The Australian Journal of Agricultural and Resource Economics, 47:4, pp. 541–562

Economics of export subsidies under costly and imperfect enforcement*

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The present paper builds on the published literature on agricultural policy analysis under costly and imperfect enforcement by introducing enforcement costs and misrepresentation into the economic analysis of export subsidies. Specifically, the present paper examines the economic causes of cheating on export subsidies and the consequences of enforcement costs and misrepresentation for the welfare effects and the transfer efficiency of this policy instrument. Policy design and implementation is modelled as a sequential game between a government that designs and enforces the policy and the recipients of the payments. Two alternative policy implementation scenarios are considered. In the first scenario, export subsidies are paid to private trading firms while in the second scenario subsidies are paid directly to the producers of the subsidised commodity. Analytical results show that the introduction of enforcement costs and cheating changes the welfare effects of export subsidies and their efficiency in redistributing income to producers. The analysis also shows that, contrary to what is traditionally believed, the incidence of export subsidies depends on the group that is subsidised to export the surplus quantity – the way the policy is implemented. The results provide additional support for the contention that the economic consequences of cheating are highly policy-specific. Finally, the analysis reveals that when the government faces restrictions on either the volume or the value of export subsidies, cheating reduces the distortionary effects of the policy on international markets. This is true irrespective of whether subsidies are paid to trading firms or to producers.

1. Introduction

Governments have traditionally used a variety of policy instruments to redistribute income in the economy. Export subsidies are a well-utilised

* The author would like to thank Murray Fulton, Lilyan Fulginiti and two anonymous reviewers for useful comments on earlier versions of the present paper. Journal Series No. 13254, Agricultural Research Division, University of Nebraska-Lincoln.

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means of income redistribution through market intervention.[1] Producers of the subsidised commodity benefit from the increased market price while consumers and taxpayers are the interest groups that fund the transfer to producers (Gardner 1987).

The government transfers through export subsidies, however, create an incentive for the recipient of the subsidies to misrepresent the quantity and/or the quality of the exported commodity and collect payments for phantom output and/or for higher quality product than that actually exported. This is especially true for the European Union (EU) where eligibility for most income transfer programs requires those entitled to payments to self-report the variable on which the payments are based.

In agriculture for instance, where export subsidies have been extensively applied, the Common Agricultural Policy's costs from 'real fraud – the export subsidies claimed on goods that do not exist, subsidies claimed on goods of higher quality than those actually exported or processed, the subsidies paid out for nonexistent olive trees, for the grubbing of phantom orchards, for the retiring of imaginary cows – … account for up to 10 per cent of the 36 billion ECU a year laid out on agricultural support …' (Gardner 1996, p. 46).[2] Whereas there is no similar figure available (to us) for the USA, the existence of a US Department of Agriculture (USDA) 'hotline' where cases of 'fraud' related to the 'submission of false claims/statements' can be reported indicates that cheating and misrepresentation are not unknown to US policy makers (USDA Office of Inspector General 2000).

Despite the incentive for and the incidence of cheating on export subsidies, this issue has not received any attention in the relevant published

[1] Even though there might be reasons for the employment of export subsidies other than income redistribution (such as increasing the domestic country's share of the world market or the provision of strategic advantage to domestic firms/oligopolists of the subsidised commodity (Brander and Spencer 1985; Itoh and Kiyono 1987; Helpman and Krugman 1989), central in this analysis is the presumption that the sole purpose of government intervention is to transfer income to domestic producers of the subsidised commodity (Bullock *et al.* 1999).

[2] EU is the major user of export subsidies accounting for almost 90 per cent of the US$27 billion in total subsidy expenditures by the World Trade Organisation (WTO) countries between 1995 and 1998 followed by Switzerland (5 per cent), the USA (1.5 per cent) and Norway (1.3 per cent) (Young *et al.* 2001). It should be noted that, in addition to direct export subsidies there are also the so-called 'implicit export subsidies' resulting from the market effects of the operation of state-trading enterprises (STE) that expand exports like the Australian Wheat Board, the Canadian Wheat Board, and the New Zealand Dairy Board (for the trade and welfare effects of STE see Ackerman and Dixit (1999)). The analysis of these implicit export subsidies is outside the scope of the present paper.

economics literature. The traditional welfare analysis of the policy takes place under the assumption that the agents involved in the export of the subsidised commodity comply completely with the provisions of the policy, or alternatively, that policy enforcement is perfect and costless. In such a world, when the trading sector is perfectly competitive, it makes no difference whether the subsidies are paid directly to producers or to the traders of the commodity; competitive pressures result in the transfer of payments to producers of the subsidised commodity (Gardner 1987).

