variability and storage costs. We choose parameter values intended to represent the U.S. corn market. Based on these parameters, we consider how income taxes distort market equilibrium and examine how possible changes in the current Federal tax system may impact market behavior. Of special interest is the impact of changing to a flat-tax system from a progressive tax system.

Consider an annual model of a primary commodity market. The supply available in year t is composed of new production (H_t) plus the preceding year's carryover (S_{t-1}). Available supply is either used domestically or exported which we lump together as consumption (C_t). Any remaining supplies are stored into the next year (S_t). This material balance relationship implies:

(8) $$H_t + S_{t-1} = C_t + S_t.$$

Production, H_t, we take as exogenous but random with a normal distribution; the mean harvest is assumed to be constant at 1,000 units per year and the standard deviation is 100. With mean production of 250 million metric tons of corn our index unit would be 250,000 tons. The implied 10 percent coefficient of variation is roughly approximate for average U.S. corn yields. By assuming no production response (i.e., perfectly inelastic supply), behavioral changes due to taxes arise through storage decisions and not production decisions.[8]

Consumption demand, which we represent in inverse demand form, depends on the current price, P_t:

(9) $$P_t = \alpha - \beta C_t.$$

The values of α and β are set so that the non-stochastic equilibrium without storage is at a price index of 100, a quantity of 1,000 and consumption demand has an elasticity of -0.25. Using data for U.S. corn use from 1985 to 1997 indicates a demand elasticity of -0.23, after correcting for an increasing trend. Our value of -0.25 is simply rounded from the actual estimate.

We now develop the tax components of the model. To do so, we assume that a representative producer exists, taking on the role of production and storage. By assumption, producer response occurs in storage decisions but not production. Without income taxes, storage decisions would depend on expected returns, characterized as the difference between next period's expected price and this period's price adjusted for storage costs. The presence of income taxes alters the expected return by the relevant marginal tax rate in each year and, therefore, changes storage decisions. Income for the representative producer under a cash accounting system is:

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[8] If supply were elastic, storage would be less important for stability and would make the storage rules that are discussed in the next section less elastic.

(10) $I_t = P_t(A_t - S_t) - kS_t - c$

where $A_t = H_t + S_{t-1}$ is the available supply in period t. Revenue comes from sales in year t, denoted by $A_t - S_t$. The costs consist of physical storage costs (kS_t) and the production costs denoted as c. We take production costs (c) to be 60,000 so that income without storage is 40,000 at the non-stochastic equilibrium. The marginal physical storage cost per unit (k) is assumed to be 10 percent of the non-stochastic equilibrium price.

The tax situation can be described by a marginal tax rate function. This tax rate we denote as $\tau_t = aI_t^b$ where τ_t is the marginal tax rate, I_t the before-tax income in period t, and the parameters a and b are used to distinguish three different tax environments. The first is a flat tax scenario where $b=0$ and $a=0.20$; a 20 percent tax rate, which this suggests, is consistent with recently proposed flat-tax legislation. The second tax scenario is $b=0.50$ which makes taxes progressive but the marginal tax function increases at a decreasing rate at higher income levels. We refer to this as the moderately progressive income case. The third case is when $b=0.75$ (highly progressive case) so that taxes are more progressive than in case 2. With highly progressive tax rates, low incomes receive a lower marginal tax rate and high incomes a higher marginal tax rate as compared to the moderately progressive tax. For both progressive income taxes, the parameter a is set so that the marginal tax is 20 percent at the average before-tax income level achieved in the flat-tax scenario. Therefore, higher (lower) than normal income levels are taxed at a higher (lower) marginal tax rate when a progressive tax is used as compared to the flat-tax case.

