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Land Taxes, Output Taxes, and Sharecropping: Was Henry George Right?

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Economists have generally argued that if a land tax is administratively feasible, then to increase efficiency it should be used to the exclusion of output taxes. This article shows that underlying this policy prescription is the assumption that institutions for pooling and spreading production risks are perfect. When account is taken of the imperfections in those institutions, some use of output taxes will be Pareto superior to a pure land tax regime and may induce higher output, as well. Henry George was wrong! These results generally apply even when the land tax is indexed to regional output, and when land is farmed under sharecropping. Even in these cases, a move from a pure land tax to a mix of land and low output taxes will reduce preexisting distortions in both consumption and production arising from the imperfection in risk markets.

Economists have long argued that a tax on unimproved land is, on efficiency grounds, an ideal tax. In developing countries where land rents are an important source of rural income, a standard recommendation for increasing efficiency is thus to use a land tax to the exclusion of agricultural output taxes.[1]

This article will show that lying behind this policy prescription is an assumption that landowners have sufficient access to market or nonmarket institutions for the exchange of risks that they maximize their expected profits from production, independent of risk aversion. For most developing countries this is an extraordinary assumption. Rural financial markets generally provide only limited spreading and pooling of production risks (see, for example, Udry 1990, and Siamwalla and others 1990), whereas these risks represent a large fraction of landowners' wealth. Many studies attest to the role of nonmarket institutions—marriage, remittances, patron-client relationships and tenancy—in spreading and reducing risk; but despite such arrangements, farmer's production decisions reflect risk aversion (see Rosenzweig 1988 and citations therein).

The main finding of this article (proposition 1; see below) is that some use of output taxes will be Pareto superior to a pure land tax regime if institutions for

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1. See, for instance, Newbery (1987, p. 381): "The obvious empirical question to ask is how desirable a crude land tax would be from an equity viewpoint (because its efficiency is not in doubt)."

sharing production risks are imperfect.[2] The result here is an application of the theorem of the second best: that is, if some of the marginal conditions required for efficiency cannot be met in an economy, then the other marginal conditions may no longer be desirable.[3] Unlike the model economy in which the classical economists analyzed the effect of land and output taxes, a developing country is hobbled by a limited set of institutions for risk sharing. An output tax alleviates the consumption and production distortions which arise in the absence of a perfect insurance market. For that reason, the introduction of a small output tax will increase welfare. Henry George was wrong!

A second finding of this article (proposition 2; see below) is that there exist plausible conditions under which an increase in output taxes, compensated by a decrease in land taxes that keeps the farmer's welfare unchanged, increases his labor supply. Under these conditions, the farmer's supply response to the decrease in risk will more than offset his supply response to the decrease in expected return.

In an economy with imperfect insurance markets, an output tax provides a financial intermediation service. But why doesn't the market provide such services? And what advantage does government have that enables it to provide insurance—via output taxation—that other institutions cannot? Four responses can be offered.

First, the random factors generating income risk are likely to be correlated across farmers in a given region, so that rural financial markets that operate over small geographical areas can provide only limited risk reduction. But if the cost of monitoring and enforcement rises sufficiently steeply with distance, financial markets that operate over large regions will not be profitable. Empirical evidence from Africa and Asia suggests a high degree of geographical segmentation in rural financial markets, even when government intervenes directly in those markets (Udry 1990, Siamwalla and others 1990, Binswanger and Khandker 1989, and Feder and Feeny, this issue).

Second, adverse selection impedes private insurance. If private crop insurance were offered, landowners that had low-quality land (land quality being unknown to insurance agents) would buy the insurance in disproportionate numbers, drive up premiums, and make the insurance unattractive to the average farmer (see Rothschild and Stiglitz 1976). Government, unlike the market, can overcome the adverse selection problem by creating mandatory programs, including tax policies.

Third, a low output tax plays less havoc with incentives than does a general crop insurance program. Because it is so difficult to monitor farmers' care of

2. Related results have been obtained for a wage tax in Eaton and Rosen (1980) and for an interest income tax in Varian (1980). This article provides a proof that clarifies the basis for the kind of results obtained in their papers.

3. A famous early demonstration of this point in the context of the debate over direct versus indirect taxes is in Little (1951, pp. 580–84). The classic reference is Lipsey and Lancaster (1956).

their crops, general crop insurance has not been successful (Newbery 1989). An anecdote cited in Newbery (p. 288) illustrates the incentive problem: "'It was further alleged by villagers that some of the participants [in the Gujarat Crop Insurance Scheme for Hybrid-4 Cotton] had avoided interculturing, weeding, application of the last dose of fertilizers, etc., when they realized that they would not obtain the expected [and insured for] yield.'"

Fourth, government is usually in a better position than private insurers to insure collective risks, such as drought, that directly affect a large proportion of the rural sector. Through tax and debt policy and privileged access to international capital markets, the scope of consumption smoothing that governments can undertake across time periods is much greater than that possible in a private financial market.

This article begins with a proof of propositions 1 and 2 for the case of owner-operated farms. Section II extends proposition 1 to cover a land tax indexed to the value of the region's aggregate harvest: it demonstrates that the Pareto-efficient mix of an output tax and an *indexed* land tax will include the output tax provided that farmers' output risks are not perfectly correlated. Section III extends proposition 1 to farms under tenancy cultivation. Here taxes will affect the contractual relations between landlords and tenants, but the Pareto efficiency of a mix of low output taxes with the land tax remains robust.