Few studies have incorporated misrepresentation or cheating in theoretical agricultural policy analysis. Giannakas and Fulton develop a game-theoretic approach to examine the effects of misrepresentation and cheating on the economics of production quotas (Giannakas and Fulton 2003a,b), decoupled payments (Giannakas and Fulton 2002), output subsidies (Giannakas and Fulton 2000a), and the normative efficiency ranking of output quotas, deficiency payments, and a combination of quotas and subsidies (Giannakas and Fulton 2000b) in the context of a closed economy. A result of these studies is that the economic consequences of cheating are highly policy-specific.

For instance, while the efficiency in redistribution of both decoupled payments and output subsidies increases with the extent of cheating,[3] the incorporation of enforcement costs and misrepresentation into the analysis of these policies reduces the transfer efficiency of decoupled payments and may increase the transfer efficiency of output subsidies relative to the perfect and costless enforcement case considered in the traditional agricultural policy analysis. On the contrary, the transfer efficiency of output quotas falls with the extent of violation of the quota limits and it is always lower than that under perfect and costless enforcement; that is, the introduction of enforcement costs and cheating results in supply restrictions being less efficient means of income redistribution than is traditionally believed.

The objective of the present study is to extend the literature on efficient income redistribution under costly and imperfect enforcement by introducing enforcement costs and misrepresentation into the theoretical analysis of export subsidies. To keep the analysis general, the case-specific complications of particular programs are not considered in the present paper. Instead, the present paper examines the economic causes of cheating on a stylised direct export subsidy scheme in which those receiving the subsidy

[3] The efficiency in redistribution (or transfer efficiency) links the social costs of market intervention to the surplus transferred to producers. The lower the welfare losses associated with a given transfer to producers, the greater the transfer efficiency of a policy instrument (Gardner 1983).

can misrepresent (over-report) the output that is eligible for payments.[4] The present paper then examines the consequences of enforcement costs and misrepresentation for the welfare of the interest groups and the efficiency of the policy in redistributing income to producers. The present paper analyses the incidence of export subsidies in the presence of quantity and quality misrepresentation under two alternative policy implementation scenarios. In the first scenario (which is the most prevalent as far as implementation of the major export subsidy programs is concerned[5]), export subsidies are paid to private trading firms while in the second scenario subsidies are paid directly to the producers of the subsidised commodity.

Following Giannakas and Fulton (2000a,b; 2002; 2003a,b), the design and implementation of the stylised export subsidy scheme is modelled as a sequential game between a government that designs and enforces the policy, and the group that is subsidised to export the excess domestic supply. The objective functions of the agents involved (i.e., government, private trading firms and producers) are assumed to be common knowledge. The government moves first and determines the levels of policy intervention and enforcement. Once the government decisions are announced, the recipients of the subsidies (i.e., private trading firms or producers) decide on the quantity to trade and the quantity on which subsidy claims are made.

All formulations of the sequential game developed in the present paper are solved using backwards induction (Gibbons 1992). The problem of the subsidised agent is considered first and the solution to the government's problem determines the (subgame perfect) equilibrium enforcement and misrepresentation. While the present paper considers the economic consequences of misrepresentation in the context of a large exporting country, the relevance of the analysis for a small open economy is discussed throughout the text.

The rest of the paper is as follows. Section 2 examines the causes and consequences of output misrepresentation when export subsidies are paid to private exporting firms. Section 3 analyses the effect of enforcement costs and output misrepresentation on the incidence of subsidies paid to producers. Section 4.1 extends the analysis to the cases of quality misrepresentation by private traders and producers. The case where penalties are endogenous to policy makers is considered in Section 4.2. Section 5 discusses the implications of misrepresentation for the trade effects of export subsidies, and Section 6 summarises and concludes the paper.

[4] The analysis thus pertains to cases where receipt of export subsidies requires an application (self-reporting) by those eligible to payments and does not apply to implicit export subsidies resulting from the operation of exporting STE.

[5] All major export subsidy programs in the EU and the USA involve subsidies being paid to private exporters.

