EFFICIENT REDISTRIBUTION USING QUOTAS AND SUBSIDIES IN THE PRESENCE OF MISREPRESENTATION AND CHEATING

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This paper introduces misrepresentation and cheating into the policy analysis of output quotas and subsidies. Analytical results show that when cheating occurs output quotas are a less efficient means of income redistribution than is traditionally believed. As well, cheating increases the transfer efficiency of output subsidies. The result is that an all-or-nothing choice between quotas and subsidies will generally favor the use of subsidies. A combination of quotas and subsidies, however, usually remains the most efficient means of income redistribution through market intervention.

Key words: agricultural policy, cheating, misrepresentation, output quotas, output subsidies, transfer efficiency.

A key assumption in agricultural policy analysis is that farmers follow the provisions of the policy instruments in the manner desired by the policy maker, or alternatively, that it is costless to ensure that farmers do so. In reality, however, farmers may be expected to act opportunistically when faced with an agricultural policy. When a production quota is in effect, farmers may cheat by overproducing and selling the above-quota amount through alternative channels; under an output subsidy scheme, farmers may report and collect on a greater quantity of production than they actually produced.

The possibility of misrepresentation and cheating arises because it is costly to determine farmers' actions. Because of this cost, farmers are in a position to misrepresent their quantity of production and/or to cheat. Very few studies have incorporated misrepresentation or cheating in theoretical agricultural policy analysis. One exception is Alston and Smith who raise the question of cheating and "black market" activity in an examination of rationing in an industry with an effective minimum price policy in place. Studies that deal with farmer opportunism can also be found in the crop insurance literature (see for example Chambers, LaDue).[1]

Cases of cheating on farm programs are often reported by the European press (Moyer and Josling). Fraud is argued to have permeated the Common Agricultural Policy (CAP) (Ockenden and Franklin, Gardner 1996), with policy rules not being rigorously applied (Swinbank and Tanner). The loss from "...subsidies claimed on goods that do not exist, subsidies claimed on goods of a higher quality than those actually being exported or processed, the subsidies paid out for non-existent olive trees, for the grubbing of phantom orchards, for the retiring of imaginary cows..." is estimated to be around 3.6 billion ECU per year (Gardner 1996, p. 46). Violation of quota limits and excess production of regulated commodities are also quite common in the European Union (EU). This is especially true for the milk quotas in the Mediterranean regions (Buckwell). Cheating on farm programs is not an exclusive European characteristic. Alston reports that when

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[1] There is also a significant body of literature examining misrepresentation and cheating in other areas of public policy. For instance, there is an extensive literature on income tax evasion (Cowell, Chander and Wilde) and the violation of environmental regulations (Harford 1978, 1987, Garvie and Keeler, Cohen). In the case of income tax evasion, taxpayers misrepresent the level of their taxable income. The nature of cheating on environmental regulations depends on the policy instrument used. For instance, when emission quotas are in effect cheating means emitting in excess of the quota limit while when firms self-report the pollution they generate, cheating is translated into misrepresentation of this pollution level.

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hen quotas were used to control the egg market in the state of Victoria, Australia, it was estimated that the black market accounted for 10–30% of all eggs. The existence of a United States Department of Agriculture (USDA) "hotline" where cases of "fraud" can be reported indicates that the problem of cheating on farm programs is not unknown to U.S. agricultural policy makers (USDA Office of Inspector General).

The objective of this paper is to introduce enforcement costs and the potential for farmer misrepresentation and cheating into the theoretical analysis of agricultural policy. The study builds on the literature on efficiency in redistribution through commodity markets introduced by Gardner (1983) and extended by numerous articles in this journal (see for instance Alston and Hurd, Moschini and Sckokai). In pursuing this objective, the paper focuses on the economic effects of misrepresentation and cheating in the context of three stylized policy instruments—output quotas, output subsidies, and a combination of an output quota and a subsidy.

Of course, real world quota and subsidy programs are rarely used in their pure form. Supply restrictions often appear as marketing or input quotas rather than production quotas. Output subsidies are often combined with price supports and/or quantity restrictions in the factor markets such as acreage restrictions (e.g., the U.S. grains policy prior to the enactment of the 1996 FAIR Act and the CAP policy for grains in the EU). To keep the analysis general, the case-specific complications of particular policies or programs are not considered in the model developed in this paper.

The paper also does not consider the social consequences of cheating even though they are potentially important. For instance, widespread cheating in a society may create a culture of dishonesty softening the moral constraints to illegal behavior (Lea, Tarpy, and Webley).

The model developed in this paper begins by assuming that penalties for cheating are set by the legal system and are therefore exogenous to agricultural policy makers. When the costs and benefits of cheating on output quotas are considered, the optimal policy depends on the size of the enforcement costs—relatively low costs imply full deterrence is optimal, while relatively high costs imply allowance. For output subsidies, the costs of full deterrence exceed the benefits, implying that the optimal policy involves the allowance of cheating. Finally, the analysis is extended to the case where penalties for cheating on quotas and subsidies are endogenous to agricultural policy makers.

Output Quotas with Cheating

In traditional agricultural policy analysis, output quotas transfer income from consumers to producers through the increased market prices that result from the output restrictions (Wallace, Gardner 1983, 1987). Taxpayer welfare is not affected by output quotas, since there are no budgetary costs from the program. The implicit assumption in this analysis is that farmers do not produce above their quota level—i.e., farmers do not cheat.

Given the increased price and rents that result from the output quota, however, farmers may be tempted to increase their returns further by producing over their quota amount. In the simplest case, suppose a representative farmer has an objective of maximizing expected profits. The problem facing the risk-neutral farmer can be written as

$$(1)\quad \max_{q^m} E[\pi] = p(\overline{Q} + Q^m)(\bar{q} + q^m) - c(\bar{q} + q^m) - \delta\rho q^m$$

where q^m is the above-quota production, $p(\overline{Q} + Q^m)$ is the market price when the industry quota is set at $\overline{Q}$ and the aggregate amount of cheating by the N representative producers equals Q^m, $\bar{q}$ is the output quota allocated to the representative farmer, $c(\bullet)$ is the cost function, ρ is the penalty charged per unit of over-produced and detected quantity, and δ is the probability that the farmer will be audited.[2] (δ is also the probability that the farmer will be detected and penalized in the case where the quota limit is violated.)