I. A Model of Owner-Operated Farms

Consider a family farm with acreage T. Output depends on T, the number of family workers, L, the level of effort, e, supplied by each worker, and the realization of a random variable, ϵ, that reflects weather, pests, and other shocks. Define units so that the expected value of the random variable, $E\epsilon$, is 1. The production function of the agricultural good is

$$Q = \epsilon F(eL, T)$$

Assuming constant returns to scale, output per unit of land, denoted by the function $f(\quad)$, will depend only on the labor-land ratio:

$$\frac{Q}{T} = \epsilon F\left(\frac{eL}{T}, 1\right) \equiv \epsilon f\left(\frac{eL}{T}\right) \tag{1}$$

with $f' > 0, f'' < 0$, and $f(0) = 0$.

The family maximizes its joint expected utility, U. Define units so that L, the number of family workers, is unity; and let output be the numeraire. Output is taxed at rate τ, and land is taxed at the per acre rate Γ. Thus family income after taxes is

$$y = T\left[\epsilon f\left(\frac{e}{T}\right)(1 - \tau) - \Gamma\right].$$

Assume, for simplicity, that the disutility of labor effort, $v(e)$, is independent of income. The family chooses its labor effort to solve

$$\max_{e} \; U = \mathrm{E}u(y) - v(e) \qquad (u' > 0, u'' < 0, v' > 0, v'' > 0)$$

with first-order condition for an interior solution

$$\frac{\partial U}{\partial e} = \mathrm{E}(u'\epsilon)(1-\tau)f' - v'(e) = 0 \tag{2}$$

and second-order condition

$$\Delta \equiv \mathrm{E}(u'\epsilon)(1-\tau)\frac{f''}{T} - \mathrm{E}u''[(1-\tau)\epsilon f']^2 - v'' < 0 \tag{3}$$

This model abstracts from the farmer's decisions other than his labor-leisure choice, and also from all avenues that he might have to insure himself against output risk. Obviously farmers do engage in consumption smoothing through hoarding and credit markets (see Deaton 1989). My qualitative results will depend only on the assumption that the opening of a perfect insurance market would not be redundant, an assumption that I formalize below.

The Pareto-Efficient Mix of Land and Output Taxes

A simple way to test the Pareto efficiency of a tax regime is to ask whether there exists a set of tax changes that would increase the social value of government revenues and leave taxpayer expected utility unchanged at some initial level, $\overline{U}$. Results of such a test would be unaffected, and the notation simplified, if we treat the case of N farmers, each of whom has land area T and identically distributed shocks ϵ_i. In this case government revenues from the agricultural sector are

$$G = T\left[\tau \sum_{i=1}^{N} \epsilon_i f\left(\frac{e}{T}\right) + N\Gamma\right].$$

Let the social value of government revenues be $\mathrm{E}W(G)$, with $W' > 0$ and $W'' \leq 0$. We assume that social valuation reflects individual valuations. The $W(G)$ function is intended to capture the notion that ultimately individuals are the beneficiaries of government expenditures.

If a pure land tax regime is Pareto efficient, then the maximization of $\mathrm{E}W(G)$,

$$\max_{\tau} \mathrm{E}W\left\{T\left[\tau \sum_{i=1}^{N} \epsilon_i f\left(\frac{e}{T}\right) + N\Gamma\right]\right\} \tag{4}$$

subject to

$$U = \overline{U} \tag{5}$$

will have a solution at a point of no output taxes: $\tau = 0$.

Note that along the constraint equation 5 we have

$$dU = \frac{\partial U}{\partial \tau} d\tau + \frac{\partial U}{\partial \Gamma} d\Gamma + \frac{\partial U}{\partial e} de = 0.$$

The value of the term $\partial U/\partial e$ is zero because the farmer is optimizing with respect to his effort choice (equation 2). Rearranging the above (and writing out the partial derivatives of utility with respect to the two tax rates) yields the expected-utility-neutral tax changes:

$$-\left(\frac{d\Gamma}{f d\tau}\right)_{\overline{U}} = \frac{E(u'\epsilon_i)}{Eu'} < 1. \tag{6}$$

The inequality in equation 6 means that to keep the farmer's welfare unchanged after raising the expected output tax burden by, say, one dollar, it suffices to reduce the land tax by less than one dollar. This is because an output tax, falling most heavily on the farmer when his income is greatest and least heavily when it is lowest, provides the farmer an insurance benefit. But is such insurance Pareto efficient? It will be if such a change in the mix of output and land taxes increases the social value of government revenues, $EW(G)$.

Differentiating $EW(G)$ in equation 4 with respect to τ and using equation 6 to keep the farmer's welfare constant yields[4]

$$\left[\frac{dEW}{d\tau}\right]_{\overline{U}} = NTfEW'\left[\sum_{i=1}^{N} \frac{\epsilon_i}{N} - \frac{E(u'\epsilon_i)}{Eu'}\right] + \tau f'\left[\frac{de}{d\tau}\right]_{\overline{U}} E\left(W' \sum_{i=1}^{N} \epsilon_i\right) \tag{7}$$

The right-hand side above is the sum of two terms. The first term is the effect of the transfer of risk. To see this, rearrange it as

$$NTfEW'\left[\frac{E\left(W' \sum_{i=1}^{N} \frac{\epsilon_i}{N}\right)}{EW'} - \frac{E(u'\epsilon_i)}{Eu'}\right]$$

The expression in brackets is the difference between the marginal social value of the pooled risk and the marginal private value of each farmer's risk. The difference would be zero if a perfect market for production risks existed or if the opening of a such a market would be redundant (as when remittances among members of extended families provided perfect risk pooling and sharing). In either case, each agent in the economy would exchange production risks until his valuation of those risks at the margin was the same as that of any other agent.