2. Export subsidies paid to private trading firms

2.1 Optimal quantity misrepresentation by the trading firms

When an export subsidy scheme where private trading firms are subsidised to dispose of the excess domestic quantity is in effect, the exporting firms might find it optimal to cheat on the program by misrepresenting the quantity of the commodity they export. By misrepresenting the quantity exported the trading firms may collect government payments for nonexistent quantities of the subsidised commodity. The possibility of cheating on export subsidies arises from an informational constraint, namely; exporters' actions cannot be directly observed – they can only be verified through costly auditing.

Assuming a perfectly competitive structure of the trading sector where firms know the export subsidy, the per unit penalty in case they are caught misrepresenting the exported quantity, and the probability of being detected cheating, the problem of the representative firm can be seen as decision making under uncertainty. In the simplest case, consider a risk-neutral firm that decides on the quantity to export and the quantity to misrepresent. The problem of the representative firm can be written as:

$$\begin{aligned} \max_{q_x, q_m} \; & E[\pi] = (v + p_w - p_d) q_x - c(q_x) + (1-\delta) v q_m - \delta \rho q_m \\ & \text{s.t.}\, q_m \geq 0 \end{aligned} \tag{1}$$

where q_x is the quantity exported; q_m is the quantity reported as eligible for government payments over and above q_x (i.e., the total quantity reported as eligible for subsidy payments is $q_x + q_m$); v is the per unit export subsidy; p_w is the world price of the subsidised commodity (i.e., the price received by the exporting firm in the world market); p_d is the domestic price of the exported commodity (i.e., the price the private trading firm pays for the commodity); $c(q_x)$ represents the trading costs for the exporting firm (such as the costs of moving the commodity from the producers, the costs of storing it, and the costs of transporting it to the world market); ρ is the penalty paid per unit of misrepresented and detected quantity; and δ is the probability (i.e., $\delta \in [0, 1]$) that the firm will be detected if it misrepresents the exported quantity.[6]

[6] The model in equation (1) can be modified to include risk aversion of the representative trading firm and/or private costs from cheating. The risk averse firm will maximise expected utility (i.e., $\max_{q_x, q_m} E[U(\Pi)] = (1-\delta) U[(v + p_w - p_d) q_x - c(q_x) + v q_m] + \delta U[(v + p_w - p_d) q_x - c(q_x) - \rho q_m]$) subject to q_m being non–negative. In terms of output misrepresentation, risk aversion results in reduced cheating relative to the case where risk neutrality is assumed. Cheating also falls when the costs incurred by firms in protecting themselves from detection (i.e., $k(q_m)$) are incorporated into the representative firm's objective function. Even though both risk averse behaviour and private costs from cheating change the results quantitatively, the qualitative nature of the results in the present study remain unaffected.

Following Giannakas and Fulton (2000a,b, 2002, 2003a,b), the detection probability is assumed to be a linear function of the quantity misrepresented; that is $\delta = \delta_0 + \delta_1 q_m$. This formulation of the detection probability captures the idea that the more a firm cheats, the greater is the likelihood that cheating will be detected. The intercept of the detection probability function, δ_0, reflects the probability that the firm will be audited.[7] The slope of the detection probability function, δ_1, is strictly positive and is assumed to be exogenous to policy enforcers. Instead the parameter δ_1 depends on the observability of firms' actions by third parties and the social attitudes towards cheating: the degree to which the third party that observes the illegal behaviour will report it to policy enforcers.

The problem specified in equation (1) is a simple, static optimisation problem with a nonequality constraint. The nonequality constraint requires that the quantity misrepresented should be non-negative – profit-maximising firms should not under-report the quantity that is eligible for payments. Solving the optimality (Kuhn-Tucker) conditions for q_x shows the standard result that the quantity exported is determined by the equality of the unit price received by exporters (i.e., the export subsidy, v, plus the price the trading firm can sell the commodity for in the world market, p_w) with the marginal costs incurred by traders (i.e., the marginal cost of acquiring the commodity, p_d, plus the marginal cost of trading the commodity, $c'(q_x)$); that is,[8]

$$p_w + v = p_d + c'(q_x). \tag{2}$$

Regarding the quantity misrepresented, q_m, the optimality conditions indicate that cheating decisions depend on the policy variable v and the enforcement parameters δ_0 and ρ. Specifically, so long as $\delta_0 < \dfrac{v}{v + \rho}$ the optimal q_m equals:

$$q_m = \frac{v - \delta_0(v + \rho)}{2\delta_1(v + \rho)} \tag{3}$$

[7] In the context of the present paper, audits are regarded as random; policy makers determine and announce the proportion of firms that will be investigated and every firm faces the same audit probability.