The audit probability takes values between zero and one (i.e., $\delta \in [0, 1]$) and is assumed to be a linear function of the over-quota quantity, i.e.,

$$(2)\quad \delta = \delta_0 + \delta_1 q^m.$$

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[2] Implicit in the formulation of the problem presented in equation (1) is the assumption that the representative producer holds competitive conjectures; he does not perceive that he has any impact on aggregate output. Even though the representative farmer believes that he faces a perfectly elastic demand curve, he does conjecture an aggregate amount of cheating, Q^m, that increases production and depresses the market price, which the farmer then takes as exogenous.

The parameters δ_0 and δ_1 are taken as given by the representative farmer. The base audit probability δ_0 is assumed to be a function of the resources spent by policy enforcers in monitoring farmers' actions. The parameter δ_1 is strictly positive and is assumed to depend on factors affecting the observability of farmers' actions outside the control of policy enforcers. The penalty ρ is assumed to be set by the legal system and is, therefore, also exogenous to agricultural policy makers. The assumption of an exogenous penalty is standard in the economics of crime literature. It is relaxed later in the paper.

The first-order condition for the problem specified in equation (1) is

$$(3) \quad p(\overline{Q} + Q^m) = c'(\bar{q} + q^m) + (\delta_0 + 2\delta_1 q^m)\rho.$$

The optimal above-quota production q^m is determined by equating the market price $p(\overline{Q} + Q^m)$ with the marginal cost $c'(\bar{q} + q^m)$ plus the marginal penalty $(\delta_0 + 2\delta_1 q^m)\rho$. The marginal penalty (mp) is the change in the expected penalty for a unit change in the above-quota output, where the expected penalty function (pf) is $\text{pf} = \delta\rho q^m$.

Figure 1 shows the impact of over-quota production from an industry perspective. Total production by all farmers, $Q^* = \overline{Q} + Q^m$, can be found by equating the (downward sloping) demand curve facing the industry, D, with the vertical summation of the industry supply curve, S, and the industry-level marginal penalty curve MP. Curve S is the horizontal summation of the individual marginal cost curves, while MP is the horizontal summation of the mp curves. The MP curve has the same intercept $(\delta_0\rho)$ as the average penalty function $(\text{APF} = (\delta_0 + \delta_1 Q^m)\rho)$, where the origin is the point $(0, \overline{Q})$. The slopes of the MP and APF curves are $2\delta_1\rho/N$ and $\delta_1\rho/N$, respectively. Above-quota production is thus a function of $\overline{Q}$, ρ, δ_0, δ_1, and the parameters of the supply and demand curve. For example, given a linear demand curve $p = a_0 - a_1 Q^*$ and a linear supply curve $p = b_0 + b_1 Q^*$, the equilibrium Q^m is

$$(4) \quad Q^m = \frac{(a_1 + b_1)(Q^e - \overline{Q}) - \delta_0\rho}{a_1 + b_1 + \frac{2\delta_1\rho}{N}}$$

where Q^e is the equilibrium quantity produced in the absence of policy intervention.

Since δ_1 and ρ are assumed to be exogenously determined, the only avenues agricultural policy makers have for influencing farmers' production decisions are the choices of δ_0 and $\overline{Q}$. Increasing $\overline{Q}$ to reduce over-quota production reduces the income transferred to farmers, while increasing δ_0 to reduce

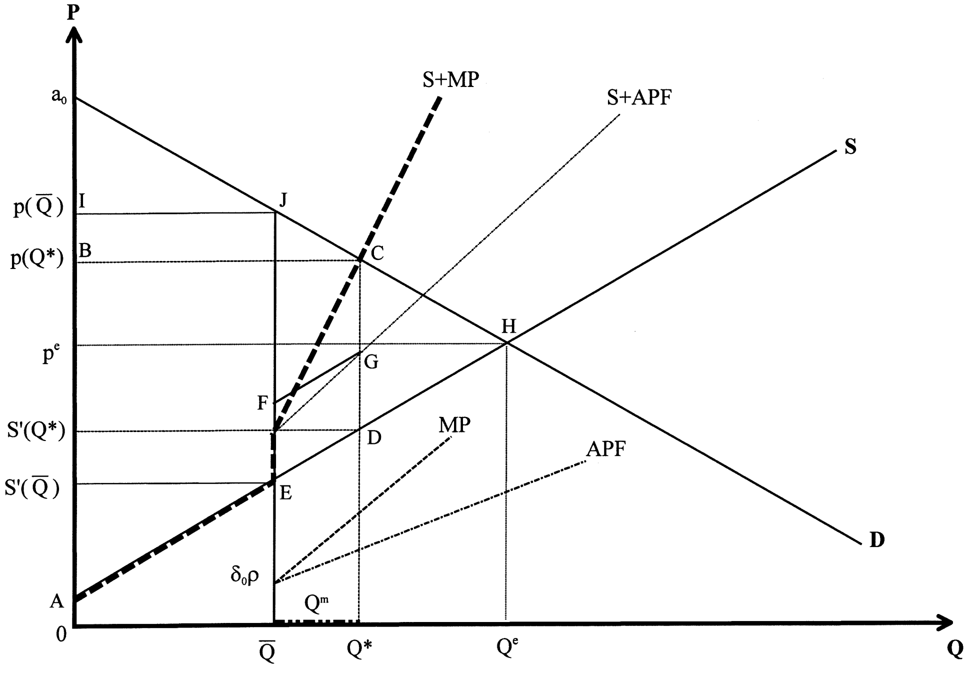

Figure 1. Welfare effects of production quotas with cheating

over-quota production results in monitoring and enforcement costs, Φ. The monitoring and enforcement costs are assumed to be an increasing function of the base audit probability ($\Phi'(\delta_0) \geq 0, \Phi''(\delta_0) \geq 0$).