But in an imperfect risk market, individuals will differ in their marginal valua-

4. The restrictions on the density function and preferences that guarantee that $(de/dt)|_{\overline{U}}$ defines the farmer's choice of effort and that equation 4 is everywhere concave in τ are summarized in Hart and Holmstrom (1987, pp. 84–87).

tions of risk. As long as the government's insurance opportunities exceed those of individuals, the condition

$$\frac{E\left(W' \sum_{i=1}^{N} \frac{\epsilon_i}{N}\right)}{EW'} \geq \frac{E(W'\epsilon_i)}{EW'} > \frac{E(u'\epsilon_1)}{Eu'} \tag{8}$$

will hold. The first inequality is strict if individual risks are less than perfectly correlated. In that case, output taxes enable the rural sector to pool risks not pooled in the market. Output taxation serves, in part, the need that would be met by a crop insurance program, while avoiding the information problems intrinsic to the operation of a private insurance market.

The second inequality in equation 8 incorporates the presumption that government (i) has privileged access to international financial markets, (ii) can spread rural risks to the urban sector by domestic spending policy, and/or (iii) can spread risk across time through domestic debt and tax policy. The government resource constraint for the rural sector is not its revenues from the rural sector in any year, but an amount that reflects the tax capacity of both rural and urban sectors over the medium or long term. Thus, the benefit function $W(G)$ should display significantly less risk aversion than the farmer's utility of income function, $u(y)$.

Finally, the role of government in financing public investment goods would also tend to ensure that the second inequality is strict. To see this, let K represent public investment. Most simply, suppose that farmer's welfare is

$$U(y,e,K) = Eu(y) - v(e) + \phi(K), \text{ with } \phi' > 0 \text{ and } \phi'' < 0$$

and assume that $W(G)$ depends linearly on the $\phi(K)$ functions of the agents in the economy. The capital stock in any period depends on the stock in the previous period plus the change arising from new government spending. If this change is a small part of the total, then the social benefit function $W(G)$ will be approximately risk neutral. A single strict inequality in equation 8 is necessary and sufficient to make the first term in equation 7 strictly positive.

The first term in equation 7 reflects the direct benefits of risk pooling and risk spreading, whereas the second term reflects the incentive effects of the output tax. Government is concerned with how a change in output tax rate will affect effort and, hence, output tax revenues. Starting from a pure land tax regime, the government initially is collecting no money from output taxes and therefore is not concerned with the change in effort. The second term vanishes. Hence, $(dEW/d\tau(G))\,|_{\overline{U},\,\tau=0} > 0$, which proves

Proposition 1. If farms are operated by landowners and the opening of a perfect risk market would not be redundant, then the Pareto-efficient tax structure will entail a positive output tax.

Proposition 1 holds independent of the level of government revenues, G. It applies equally to a tax on marketed, exported, or total output, because in any

of these cases the insurance benefit of the tax (the first term in equation 7) is the only first order effect at $\tau = 0$. It also applies where effort is provided by hired labor, as can be easily verified.

It is tempting to call the second term in equation 7 the "distortion" in the effort-leisure tradeoff caused by the output tax. In general this is not correct. The sign of the second term is the same as the sign of $\tau \mathrm{d}e/\mathrm{d}\tau_{\overline{U}}$. As I show in the next section, there exists a set of reasonable conditions under which this term is strictly positive—which means that an increase in the output tax rate increases expected output. Under those conditions, incremental substitution of an output tax for a land tax will reduce not only distortions in the allocation of consumption, but also distortions in the labor-leisure tradeoff arising from imperfections in the risk market.

In a set of simulations that take account of consumption but not production benefits from risk pooling, Jonathan Skinner (in this issue) finds that a pure output tax regime Pareto-dominates a pure land tax regime for sufficiently highly risk-averse taxpayers.

Equation 7 provides a simple condition characterizing the optimal mix of land and output taxes. Because $(\mathrm{d}\mathrm{E}W/\mathrm{d}\tau)_{\overline{U}} = 0$ is necessary for Pareto efficiency, the Pareto efficient tax mix has the property that

$$(9) \qquad -\tau \frac{f'}{Tf}\left[\frac{\mathrm{d}e}{\mathrm{d}\tau}\right]_{\overline{U}} = 1 - \frac{\mathrm{E}u'\epsilon_i/\mathrm{E}u'}{\mathrm{E}\left(W'\sum_{i=1}^{N}\frac{\epsilon_i}{N}\right)/\mathrm{E}W'}$$

From equation 8, the right-hand side of equation 9 is strictly positive for $\tau < 1$. Hence equation 9 implies that to achieve the optimal mix of output and land taxes, a government will set the output tax sufficiently high to make $\tau(\mathrm{d}e/\mathrm{d}\tau)_{\overline{U}} < 0$. At the optimum, the insurance benefits of an increase in the output tax (the right-hand side of equation 9) are just offset by the loss in government revenues arising from the discouragement of effort (the left-hand side of 9).

The Supply Effect of Changing the Mix of Land and Output Taxes

If a perfect insurance market existed, all risks would be tradable and production decisions would depend only on market prices (including market prices for risk). If the insurance market is imperfect, not all risks are priced and production decisions depend, in part, on the decisionmaker's risk preferences. In that case, I suggested above that substitution of an output tax for a land tax can increase effort by reducing the decisionmaker's risk. This section derives that result.