The model is closed by expressing the market-level equilibrium conditions. These conditions, which are more formally called the complementary slackness conditions, are similar in form to those in the standard storage problem. Here, however, we must augment these terms by the relevant marginal tax rate in each period. Therefore, intertemporal equilibrium with taxes is guaranteed by the following conditions:

(11) $E[P_{t+1}(1 - aI_{t+1}^b)] \leq (1+r)(P_t + k)[1 - aI_t^b]$,

(12) $S_t \geq 0$,

(13) $\{E[P_{t+1}(1 - aI_{t+1}^b)] - (1+r)(P_t + k)[1 - aI_t^b]\}S_t = 0$,

where E[] is the expectation operator and r is the interest rate or opportunity cost of funds tied up holding stocks, which we assume is 5 percent.[9] Equation (11) is the familiar intertemporal arbitrage condition, augmented by the presence of taxes while equation (12) requires that the economy as a whole cannot borrow from the future (i.e., no negative storage). If stocks are positive, then the arbitrage condition is satisfied by equality so all further storage activities are unprofitable. This is guaranteed by equation (13).

Using equations (8)-(13) the storage rule $S_t = s(A_t)$ can be determined which dictates the optimal storage given a current amount of availability $A_t = H_t + S_{t-1}$. In essence, this a reduced-form relation between the current state variable, A_t, which summarizes all pertinent information about the current circumstances and the endogenous control variable, S_t. The function, $s()$ is unknown

[9] Interest costs are assumed to be an opportunity cost and therefore, are not treated as an expense in (9). If included as a direct expense, the impact would be negligible for storage and price behavior as long as the interest rate is low.

and, indeed, has no closed form solution. Numerical methods are widely available for solving this type of problem. We utilize the numerical solution technique of Chebychev collocation to solve for the storage rules. Chebychev polynomials have become popular in recent research on numerical economics because of the high degree of accuracy they provide as compared to more common polynomial methods e.g., Judd (1992).

Results

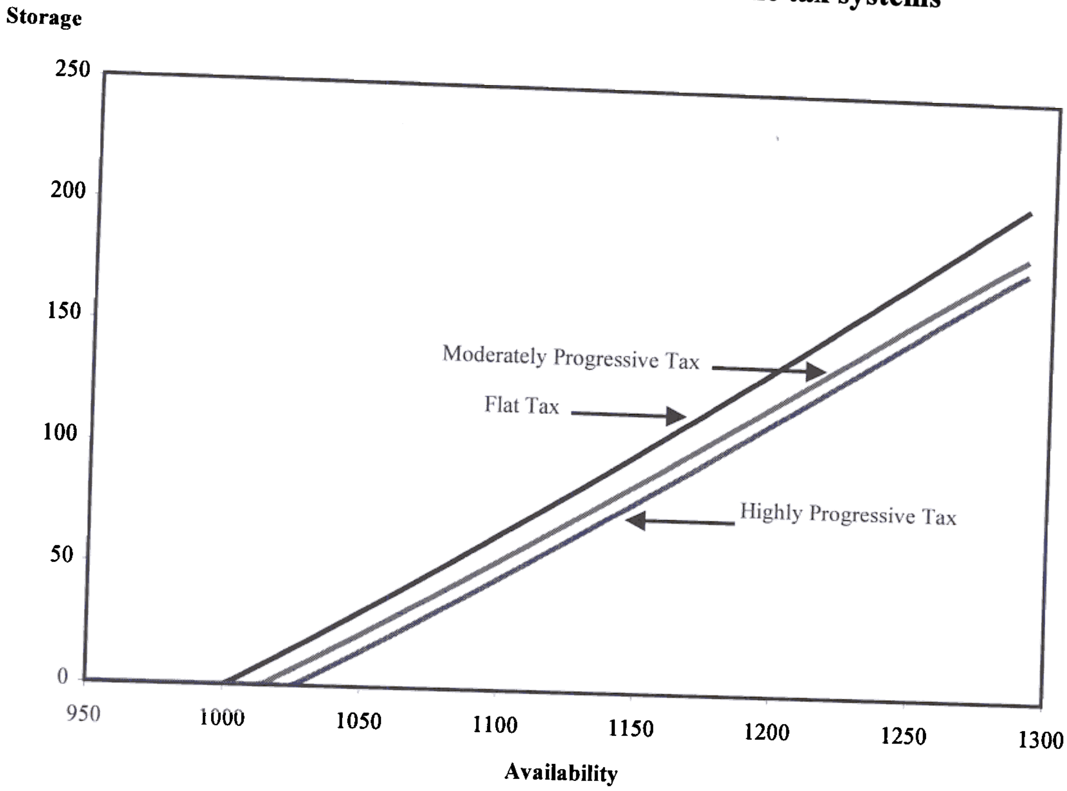
The model and solution method described in the previous section are used to assess the impact of taxes on the endogenous behavior of prices and storage. Our interest here is how various tax policies impact the storage levels and price variability. In addition, it is useful to characterize how each tax policy impacts government tax receipts and farm income.