When cheating is not considered, producer welfare is given by the area $0IJ\overline{Q} - 0AE\overline{Q}$, while consumer welfare is equal to area a_0IJ in figure 1. When cheating is introduced into the analysis, the above-quota production results in increased consumer surplus by the area IJCB. If the government incurs the cost of monitoring and receives the penalties collected when farmers are penalized, the expected benefits to farmers are equal to area $0BCQ^* - 0ADQ^* - DEFG$, where area DEFG represents the penalty farmers expect to pay on over-quota production, $\delta\rho Q^m$. Alternatively, when the monitoring costs are incurred collectively by the producers of the regulated commodity (e.g., the case with tobacco growers in the United States who pay for monitoring crops grown outside the marketing quota system), the expected benefits to farmers are reduced by $\Phi(\delta_0)$. In such a case, taxpayers are net beneficiaries of the program, since they receive the revenues from penalties on detected overproduction.

The consequence of introducing cheating into the analysis of production quotas can be summarized in the surplus transformation curve (STC) analysis (see Gardner 1983 for details on the STC). The curve STC in figure 2 is hypothetical and can be interpreted as either: (*a*) farmers do not cheat or (*b*) program enforcement is perfect and costless. Curve STC has the same shape and position as the STC drawn in the standard agricultural policy analysis when cheating is not considered (Gardner 1983). Although STC is useful as a reference point, it ignores enforcement costs and above-quota production.

The other curves in figure 2 show the trade-off between producer surplus and consumer surplus plus taxpayer surplus when cheating is considered and is costly to deter. The situation where the government incurs the monitoring costs is examined first, followed by consideration of the case where farmers incur the monitoring costs. Curve STC_0 represents the situation where $\delta_0 = 0$. With $\delta_0 = 0$ enforcement costs are zero and cheating occurs. Cheating implies some probability of detection and detection means some of the surplus is returned to taxpayers in the form of a producer penalty. Because of this transfer to taxpayers, total output has to be reduced further than would otherwise be required to ensure a given transfer to producers. Since this reduction in output results in a further deadweight welfare loss (DWL), STC_0 lies below STC everywhere to the left of E, the

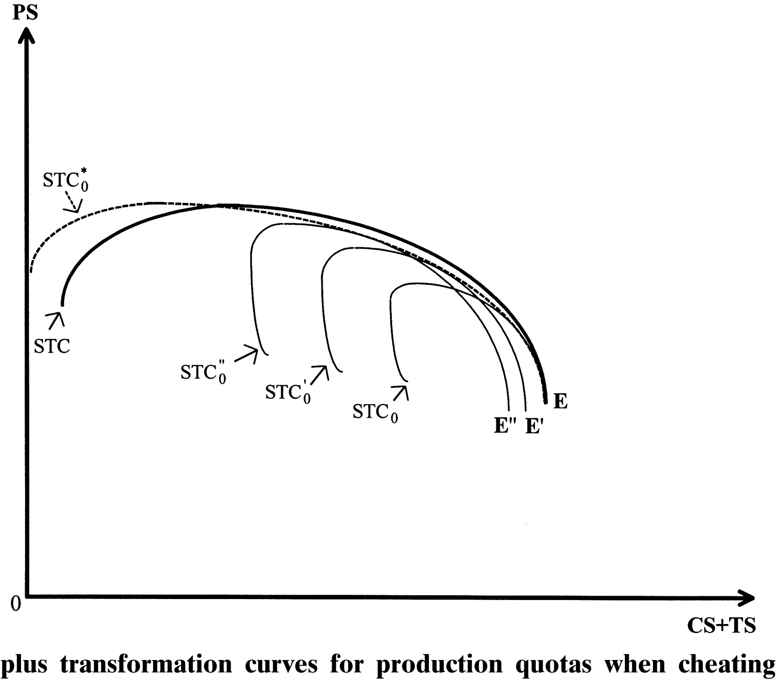

Figure 2. Surplus transformation curves for production quotas when cheating occurs (low $\Phi(\delta_o)$)

point of no-intervention.[3] Thus the introduction of cheating makes the resource transfer less efficient than the hypothetical situation illustrated in STC.

The positions of the surplus transformation curves for other values of δ_0 depend on the monitoring and enforcement costs $\Phi(\delta_0)$. If $\Phi(\delta_0)$ is relatively low, policy makers will wish to deter cheating completely. However, if monitoring and enforcement costs are relatively high, policy makers may find it desirable not to spend resources to deter cheating.

Figure 2 illustrates the case when monitoring costs are relatively low. Curves STC_0' and STC_0'' represent cases where δ_0 equals δ_0' and δ_0'', respectively, where $0 < \delta_0' < \delta_0''$. Curves STC_0' and STC_0'' start out to the left of E at points E′ and E″, respectively. The horizontal difference between E and the starting points for STC_0' and STC_0'' represents the monitoring and enforcement costs $(1 + d)\Phi(\delta_0)$, where d is the marginal deadweight loss in the economy resulting from increased taxation to fund the program enforcement (Fullerton, Ballard and Fullerton). Since δ_0' and δ_0'' are constant, $(1+d)\Phi(\delta_0')$ and $(1+d)\Phi(\delta_0'')$ are essentially a fixed cost to taxpayers.