The farmer equates his marginal rate of substitution between income and effort $(v'/\mathrm{E}u')$ to the expected return to effort after taxes less an amount that depends on risk and risk aversion. To see this, the first-order condition for effort in equation 2 can be rewritten as

$$(10) \qquad \left.\frac{\mathrm{d}y}{\mathrm{d}e}\right|_{\overline{U}} = \frac{v'}{\mathrm{E}u'} = (1-\tau)f' - (1-\tau)f'\left[\frac{-\mathrm{cov}\,(u', \epsilon)}{\mathrm{E}u'}\right]$$

This last term corresponds to the farmer's *marginal risk premium* with respect to effort, which is the highest amount that he would pay to be guaranteed the expected value of his marginal productivity. (See the appendix for a proof.)[5]

Intuition suggests that risk may either decrease labor effort because it makes its reward less certain (so that the marginal risk premium rises), or increase labor effort because it threatens the farmer's minimum standard of living (so that $\mathrm{E}u'$ and hence the shadow value of income rises, which reduces $v'/\mathrm{E}u'$ in equation 10).

Formally, the effect of varying levels of output tax on labor effort $(\mathrm{d}e/\mathrm{d}\tau)_{\overline{U}}$ can be evaluated by differentiating the first-order condition, equation 2, with respect to the output tax rate using equations 3 and 6:

$$(11) \qquad \left(\frac{\mathrm{d}e}{\mathrm{d}\tau}\right)_{\overline{U}} = \frac{f'}{-\Delta}\mathrm{E}\left\{-u'\epsilon + Tu'A(1-\tau)f\left[\epsilon^2 - \frac{\epsilon\mathrm{E}(u'\epsilon)}{\mathrm{E}u'}\right]\right\}$$

where A is the absolute risk aversion function, $-u''/u'$. This equation shows the change in effort in response to an increase in the output tax and a fall in the land tax that keeps the farmer's expected utility constant. The direction of change (the sign of equation 11) will be the same as the sign of the expression in curly brackets.

The first term in curly brackets represents the individual's valuation of the drop in the after-tax price of output: it is negative.

The change in tax regime also induces a decrease in risk. This is captured in the second term within curly brackets, which is ambiguous in sign.[6] Consider three cases, which illustrate the response at different values of risk aversion and output taxes.

Case 1. As output taxes approach 100 percent ($\tau \approx 1$), the farmer's welfare becomes independent of his output fluctuations. The second term within curly brackets drops out, so that $(\mathrm{d}e/\mathrm{d}\tau)|_{\overline{U}}$ is negative.

Case 2. If relative risk aversion, $u''y/u'$, denoted by R, is constant and land taxes approach zero, then the second term within curly brackets again vanishes:

$$R\mathrm{E}\left[u'\left(\frac{\epsilon - \mathrm{E}u'\epsilon}{\mathrm{E}u'}\right)\right] = 0$$

This means that investment in effort depends only on the mean return, not its riskiness, so $(\mathrm{d}e/\mathrm{d}\tau)|_{\overline{U}}$ is negative.

5. Again, nothing essential is changed if the marginal unit of effort is provided by a hired hand. Let the utility function of the hired hand be $U_w = u_w(y_w) + v_w(e_w)$, and let $u(y)$ still denote the landowner's utility of income. Then the analog to equation 10 is

$$\left.\frac{\mathrm{d}y_w}{\mathrm{d}e_w}\right|_{\overline{U}} = \frac{v'_w}{u'_w} = (1-\tau)f'\left[1 + \frac{\mathrm{cov}(u',\epsilon)}{\mathrm{E}u'}\right]$$

6. The general case of mean-utility-preserving increases in risk is treated in Diamond and Stiglitz (1974). They show that the effect of an increase in risk on any action will be unambiguous only if the derivative of utility with respect to that action is strictly concave or convex in utility.

Thus, in cases 1 and 2, a compensated increase in the output tax will reduce effort, just as in the perfect markets models analyzed by the classical economists. Let (τ_0, Γ_0) represent the original tax regime in figure 1, and let $e(\tau_0, \Gamma_0)$ represent the farmer's effort choice at that tax regime (the solution to the first-order condition in equation 2). The change in tax mix toward higher output taxes and lower land taxes induces a leftward shift in the expected utility function, illustrated in figure 1.

Case 3. If absolute risk aversion, A, is constant, the second term within the curly brackets in equation 11 can be rewritten as

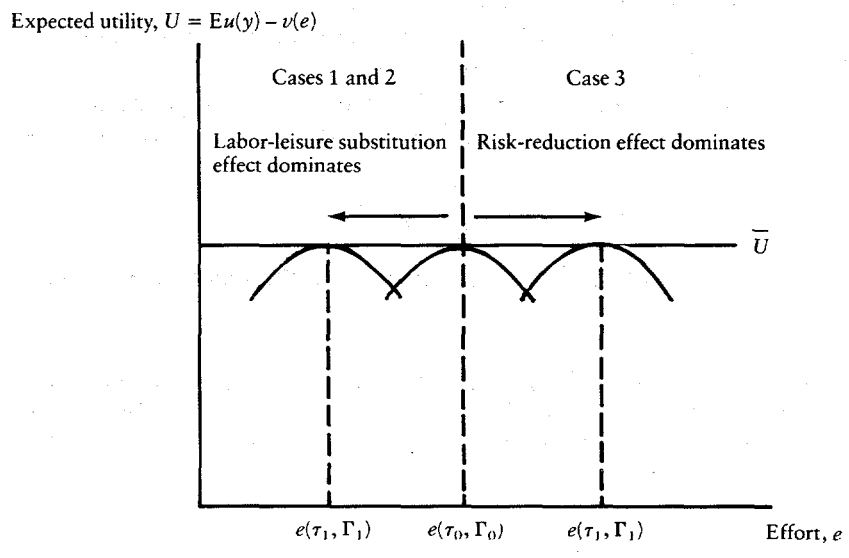
$$TA(1-\tau)f\left\{ \mathrm{E}(u'\epsilon^2) - \frac{[\mathrm{E}(u'\epsilon)]^2}{\mathrm{E}u'} \right\} > 0 \tag{12}$$

In this case, the insurance effect of a shift to output taxes will increase effort.