Storage rules for alternative tax rate structures are displayed in figure 1. Given supply availability (production plus carryover from the previous year) the storage rule, $S_t=s(A_t)$, establishes the level of stocks to be carried forward into the following year. Storage rules are presented for the flat tax, the moderately progressive income tax (b=0.5), and the highly progressive income tax (b=0.75). The presence of a progressive income tax reduces the amount of storage at all levels of availability. The flat-tax case results in the highest storage at each level of availability while the highly progressive income tax policy has the lowest storage.

The almost parallel shifts in the storage rule differ from the preliminary firm-level example described earlier in one important respect. The individual faced with a progressive tax system increases storage in high-price years. In terms of the storage rules shown in figure 1, this would imply higher stock levels at low levels of availability (when prices are high) for a progressive tax as compared to a flat tax. The result would be a storage rule for a progressive tax that crossed the flat-tax storage rule and had a smaller slope. That is, a progressive tax system causes the storage to be less responsive to availability. Since availability has a one-to-one monotonically declining relationship to the price, this result can also be expressed by saying that the demand for carryover stocks is less elastic with respect to current-year price under a progressive tax.

This qualitative result occurs in the market-level as well as firm-level situation, as can be seen in figure 1 by the storage rule under the flat tax being slightly steeper than the rule with b=0.5. For example, when availability is 1,200 units, the moderately progressive storage rule has a slope of 0.70 while the flat-rate storage rule has a slope of 0.75. The more important effect in figure 1 is that average stock levels are larger under the flat tax, so that stock-outs occur less frequently. The economic reason for decreased stocks at all availability levels under progressive taxation is that price is a convex function of availability (because demand for stocks makes total demand flatter at lower prices). Therefore, the expected price next period is always larger than current price when stocks are being held. Since higher prices are associated with a higher tax rate, progressive taxes always reduce the post-tax returns to holding stocks.

Figure 1. Storage rules under different income tax systems



To investigate how the tax system impacts price volatility, we simulate 2,000 random harvests assuming the harvest size is normally distributed with a mean of 1,000 and a standard deviation of 100. The same random harvest realizations were used for comparisons across policies to illustrate the consequence of tax policies and not the impact of any sampling differences. Mean stock holdings along with the coefficient of variation are presented in table 1. As a point of reference, the case of no taxes and no storage is also presented in table 1.

The simulation quantifies the implications of the storage rules that taxes reduce the amount stored. Under a flat tax system, there is nearly no difference from the no-tax case. This is because the constant tax rate cancels on both sides of the arbitrage conditions in (10) when income is sufficiently large. Any differences from the no-tax case are a consequence of negative income in some years, so that the marginal tax rate is zero. In this sense, even the flat tax is slightly progressive.

When taxes are progressive, there is a significant reduction in long-term storage levels and, as a result, price variability is increased. Going from the flat-tax case to the moderately progressive income tax causes average stock levels to fall by 14 units (1.4 percent of mean production) and increases price variability from 26.3 percent to 28.6 percent, as measured by the coefficient of variation. Similarly, as taxes become more progressive (as illustrated by the highly progressive income tax), storage levels decline and price variability increases. A comparison of the flat-tax case to the highly progressive tax case suggests an increase in price variability of nearly 10 percent of the no-storage case. Thus, the presence of progressive income taxes can significantly reduce the price stabilizing affect of storage.

Table 1. Mean Storage and Price Coefficient of Variation.