Curve STC_0' rises faster than STC_0 because the increase in δ_0 reduces cheating, which in turn reduces the penalty paid to taxpayers. Thus, the same producer transfer can now be made without having to reduce total output by as much as would have been the case with $\delta_0 = 0$. The result is a smaller deadweight loss. As long as the reduction in the deadweight loss is greater than the increased monitoring costs, STC_0' will eventually cross STC_0 from below. The position of STC_0'' is determined in a similar fashion. The outer envelope of these curves shows the feasible set available to policy makers should they wish to transfer surplus from consumers/taxpayers to producers. This envelope—labeled STC_0^*—is the surplus transformation curve determined by assuming that δ_0 is set so that cheating is completely deterred (i.e., $\delta_0 = \delta_0^* = (a_1+b_1)(Q^e - \overline{Q})/\rho$).[4]

A comparison of STC_0^* and STC shows that the same level of surplus can be transferred to producers in both situations; for instance, both curves reach a maximum at the same level of producer surplus. However, the cost of making this transfer in the case of STC_0^* is increased by the resource costs $(1 + d)\Phi(\delta_0^*)$ needed to ensure complete deterrence of cheating. Since this resource cost increases with the level of surplus transferred to producers—the lower $\overline{Q}$ is, the greater the level of δ_0^* required to deter cheating—the horizontal distance between STC_0^* and STC increases with a leftward movement from E.

Now consider the situation where the costs of monitoring farmer compliance are incurred collectively by the producers of the regulated commodity. Relative to the situation where the enforcement costs of the program are incurred by the taxpayers, producer surplus is reduced by $\Phi(\delta_0)$, while taxpayer surplus is increased by this amount adjusted to account for the positive deadweight losses from taxation, i.e., $(1 + d)\Phi(\delta_0)$.[5]

The effect of this change is to shift the curves STC_0', STC_0'', and STC_0^* in figure 2 downward (by the amount of the relevant $\Phi(\delta_0)$) and to the right (by an amount equal to $(1 + d)\Phi(\delta_0)$). The positions of STC and STC_0 remain unaffected. The reason is that in these cases enforcement is either costless (the case for STC) or zero (the case for STC_0).

The downward shifts of STC_0', STC_0'', and STC_0^* indicate that the surplus transferred to producers under a given intervention is reduced relative to the case where taxpayers pay the enforcement costs. This implies that for a given surplus to be transferred to producers the quota should be reduced more than would have otherwise been required. Reduced quota means an increased DWL triangle associated with the (given) transfer to producers. At the same time, when farmers pay for program enforcement, the monitoring costs are reduced (see footnote 5).

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[3] The backward bending portion of the STC_0 curve arises because, as Q^* falls below the monopoly quantity, the total surplus available to both producers and consumers/taxpayers falls. Consumer/taxpayer surplus rises when the penalty collected exceeds the loss in consumer surplus.

[4] When monitoring costs are relatively high, the curve STC_0' never cuts STC_0 from below and part of the outer envelope of the STCs includes STC_0. The implication of this is that policy makers may find it desirable to set $\delta_0 = 0$—i.e., not to spend resources to deter cheating. This result only holds if policy makers choose to make a relatively small transfer. As policy makers move away from E, cheating is more likely to be completely deterred.

[5] Note that there are also deadweight losses associated with the collection of the funds from producers that are not included in the analysis. However, these costs are likely to be smaller than the DWL associated with the collection of taxes when taxpayers pay for monitoring. The reason is the smaller number of producers relative to taxpayers and also the avoidance of distortions in other markets when farmers incur the monitoring costs. Inclusion of these costs would change the quantitative nature of the results by reducing the relevant producer surplus by more than $\Phi(\delta_0)$ when farmers pay for enforcement. However, since the decrease in producer welfare is smaller than the increase in taxpayer surplus, the qualitative nature of the results remains unaffected.

As long as the increase in the Harberger triangle exceeds the reduction in the resource costs from enforcement, the transfer efficiency of output quotas falls when enforcement is positive (i.e., $\delta_0 > 0$).

The change in the relative position of the STCs when farmers pay for program enforcement has another important implication: the greater the size of the enforcement costs, the greater the downward shift of the STCs associated with positive monitoring, and the greater the likelihood that some cheating will be allowed. Indeed, for significantly high enforcement costs, allowance of cheating might be the only feasible way of transferring income to producers of the regulated commodity.

Misrepresentation under an Output Subsidy

In addition to output quotas, the other major method of transferring income to farmers is through subsidies linked to the output produced. Given the extra profits that result from the subsidy, farmers may be tempted to increase their returns further by misrepresenting the quantity of output eligible for the subsidy.[6] In the EU, for instance, the possibility for cheating arises from the fact that eligibility for numerous government payments requires "individual farmer application…rather than market intervention" (Harvey, p. 167). Even in the United States, where deficiency payments were based on farmers' historical acreage and yield (i.e., normal rather than current production; see Gardner 1995), the possibility of misrepresentation and cheating existed when the base acreage and yield were determined. The model developed in this section examines a stylized output subsidy scheme where farmers can potentially misrepresent the quantity of output on which they claim payments.

In the simplest case, suppose a risk-neutral, representative farmer is deciding on the output q^t to produce and the amount q^m to misrepresent when an output subsidy is in effect. The quantity reported, q^*, equals $q^t + q^m$. Note that q^m is not actually produced—instead, this amount is simply reported by farmers as being produced.

Given a probability δ of the farmer being audited (detected and penalized in case of misrepresentation) and an associated penalty per unit of misrepresented and detected quantity equal to ρ, the problem facing the farmer can be written as

$$(5) \quad \max_{q^t,\, q^m} E[\pi] = (p^c + v)q^t - c(q^t) + (1-\delta)vq^m - \delta\rho q^m$$

where p^c is the market clearing price, v is the output subsidy, and $c(q^t)$ is the cost function.

The audit probability takes values between zero and one (i.e., $\delta \in [0, 1]$) and is assumed to be a linear function of the quantity misrepresented, i.e., $\delta = \delta_0 + \delta_1 q^m$. Similar to the case of output quotas, the parameters δ_0 and δ_1 are taken as given by the representative farmer. The base audit probability δ_0 is assumed to be a function of the resources spent by the policy enforcers while the parameter δ_1 is assumed to be strictly positive and exogenous to agricultural policy makers.