The sign condition in equation 12 follows from the Schwarz inequality, which states that for any two random variables X and Z defined on the same space, $\mathrm{E}(X^2)\mathrm{E}(Z^2) \geq [\mathrm{E}(XZ)]^2$ with equality only if X is proportional to Z. Let $X = \sqrt{u'}$ and $Z = \sqrt{u'}\epsilon$. Then the Schwarz inequality becomes $\mathrm{E}u'\mathrm{E}(u'\epsilon^2) \geq [\mathrm{E}(u'\epsilon)]^2$, which implies that the left-hand side of inequality 12 is nonnegative and is strictly positive unless $\sqrt{u'}\epsilon$ is proportional to ϵ. Equivalently, it is strictly positive unless output is riskless.

For sufficiently high-risk or absolute risk aversion or after-tax expected out-

Figure 1. *The Effect on Labor Effort of an Increase in Output Taxes and a Decline in the Land Tax that Keeps Utility Constant*



Note: Γ = land tax per acre; τ = output tax in percent. In case 1, $\tau_0 \approx 100$; in case 2, $\Gamma_0 \approx 0$ and relative risk aversion is constant; and in case 3, absolute risk aversion is constant and income risk is large.

put $[T(1 - \tau)f]$, the positive effect on effort of the reduction in income fluctuations (captured in inequality 12) will exceed the negative substitution effect $[-E(u' \epsilon)$ in equation 11], and effort will be a rising function of the output tax. Thus, for some positive output tax $\tau < 1$, an *increase* in output tax compensated by a *reduction* in land tax will induce the rightward shift of the farmer's utility functions, illustrated in figure 1, the opposite of the shift that the classical economists would have predicted. My results are summarized below:

Proposition 2. If farms are operated by landowners and the opening of a perfect risk market would not be redundant, then the output effects of changes in the mix of land and output taxes (holding the landowner's expected utility constant) are ambiguous. For example, (i) if landowners have constant *relative* risk aversion, a higher output tax will reduce expected output; and (ii) if landowners have constant *absolute* risk aversion and risk and risk aversion are sufficiently great, then a higher output tax will increase output over some range of output taxes, $0 < \tau < 1$.

It is well known that income effects of taxation also increase labor effort; that is, leisure is a normal good. Hence, the surprising ability of an output tax to increase output is strengthened if the tax is not compensated. Reconsider, for example, case 2, in which relative risk aversion is constant and land taxes approach zero. Using equation 11:

$$\text{sign } de/d\tau = \text{sign } [Eu'\epsilon(R - 1)]$$

so that if $R > 1$, an uncompensated output tax increases labor effort (for a comparable result using a sharecropping model, see Braverman and Stiglitz 1989, p. 9).

II. The Jomen and the Kemi

Newbery informally suggests: "The problem [posed for land taxation by] fluctuating income can be met by linking last year's tax liability to the value of aggregate output throughout the country or region" (1987, p. 380). This form of land taxation has been used in many countries. In Japan, for much of the Tokugawa period land taxes were collected as a variable levy based on estimates of aggregate crop yields prorated according to land quality and area. This variable levy, called the *kemi*, was replaced by a lump sum tax on land value, the *jomen*, toward the end of the Tokugawa period (Otsuka, Chuma, and Hayami 1989, p. 20).

This section first compares the risk and incentive properties of the *jomen* and *kemi*. It then demonstrates that, in general, a Pareto-efficient mix of a *kemi* and a simple output tax (τ, as before) will include an output tax.

Let subscript i index farms, $i = 1, 2, \ldots, N$, and let subscript j index time

periods. Farm outputs over space and time can be represented in a matrix

$$
\begin{array}{cc}
 & \textit{Period} \\
\textit{Farm} & \begin{bmatrix}
q_{11} & \cdots & q_{1j} & \cdots & q_{1,j+1} & \cdots \\
\vdots & & \vdots & & \vdots & \\
q_{i1} & \cdots & q_{ij} & \cdots & q_{i,j+1} & \cdots \\
\vdots & & \vdots & & \vdots & \\
q_{N1} & \cdots & q_{Nj} & \cdots & q_{N,j+1} & \cdots
\end{bmatrix}
\end{array}
$$

← *Jomen*, fixed land tax based on value of a farm's output over time

↑ *Kemi*, variable rate harvest tax based each period on crop yields throughout a region

With the simple technology of equation 1 and homogeneous land and labor, a *jomen* amounts to taxing the ith landlord on the discounted sum of the ith row adjusted for labor costs. A variable aggregate output levy, such as the *kemi*, amounts to taxing the landlord on the sum of a column, adjusted for total labor costs within one period and prorated according to land quality and area. A simple output tax is a tax on the individual cells of the matrix.