Simulation	Storage	CV of Price (percent)
No Storage	.	40.0
No-Tax	49.0	26.2
Flat Tax	48.8	26.3
Moderately Progressive	34.4	28.6
Highly Progressive	27.4	30.0

The analysis also gives insight on the impact that the tax system would have on farm income and tax receipts. This data is presented in table 2. With no taxes, in our 2000-year simulation of normally distributed harvests, the average income is $38,137. Pre-tax income under the flat tax case is virtually the same ($38,136) as in the no-tax case and the average yearly tax receipts from a flat-tax of 20 percent of income is $7,641.

Table 2. Mean Tax Proceeds, Income and Tax Rates

	Before Tax Income	Tax Proceeds	After Tax Income	Marginal Tax Rate	Average Tax Rate[1]
No Storage	36,173		[illegible]		
No-Tax	38,137		38,137		
Flat Tax	38,136	7,641	30,495	0.200	0.200
Moderately Progressive	37,876	5,545	32,331	0.192	0.129
Highly Progressive	37,702	5,114	32,588	0.192	0.

[1]The average tax rate is the ratio of tax proceeds to taxable income, averaged over the 2000 crop years

Under a progressive tax system, before-tax income is lower but after-tax income is higher as compared to the flat-tax case. The reason is that farmers' storage actions in response to tax incentives reduces government revenue. With moderately progressive income taxes, before-tax income is lower by $350 but after-tax income is higher by $1,836 as compared to the flat-tax case. The same consequences hold as taxes become more progressive (compare the highly progressive income tax results to the moderately progressive results), although after-tax income increases by only $257 dollars in the highly progressive case. In each case, however, tax receipts are lower when the system is progressive.

It may be more useful to consider how much price variability would increase under a progressive tax system which yields the same average tax revenue as the flat tax. To answer this question we adjusted the tax functions by changing the parameter *a* so that the income level at which the tax rate was 20 percent produced an average tax level of $7,641--the average tax receipts under a flat tax. For the moderately (highly) progressive tax case, this meant that an income level of 20,385 (23,277) received a 20 percent tax rate.

Table 3 shows the impact of a progressive tax system that collects the same average tax receipts as a flat-tax system. For both the moderate and highly progressive income taxes, average storage levels are substantially less than the same tax systems which collect less tax revenue. As a result, price variability is increased even more than in our previous comparison. For example, collecting the same amount of tax revenue from the moderately progressive tax system as would be collected from the flat tax system causes price variability to increase from 26.3 percent to 30.3 percent. Similarly, a highly progressive tax system which collects the same average tax receipts as a flat tax would increase price variability to 33.3 percent.

Table 3. Constant Average Tax Proceeds.

	Before Tax Income	Tax Proceeds	After Tax Income	Marginal Tax Rate	Storage	CV of Price
Moderately Progressive	[illegible]	[illegible]	[illegible]	[illegible]	26.4	[illegible]
Highly Progressive	37,247	7,641	29,606	0.273	13.9	33.3

Concluding Comments

Income taxes are known to distort economic decisions. This study shows how these distortions impact storable commodity markets. Our results indicate that the current U.S. tax system could have a sizable effect on storage and price behavior.

With a progressive tax system, prices become more volatile because of the diminished incentives for storage. For our simulations, the move from a progressive to a flat-tax system would lower price variability by about 8 percent. In addition, the presence of progressive taxes tends to lower the amount of tax receipts collected and increase after-tax income when compared to a flat-rate tax. For our simulations, going from a flat-tax system to a progressive tax with a rate roughly equal to the marginal rate of mean pre-tax income, would increase after-tax income by about 6 percent.

While the distortions caused by progressive taxes could be virtually eliminated by going to a flat-tax policy, another option would be a switch from cash accounting to accrual accounting for income tax reporting. The effect created by cash accounting is not so much on the storage function itself, but more in the fact that storage allows one to defer income from one tax year to the next. Accrual accounting does not permit income to be deferred and therefore, if used, would eliminate the distortion caused by a progressive tax system. Currently, farmers may voluntarily choose to use either cash or accrual accounting methods to report income taxes. If a change to accrual accounting were mandated this would likely lead to less price variability in grain markets.

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