The first-order conditions for the problem specified in equation (5) are

$$(6) \quad p^c + v = c'(q^t)$$

$$(7) \quad \frac{v}{v+\rho} = (\delta_0 + 2\delta_1 q^m).$$

Equation (6) shows the standard result that a farmer increases output until the point where the market price plus subsidy equals the marginal cost of production. The quantity produced does not depend on any of the parameters affecting output misrepresentation. The total quantity produced, Q^t, equals the sum of the output produced by the individual farmers, i.e., $Q^t = \Sigma q^t$.

The optimal quantity to misrepresent, q^m, is determined by equation (7). The left-hand side of equation (7) gives the subsidy paid on misrepresented output (v) as a fraction of the effective penalty paid on the quantity that is expected to be penalized ($v + \rho$).[7] The right-hand side of equation (7) gives the marginal penalized output (mpo) or the change in the output that is expected to be penalized for a unit change in the output that is misrepresented.

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[6] Cheating on output subsidies is similar to cheating on income taxes and environmental regulations in that in all cases self-reporting agents misrepresent a reported parameter. While farmers over-report the output eligible for government payments, taxpayers and companies under-report their taxable incomes and pollution levels, respectively.

[7] The effective penalty equals the actual penalty ρ plus an opportunity cost v, since farmers caught cheating lose $v + \rho$.

Figure 3 shows the determination of the aggregate misrepresented quantity, Q^m, and the aggregate income transferred to farmers. For a given v and ρ, the intersection of a horizontal line at $v/(v+\rho)$ with line MPO determines the aggregate quantity $Q^m(=Nq^m)$ that is misrepresented by the N representative farmers. The line MPO is the horizontal summation of the individual farmers' mpo curves. The audit probability δ is determined by the intersection of a vertical line at Q^m and line DELTA, where DELTA is the horizontal summation of the individual farmers' delta curves. The delta curve for the individual farmer is a graph of equation (2) (i.e., $\delta = \delta_0+\delta_1 q^m$), and shows the audit probability for different levels of misrepresentation. Both MPO and DELTA are graphed relative to the origin of point D in figure 3. The MPO and DELTA curves have an intercept of δ_0. Their slopes equal $2\delta_1/N$ and δ_1/N, respectively.

The expected producer benefits from misrepresentation, $[v-\delta(v+\rho)]Q^m$, are depicted by the shaded area BEGH in figure 3. This area must be added to the traditional income transfers from the policy. In addition, there is an added cost to the taxpayer equal to $(1 + d)(\text{BEGH} + \Phi(\delta_0))$, where d is the marginal deadweight loss from taxation and $\Phi(\delta_0)$ is the monitoring and enforcement cost.

As figure 3 illustrates, an increase in δ_0 causes an upward parallel shift of the MPO curve and, *ceteris paribus*, reduces both output misrepresentation and the benefits flowing to farmers (area BE′G′H′ versus BEGH). Taxpayer costs are then reduced by the benefits foregone by producers adjusted to account for the positive deadweight losses from taxation. An increase in δ_0 also means increased monitoring and enforcement costs. Figure 3 also shows that an increase in v increases the producer price and the quantity supplied to the market. The higher v also increases the expected returns to cheating and hence output misrepresentation.

With this in mind, consider the case where agricultural policy makers would like to transfer a given surplus to producers and have control over v and δ_0. In this situation, policy makers can always reduce the resource costs associated with the transfer to producers by simultaneously reducing v and δ_0. While a reduction in v lowers the transfer to producers, it also reduces the deadweight loss (i.e., area BCD plus $d(p^t\text{BD}p^c+\text{BEGH})$ in figure 3). The reduction in the transfer can be offset by reducing δ_0. This reduction in δ_0 also reduces resource costs by $(1+d)\Delta\Phi(\delta_0)$.

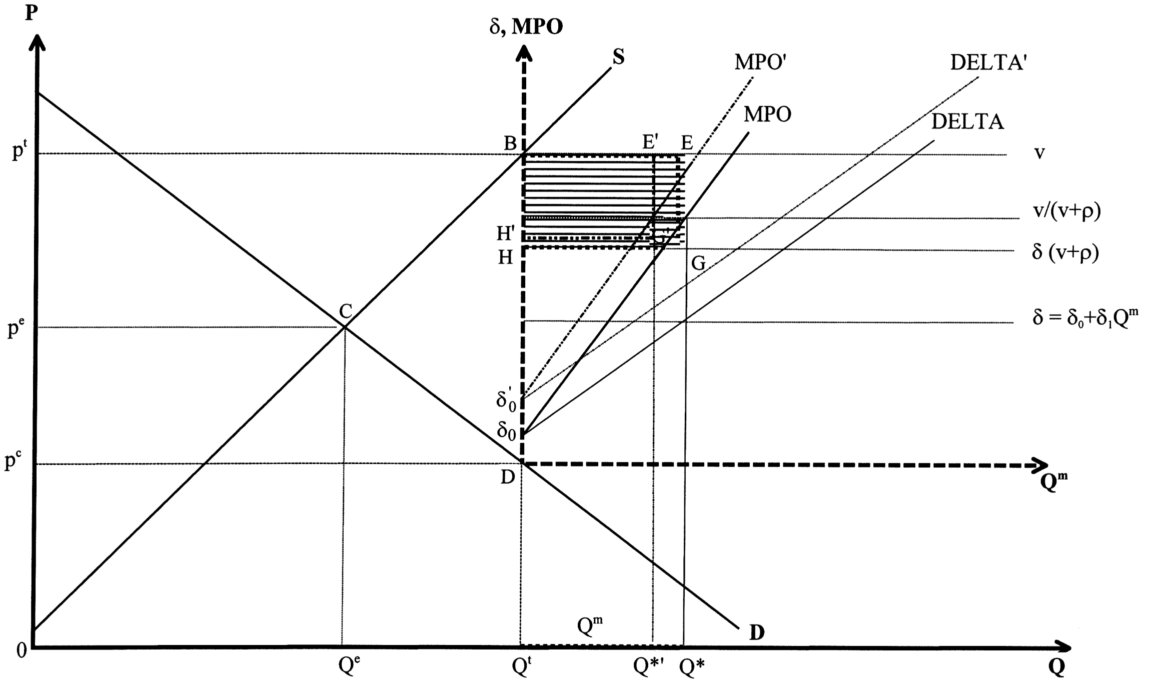

Figure 3. The welface effects of output subsidies with and without misrepresentation

Thus, simultaneously reducing v and δ_0 can ensure a given income transfer at a lower resource cost. The implication is that when both v and δ_0 are variable, the optimal policy is to always set $\delta_0 = 0$. The choice of v then depends on the trade-off the policy maker wishes to make between the welfare of producers and the welfare of consumers and taxpayers. Note that with $\delta_0 = 0$ misrepresentation is nevertheless deterred to some extent because δ_1 is greater than zero.