A *kemi* permits new possibilities for risk sharing and incentives if farmers' risks in any period are correlated. Suppose that output per worker on farm i in period j is

$$q_{ij} = [g_j + \epsilon_{ij}] f\left(\frac{e}{T}\right) T$$

where g_j is a common random variable, normalized at mean one, and is uncorrelated with the independently distributed individual shocks, ϵ_{ij}:

$$\text{(13)} \qquad \mathrm{E}\epsilon_{ij} = \mathrm{E}(g_j\epsilon_{ij}) = \mathrm{E}(\epsilon_{ij}\epsilon_{i'j}) = 0 \quad \text{for } i \neq i'.$$

Finally, suppose that there are a large number (N) of identical family farms (with the number of workers on each normalized at one). All then have the same expected output, $\bar{q}$. Total output in period j (the sum of a column in the output matrix) is

$$\sum_{i=1}^{N} q_{ij} = \bar{q}\left(Ng_j + \sum_{i=1}^{N} \epsilon_{ij}\right).$$

Replacing a *jomen* by a *kemi* that yields the same expected tax revenue induces a mean income-preserving decrease in the landowner's risk:

$$y_{\text{with kemi}} = y_{\text{with jomen}} + k(1 - g_j)\,\bar{q}$$

where k is the rate of *kemi* tax expressed as a proportion of the aggregate harvest, Σq_{ij}, per unit of land. A *kemi* is thus equivalent to a *jomen* plus an actuarily fair insurance plan. The farmer's insurance receipts are positive if the year is bad for the collective of farmers ($g < 1$), and negative otherwise.

This discussion is not academic. After the *kemi* was replaced by the *jomen* at the end of the Tokugawa period (as part of a general legal reform in property rights in land), bad crop years sometimes saw revolts against the tax (Dore 1959).

Under the assumption that the individual (ϵ_{ij}) and the common (g_j) sources of risk are independently distributed (equation 13), the *kemi* provides risk pooling with nearly perfect incentives. The farmer's choice of effort solves

$$\max_e = \mathrm{E}u[(g_j + \epsilon_{ij})f(e/T)T - Tkg_j\bar{q}] - v(e)$$

yielding the first-order condition

$$f'\mathrm{E}\left[u'\left(g_j + \epsilon_{ij} - kTg_j\frac{\mathrm{d}\bar{q}}{\mathrm{d}q_{ij}}\right)\right] = v'$$

Given many small farms, to an individual farmer the effect of an increase in his farm's output on the *kemi* tax will not be perceptible, so that each acts as a price-taker with respect to the *kemi*: $\mathrm{d}\bar{q}/\mathrm{d}q_{ij}$ will be ignored and the risk advantage of the *kemi* comes without cost in incentives. It is apparent that a *kemi* dominates a *jomen* when assumption 13 holds and administrative costs and problems are excluded.

A *kemi* that is levied on the individual farmer will have the further advantage, not captured in this model, of increasing the expected utility cost of poor farm management. Unlike a *jomen* or an output tax, the landowner under the *kemi* will bear increased risk if he fails to take reasonable care to make his land productive. The tax due under the *kemi* will be high in years in which agricultural conditions are generally favorable and low in unfavorable years, so the penalty for poor management will become a random variable.[7]

I return now to the question posed at the beginning of this section: does the land tax in the form of a *kemi* solve the problem of fluctuating incomes? Consider first the Pareto-efficient mix of a *kemi* and a simple output tax. Using a proof virtually identical to that for proposition 1 leads to the following result:

7. The *kemi*'s potential role in reducing slack among landowners is analogous to the role played by the competitive price system in reducing managerial slack: when environmental conditions are good so that output rises, the competitive market price falls and managers who did not take advantage of the good conditions may be forced into bankruptcy (see Nalebuff and Stiglitz 1983).

Proposition 3. The Pareto-efficient mix of an output tax and a land tax at rate k that is indexed to the aggregate regional harvest will entail a positive output tax if (i) individual risk is at least as great as the farmer's share of the common risk, $(1 - k)g$, and (ii) the opening of a perfect risk market would not be redundant.

From the government's perspective, the risk properties of the simple output tax and *kemi* are identical. But from the farmer's perspective, the simple output tax has the advantage that it absorbs his individual risk as well.

There are sharp limits to the ability of the *kemi* to reduce risk if individual farm shocks are negatively correlated within a region. Dropping assumption 13, suppose that $E\epsilon_i\epsilon_{i'} < 0$ for $i \neq i'$. This case would plausibly arise when inputs (such as tubewells, draft animals, and seed qualities) are heterogeneous across farms, so that some landowners cope well with dry weather and others cope well with wet weather. Under a *kemi*, a farmer's tax will be a higher share of his output, the *worse* his relative good fortune. Under these conditions, for some farmers the risk-sharing properties of a *jomen* will be superior to those of a *kemi*. This tends to strengthen the case for combining the indexed land tax with a simple output tax.

III. Sharecropping Economies

Economies adapt to the absence of risk markets by developing institutions that perform the functions that would otherwise have been served by the missing markets. Sharecropping is partly an adaptation to the absence of risk markets. Evidence suggests that in rural areas where the risk-sharing properties of tax instruments are most important, contracts between landowners and workers are likely to be characterized by sharecropping in lieu of simple rental and wage contracts.[8] Hence it is important to ask whether the central results of this article, proposition 1 and its corollary, proposition 3, extend to the case in which land is farmed under sharecropping. To highlight the main issues, I treat the linear sharecropping contract here. My qualitative results will also apply to a nonlinear sharecropping contract, which can be analyzed along the lines set forth in Hart and Holmstrom (1987, p. 78).

Taxation in the presence of sharecropping is a nested principal-agent problem. The landlord can be viewed as a local tax authority whose "tax system" will change to take advantage of changes in the government's tax regime. The gov-

8. See, for example, Rosenzweig (1988, table 2). Stiglitz (1974) and Newbery (1977) show that the ability of share contracts to spread risk is redundant only in the special case that three conditions hold at the same time: (i) the labor market provides a riskless wage, w, and full employment, (ii) the productivity of workers paid a wage is the same as that of workers who are paid an output share, and (iii) the farmer can divide his time between working on rented land and working for a wage. Under these conditions, a farmer that spends a share α of his time on land rented at rate r and the rest as a wage earner will earn income $\alpha(q - r) + (1 - \alpha)w$, which spans the space of linear sharecropping contracts.

ernment can be thought of as maximizing its expected value of revenues function, $EW(G)$, subject to the constraint that taxpayers achieve a given level of utility from private goods, while landowners choose a sharecropping contract subject to the constraint that sharecroppers achieve a reservation utility level.

Determination of the Linear Tenancy Contract

Consider the determination of the equilibrium tenancy contract in the medium run, where the landlord is free to adjust the parameters of the contract but not the number of his tenants.[9] For simplicity, assume he has only one tenant and normalize land units so that he owns $T = 1$. To induce the tenant to work on his land, the landlord must offer a contract that yields the tenant his reservation utility level, $\overline{U}$. The tenant has the same utility function as the independent farmer in section I: $U = Eu(y) - v(e)$. The production function also is as in equation 1. With the normalization $T = 1$ and the assumption that $L = 1$, the landlord's production function reduces to $q = \epsilon f(e)$. Define output units so that $E\epsilon = 1$.

The assumption of a fixed number of tenants simplifies the model and is inessential to the results below. However, the assumption of a fixed reservation utility for the tenant, invariant to tax regime, is important and restrictive. In the long run, both the number of tenants per landlord and their "price" U would be endogenous.[10] A fixed tenant reservation utility level is consistent with long-run general equilibrium only if other sectors in the economy can absorb tenants at a fixed wage.

A linear tenancy contract provides payment to the sharecropper as some combination of a share of output, α, and a lump sum, β, yielding tenant after-tax income of:

$$y_w = \alpha(1 - \tau)\,\epsilon f(e) + \beta$$

Notice some special cases: $\beta = 0$: pure sharecropping; $\beta < 0$, $\alpha = 1$: lump-sum rent; $\beta > 0$, $\alpha = 0$: lump-sum wage. So long as $0 < \alpha < 1$, the contract will have a sharecropping element to it.

Landlord income after tax is

$$y_r = (1 - \alpha)(1 - \tau)\,\epsilon f(e) - \beta - \Gamma$$

The landlord wishes to choose a contract that maximizes his own expected

9. The contract described here is based on Stiglitz (1974, part 2).

10. The general equilibrium problem yields a matrix equation. The variables entering into the demand for tenants are the parameters of the share contract and also e, L, $\overline{U}$, and the Lagrange multiplier on the sharecropper utility constraint perceived by the landlord. The shift in the demand curve for tenants $L(\overline{U})$ induced by changes in the tax regime depends on income effects and output elasticities. This article does not consider the incidence of the land tax, but preliminary work suggests that solutions are quite messy and that in particular cases the tax may be borne partly by the tenant.

utility, denoted $EV(y)$, subject to the constraint of providing a reservation utility level to the sharecropper:

$$\max_{\alpha} \; EV\,[(1-\alpha)(1-\tau)\,\epsilon f(e) - \beta - \Gamma] \text{ subject to } U \geq \overline{U} \tag{14}$$

The landlord can observe tenant output, but we make the reasonable assumption that there is at least some dimension of effort that the landlord cannot monitor.

The structure of the landlord's problem in equation 14—his choice of a $(1 - \alpha)$ share in the tenant's output and the tenant's choice of an effort level—is an instance of the same principal-agent relation as in equations 4 and 5, in which the government chose a τ share in farm output and the family chose its effort level. In this light, proposition 1 above can be seen as a straightforward extension of the well-known explanation of sharecropping as a (locally) Pareto-efficient contract between landlord and tenant when risk markets are absent and effort is difficult to monitor (Stiglitz 1974, proposition 11).

Stiglitz's result and proposition 1 can be summarized as follows: if risk markets are insufficiently developed to equate the marginal valuations of risk of landlord and tenant (or government and taxpayer), then the Pareto-efficient linear tenancy contract (or tax regime) must have a share element to it, that is, $0 < \alpha < 1$ (or $0 < \tau < 1$). The next section considers whether this result applies as well to the Pareto-efficient tax regime in the presence of sharecropping.

The Pareto-Efficient Mix of Output and Land Taxes under Sharecropping

Define the tenant's after-tax share in output,

$$\hat{\alpha} \equiv \alpha\,(1-\tau)$$

and think of the landlord, given some output tax τ, as choosing the variable $\hat{\alpha}$ instead of α. The tenant's effort can then be written as a function of $\hat{\alpha}$.

Government revenues from the representative landlord are

$$G = \tau\,\epsilon f[e\,(\hat{\alpha})] + \Gamma$$

The effect of an increase in the output tax rate on the social value of government revenues, $EW(G)$, holding landowner expected utility unchanged, is

$$\left.\frac{dEW(G)}{d\tau}\right|_{\overline{U}} = fE\left[W'\left(\frac{\epsilon - EV'\epsilon}{EV'}\right)\right] + \tau E\,(W'\epsilon)f'\left(\frac{de}{d\hat{\alpha}}\right)\frac{d\hat{\alpha}}{d\tau} \tag{15}$$

The last term is ambiguous in sign, but vanishes at $\tau = 0$.