The consequence of introducing misrepresentation into the analysis of output subsidies can be summarized in the surplus transformation curves. The solid curve STC in figure 4 is hypothetical and has the same shape and position as the STC drawn in the standard agricultural policy analysis when misrepresentation is not considered (Gardner 1983). The dashed curves in figure 4 show the trade-off between producer surplus and consumer/taxpayer surplus when misrepresentation is considered and is costly to deter. Curve STC_0 represents the situation where $\delta_0 = 0$, while STC_0' and STC_0'' represent cases where δ_0 equals δ_0' and δ_0'', respectively, where $0 < \delta_0' < \delta_0''$.

The position of curves STC_0, STC_0', and STC_0'' relative to STC and to each other can be determined as follows. Curve STC_0 lies above STC_0', which in turn lies above STC_0'', because policy makers can always reduce the resource costs associated with transferring a given surplus to producers by simultaneously reducing v and δ_0. Similar to the quota case, curves STC_0' and STC_0'' begin to the left of E because of the monitoring and enforcement costs associated with δ_0' and δ_0'' (i.e., $(1+d)\Phi(\delta_0')$ and $(1+d)\Phi(\delta_0'')$, respectively).

Curve STC_0 also lies everywhere above STC to the left of point E. The reasoning is as follows. The absolute value of the slope of STC, s, equals

$$s = \left|\frac{\partial \text{PS}}{\partial(\text{CS} + \text{TS})}\right|$$

where ∂PS is the change in producer surplus and $\partial(\text{CS}+\text{TS})$ is the change in the consumer and taxpayer surplus generated by a change in v. The slope of STC_0, however, involves an additional element, namely the transfer to producers as a result of misrepresentation. Thus, the absolute value of the slope of STC_0, s_0, equals

$$s_0 = \left|\frac{\partial \text{PS} + \partial \text{EB}}{\partial(\text{CS} + \text{TS}) + (1 + d)\partial \text{EB}}\right|$$

where ∂EB is the change in the expected benefits from misrepresentation for a change in v. By manipulating the expressions for s and s_0, the slope of STC_0 can be shown to be greater than the slope of STC in absolute value terms when the following condition holds:

$$\frac{1}{s} > 1 + d.$$

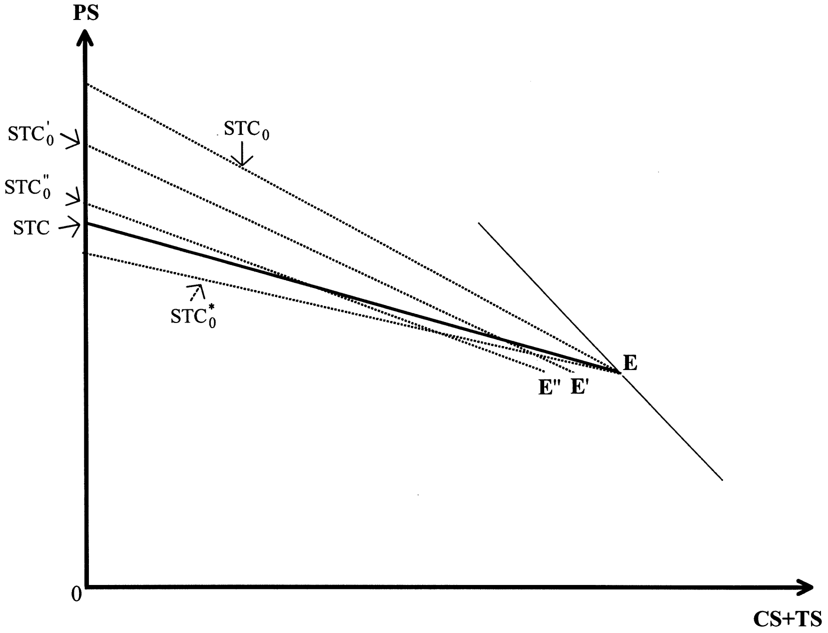

Figure 4. Surplus transformation curves for output subsidies with misrepresentation

This condition always holds; $1/s$—the marginal cost to consumers/taxpayers of transferring another dollar to producers—is always greater than $1+d$ because a subsidy produces a production distortion in addition to generating deadweight losses from taxation.

Curve STC_0^* represents the case where misrepresentation has been completely deterred by setting $\delta_0 = \delta_0^* = v/(v + \rho)$. To the left of E, curve STC_0^* lies everywhere below STC, with the vertical distance between STC_0^* and STC increasing with a leftward movement from E. Curve STC_0^* lies below STC because movements leftward from E involve an increase in v, which requires a larger δ_0 to deter misrepresentation, which results in higher and higher monitoring and enforcement costs, $\Phi(\delta_0^*)$, to ensure complete deterrence. In addition, the marginal deadweight loss in the economy resulting from increased taxation to fund the monitoring and enforcement costs, $d\,\Phi(\delta_0^*)$, rises with an increase in v.

The surplus transformation curves in figure 4 allow a choice of the optimal v and δ_0. As pointed out earlier, when both v and δ_0 are choice variables, the optimal v is chosen from along curve STC_0, implying that $\delta_0 = 0$. Recall that setting δ_0 to zero does not imply that misrepresentation goes unchecked. Since δ_1 is assumed to be positive, misrepresentation is deterred to some extent. Nevertheless, the model shows that policy makers will not actively spend resources to deter misrepresentation over and above what would otherwise occur.

Mixed Instruments: Production Quotas and Output Subsidies

Although most policy analysis focuses on the use of a single instrument, the use of a mix of instruments can be more efficient (Theil, Innes and Rausser, Alston and Hurd, Alston, Carter, and Smith, Bullock). Alston and Hurd show that, if the deadweight costs from taxation are zero, a combination of a production quota set at the free market level and a subsidy can transfer income at a zero deadweight loss. Even with a deadweight loss of taxation, a combination of a production quota set below the free market level and a subsidy payment can improve redistributive efficiency.

Figure 5 shows the impact of a production quota/output subsidy mix when enforcement is costly and cheating can occur. Suppose the quota is set at $\overline{Q}$ and the base audit probability is set at δ_0. Given the resulting aggregate marginal penalty function MP, farmers as a group will produce output Q^*. With output Q^*, the market price equals $p(Q^*)$. Assume the subsidy payment is structured to equal the quota quantity $\overline{Q}$ multiplied by the difference between the chosen target price p^t and the observable market price $p(Q^*)$; i.e., the subsidy payment equals $(p^t - p(Q^*))\overline{Q}$. Since $\overline{Q}$ is arbitrarily chosen, no misrepresentation is possible on the subsidy payment.

The welfare impact of this policy mix is as follows. Farmers earn producer surplus equal to area $0BCQ^* - 0ADQ^* - DEFG + p^t HIp(Q^*)$, consumers earn a surplus equal to $a_0Cp(Q^*)$, and taxpayers directly pay the amount of the output subsidy $p^t HIp(Q^*)$, plus the monitoring costs $\Phi(\delta_0)$, less the area DEFG which is the revenue received from the penalty imposed on detected over-quota production. There is also a deadweight loss to the economy from taxation equal to $d(p^t HIp(Q^*) + \Phi(\delta_0) - DEFG)$ on top of the resource costs due to market intervention.

Figure 6 shows the surplus transformation curve for the production quota/output subsidy mix assuming monitoring and enforcement costs are relatively low. Curve STC (line EFH) is hypothetical and has the same shape and position as the STC drawn in the standard agricultural policy analysis when misrepresentation is not considered. Curve STC_0^* (line EGI) is drawn for the situation where cheating is considered and is costly to deter. The range EG is from the surplus transformation curve drawn in figure 2. At point G, the slope equals $-1/(1 + d)$; from this point leftward the surplus transformation curve is a straight line with this same slope. The range GI shows the surplus that can be transferred to producers by increasing the output subsidy v in a production quota/output subsidy mix. The slope of this line is $-1/(1+d)$ because the cost of making the transfer using p^t is the resource cost of taxation.

The quota associated with point G is greater than the quota associated with point F. At both F and G, the marginal deadweight cost equals $(1 + d)$. In the case of F, the marginal deadweight loss is given solely by the change in the standard deadweight welfare loss triangle, while at G the marginal deadweight loss is given by the change in the