Proceeding as we did with equation 7, we can rewrite the first term on the right-hand side of equation 15 in terms of the difference between the social marginal valuation of risk and the landlord's marginal valuation:

$$fEW'\left[\frac{E(W'\epsilon)}{EW'} - \frac{EV'\epsilon}{EV'}\right] > 0 \tag{16}$$

Recall that the landlord will choose to bear some risk (that is, $0 < \hat{\alpha} < 1$ for $\tau < 1$). If the opening of a perfect risk market would not be redundant, then equation 16 holds as before, because of the superior risk-spreading and risk-pooling opportunities available to the government. From this it follows that $dEW(G)/d\tau|_{\overline{V},\ \tau=0} > 0$. This proves that proposition 1 extends to land under sharecropping:

Proposition 1'. If land is farmed by sharecroppers and the opening of a perfect risk market would not be redundant, then the Pareto-efficient tax structure will entail a positive output tax.

Of course, if the landlord is risk neutral, then $E(V'\epsilon)/EV'$ is equal to one, inequality 16 becomes nonpositive, and proposition 1' does not apply. From the perspective of a risk-neutral landlord, the opening of a perfect risk market would be redundant. From the perspective of the tenant, risk markets appear imperfect, but the imperfection in fact lies in moral hazard in the labor relationship between landlord and tenant. If the landlord could costlessly monitor the tenant's work, then a risk-neutral landlord would offer his tenant a fixed wage contract.[11] The landlord would thus bear all income risk. Because he is risk-neutral, the opening of a perfect risk market would be redundant.

IV. Conclusion

This article has argued that there is a misconception in the pure theory of land taxation. In economies in which landowners are unable to obtain complete insurance against production risks—for practical purposes, all developing economies—the classical propositions on the efficiency of land taxes do not hold. Compared with a mix of land and output taxes, a land tax will exacerbate the distortions arising from missing risk markets. The right mix of output and land taxes will yield larger average government revenues (and higher social welfare) than a pure land tax, at a fixed cost in taxpayer utility.

Moreover, output taxes need not stifle economic activity. Under plausible conditions for a rural sector of small landowners, a small output tax and offsetting cut in land taxes will increase effort and, hence, output.

This article has ignored administrative costs. Jonathan Skinner (in this issue) argues that the problem of equitably administering a tax on land value is the most important economic deficiency in the land tax compared with an output tax.

This article also has not considered the incidence on sharecroppers of changes in the mix of land and output taxes. Preliminary work indicates that landlords may not bear the entire burden of the tax; thus, empirical research in this area

11. The intuition is straightforward. With effort costlessly observable, it will be contractually specified. The contract between landlord and tenant then no longer serves as an incentive mechanism but only as a means to attract the tenant. The cheapest way for a risk-neutral landlord to compensate a risk-averse tenant is through a riskless payment—a fixed wage.

would be important. The analysis of output taxes on farms under tenant cultivation also could be extended to other problems involving nested principal-agent relations. The sharecropping model is a prototype for many agency relations where, because of missing markets and costly information, markets clear through contracts based on more than just a price. This suggests that analyses that take account of the nature of contracting in specific markets may overturn the standard results on tax incidence.

Appendix: The Marginal Risk Premium with Respect to Effort

The total risk premium is the maximum amount that the farmer would pay for crop insurance. In the following identity, it appears as c:

$$u\left[T(1-\tau)f\left(\frac{e}{T}\right) - T\Gamma - c\right] = \mathrm{E}u\left[T(1-\tau)\epsilon f\left(\frac{e}{T}\right) - T\Gamma\right]$$

in which u is farmer utility of income, T is the number of acres farmed, f is output per unit of land, e is labor effort, τ is the output tax, Γ is the land tax per acre, and ϵ is a random variable with mean of one.

Differentiating both sides with respect to effort (and letting y denote after-tax income from farm production) yields

$$\begin{aligned} u'(\mathrm{E}y - c)\left[(1-\tau)f' - \frac{\mathrm{d}c}{\mathrm{d}e}\right] &= \mathrm{E}[u'(y)\epsilon](1-\tau)f' \\ &= (1-\tau)f'[\mathrm{E}u'(y) + \mathrm{cov}(u', \epsilon)] \end{aligned}$$

But

$$u'(\mathrm{E}y - c) \approx \mathrm{E}u'(y) \tag{A-1}$$

so that the marginal risk premium with respect to effort can be written as:

$$\frac{\mathrm{d}c}{\mathrm{d}e} \approx -(1-\tau)f'\left[\frac{\mathrm{cov}(u', \epsilon)}{\mathrm{E}u'(y)}\right] \tag{A-2}$$

Equation A-2 establishes that the marginal risk premium with respect to effort is approximately equal to the last term in equation 10 in the text.

Equations A-1 and therefore A-2 hold exactly if marginal utility is a linear function of utility. To see this, let $y(u)$ be the inverse utility function and note that by construction $u[y(u)]$ (the random utility obtained when income is risky) is a mean utility preserving spread of $u(\mathrm{E}y - c)$ (the utility obtained at the riskless income $\mathrm{E}y - c$). The condition that marginal utility is linear in utility is identical to the condition that preferences are characterized by constant absolute risk aversion, because

$$\begin{aligned} \frac{\mathrm{d}^2}{\mathrm{d}u^2}\{u'[y(u)]\} = \frac{\mathrm{d}}{\mathrm{d}u}\frac{u''}{u'} &= -\frac{\mathrm{d}}{\mathrm{d}u}A[y(u)] \\ &= \frac{-A'}{u'} \gtreqless 0 \Leftrightarrow A'(y) \lesseqgtr 0 \end{aligned}$$

Hence equation A-2 holds exactly if the farmer's degree of absolute risk aversion is independent of his income.

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