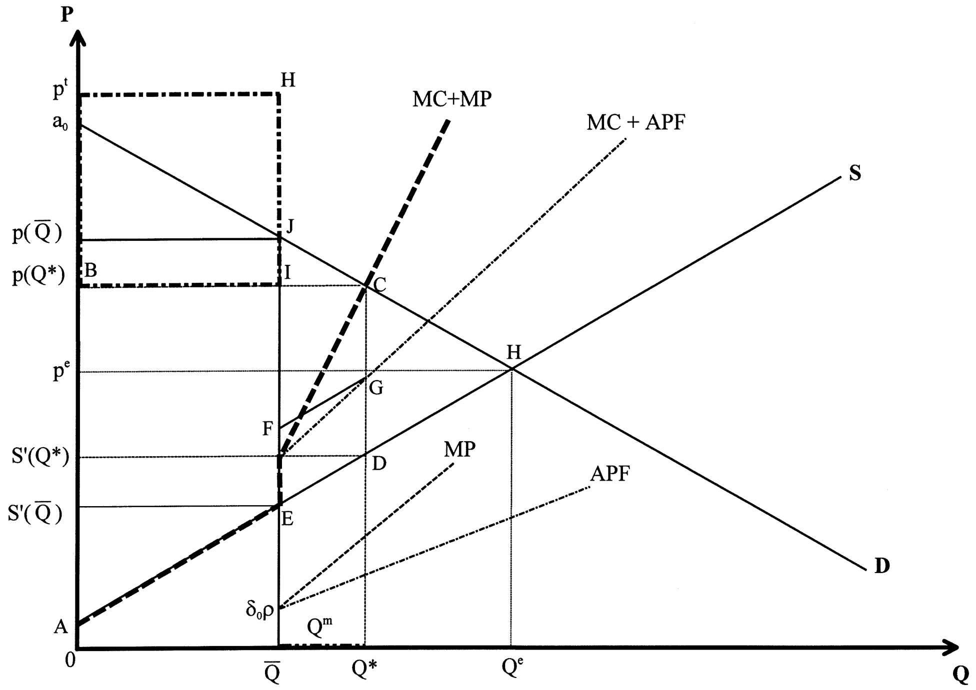

Figure 5. Welface effects of production quota and subsidy with cheating

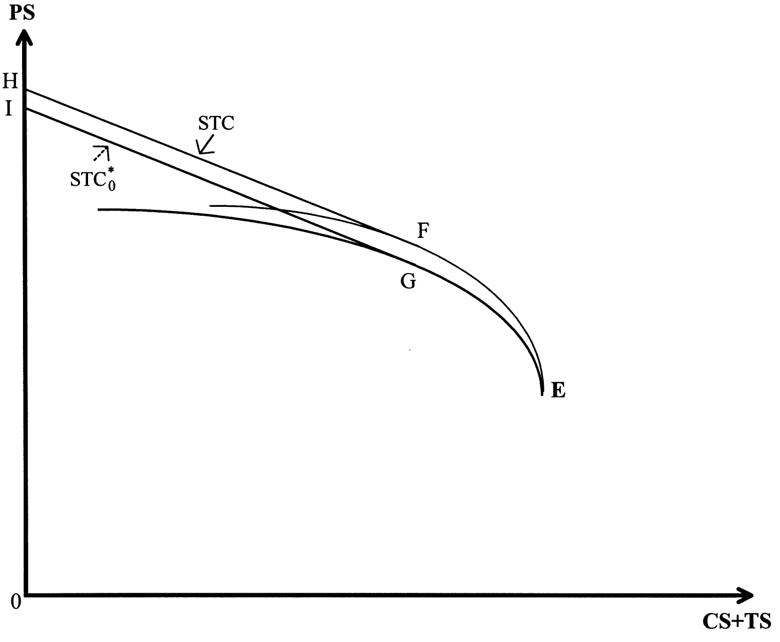

Figure 6. Surplus transformation curves for production quota and subsidy with cheating

Harberger triangle plus the marginal costs of monitoring. Thus, to equate the marginal deadweight cost with $(1 + d)$ when cheating is possible, the standard deadweight loss welfare triangle has to be reduced. This is done by increasing the quota quantity.

Extension of the Model—Endogenous Penalties

The above analysis assumes that penalties are exogenous to agricultural policy makers. This is a standard assumption in the economics of crime literature due to the extreme results that emerge when penalties are endogenous to policy makers (see Becker, Stigler, Stern, Shavell). This section of the paper examines the incidence of quotas and subsidies when agricultural policy makers have control over both δ_0 and ρ. As expected, extreme results emerge.

More specifically, when penalties are endogenous under an output quota scheme, agricultural policy makers will always find it economically optimal to completely deter cheating with the establishment of a zero δ_0 and an infinite per unit penalty. Assuming there are no economic costs associated with the establishment of fines, program enforcement is then perfect and costless. This enables the policy makers to transfer a given surplus to producers while incurring the minimum possible costs, namely the distortionary costs of market intervention associated with the output quota. Since cheating is perfectly and costlessly deterred when penalties are endogenous, the welfare effects of production quotas and their efficiency in transferring income to producers are those derived by the traditional analysis.

On the other hand, when an output subsidy is in effect and penalties are endogenous, the economically optimal choice of agricultural policy makers in terms of enforcement will be to allow misrepresentation completely by setting δ_0 and ρ equal to zero. The reasoning goes as follows. By setting both enforcement parameters equal to zero, output misrepresentation is maximized. The increased misrepresentation increases the producer benefits from cheating and reduces the subsidy payment v required to transfer a given surplus to producers. Reduced v means reduced welfare losses associated with the specific transfer and increased transfer efficiency of the policy instrument.

This result should be treated carefully, however, since all the relevant benefits and costs have not been examined. Institutionalized zero fines for farmers cheating on output subsidies could soften moral constraints to illegal behavior and countenance cheating within this population. As Cowell and Lea, Tarpy, and Webley argue, widespread misrepresentation and cheating could become epidemic, creating a culture of dishonesty in the society and a public disrespect for both the government and community rules. The expected social costs of such a situation might outweigh the economic efficiency gains from farmer misrepresentation and make deterrence of cheating the optimal choice of policy makers. The expected social costs of cheating also need to be considered in the models examined where ρ is assumed fixed.

Discussion and Implications

This paper relaxes the assumption of perfect and costless enforcement that is implicit in the traditional agricultural policy analysis and introduces enforcement costs and cheating into the economic analysis of output quotas and output subsidies. Analytical results show that the introduction of enforcement costs and cheating changes the welfare effects of the policy instruments and their efficiency in redistributing income to producers. Since cheating changes the transfer efficiency of the policies, the question that naturally arises is whether and to what extent enforcement costs and cheating affect the relative transfer efficiency and therefore the normative ranking of the policy mechanisms under consideration.

The introduction of farmer misrepresentation and cheating does affect the relative efficiency ranking of output subsidies versus quotas. Compared to the standard analysis, the introduction of cheating and misrepresentation results in output subsidies being generally more efficient than output quotas as a way of transferring income to farmers. The reasoning is as follows. Misrepresentation with output subsidies results in a clockwise rotation of the STC around E (compare STC_0 to STC in figure 4), while cheating under production quotas causes a leftward elongation of the STC (compare STC_0^* to STC in figure 2). Since these results are general, this conclusion holds regardless of the underlying elasticities of supply and demand. Although this general result is the norm, there are specific conditions under which quotas are likely to be more efficient than output subsidies. If supply is more elastic than demand, the cost of monitoring is low, and if relatively small total income transfers are being made, then output quotas may be the more efficient policy instrument.

A combination of policy instruments can usually result in a more efficient transfer than using policy instruments separately. As figure 6 shows, combining production quotas and subsidies is the most efficient policy instrument in terms of redistributing income from consumer and taxpayers to the farmers for relatively larger transfers. For small transfers, particularly if the resource costs of monitoring and enforcement are low, production quotas can be more efficient, however.

The introduction of cheating and misrepresentation affects policy analysis in other ways besides those outlined above. For instance, a failure to recognize the presence of cheating may result in output quotas that are ineffectual, or in greater than expected increases in income transfers to farmers when output subsidies are introduced. The failure to identify cheating may also result in the misspecification of supply curves in econometric work.

Misrepresentation and cheating will have distributional consequences other than those considered in this paper. For instance, allowing these activities to occur has the arguably undesirable effect of redistributing income from honest people to those who cheat and misrepresent their actions; by focusing on a representative farmer, this paper does not consider this issue. Finally, as discussed in the section on endogenous penalties, allowing cheating might have social costs that have not been considered in this analysis. The introduction of these costs might outweigh any potential economic efficiency gains from cheating and make induced compliance the optimal choice of agricultural policy makers even when enforcement costs are significantly high. Further research is required to examine these issues and to determine the empirical importance of misrepresentation and cheating on real world farm policies.

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