[8] Note that the disconnect between the trading and the cheating decisions of the firm is a result of the detection probability being a function of the quantity misrepresented. An alternative formulation of the detection probability could involve δ being a function of the relative misrepresented quantity, for example, $\delta = \delta_0 + \delta_1 \dfrac{q_m}{q_x}$. In such a case, the trading decisions of the firm are no longer independent from its cheating decisions. Given that both formulations are equally plausible, we have chosen the one that enhances the tractability of our analysis.

and the aggregate quantity misrepresented, Q_m, is given by:

$$Q_m = Nq_m = \frac{v - \delta_0(v + \rho)}{2\delta_1'(v + \rho)} \tag{4}$$

where N is the number of private trading firms exporting the subsidised commodity and $\delta_1' = \frac{\delta_1}{N}$.

Equation (4) indicates that, similar to the cases of output subsidies (Giannakas and Fulton 2000a) and decoupled payments (Giannakas & Fulton 2002), the extent of misrepresentation falls with a reduction in the subsidy payment and/or an increase in the detection probability and per unit penalty parameters $\left(\text{i.e., } \frac{\partial Q_m}{\partial v} > 0, \frac{\partial Q_m}{\partial \delta_0} < 0, \frac{\partial Q_m}{\partial \delta_1'} < 0 \text{ and } \frac{\partial Q_m}{\partial \rho} < 0\right)$. If $\delta_0 \geq \frac{v}{v + \rho}$, then the expected costs from cheating outweigh the expected benefits and the trading firms will find it optimal to truthfully reveal their exported quantity (i.e., $Q_m = 0$).

2.2 Incidence of export subsidies paid to private trading firms

When the combination of the policy variable and the enforcement parameters is such that cheating occurs (i.e., $Q_m > 0$), the traditional analysis of the policy instrument fails to consider the private trading firms' aggregate expected benefits from misrepresentation. In the current setting, these benefits to trading firms are given by $EB_c = [(1 - \delta)v - \delta\rho]Q_m$ and constitute a direct (decoupled) transfer from taxpayers.

Furthermore, the assumption of 'perfect and costless policy enforcement' results in the negligence of the monitoring and enforcement costs, $\Phi(\delta_0)$, that arise whenever the audit probability, δ_0, is positive. These costs are essentially transaction costs associated with policy implementation. They are assumed to be a non-decreasing function of δ_0 (i.e., $\Phi'(\delta_0) \geq 0$, $\Phi''(\delta_0) \geq 0$), and should be included into both the budgetary costs and the welfare losses from the program.

Specifically, the welfare effects of the policy instrument when subsidies are paid to private trading firms and cheating occurs are as follows. An export subsidy scheme increases the price of the commodity in the country that subsidises its exports (i.e., price p_d in equation (1)). The higher market price causes producer surplus to increase and consumer welfare to fall. When the exporting country faces a downward sloping export demand curve, disposal of the increased domestic surplus into the world market requires the world price of the commodity to fall. The reduction in the world price because of export subsidies results in welfare transfers to foreign consumers of the subsidised commodity.

The cost of subsidising the exported quantity (i.e., vQ_x) is borne by taxpayers. Taxpayers also fund the transfer to producers when cheating occurs (i.e., EB_c) as well as the monitoring and enforcement costs of the program, $\Phi(\delta_0)$. More specifically, the taxpayer costs when export subsidies are paid to private trading firms equal $(1 + d)[vQ_x + EB_c + \Phi(\delta_0)]$, and are increased relative to the 'perfect and costless enforcement' case by an amount equal to $(1 + d)[EB_c + \Phi(\delta_0)]$, where d is the marginal deadweight loss from taxation (Fullerton 1991; Ballard and Fullerton 1992).

The aforementioned increase in taxpayer costs causes the deadweight welfare loss (*DWL*) from export subsidies also to increase. Specifically, when enforcement is costly and cheating occurs the *DWL* from the program exceeds that under 'perfect and costless enforcement' by an amount equal to $dEB_c + (1 + d)\Phi(\delta_0)$.[9]

Since, for any positive subsidy v, output misrepresentation increases the deadweight losses from the program while having no effect on producer surplus, the efficiency of export subsidies in redistributing income to producers (i.e., the ratio of the welfare losses from the program over the increase in producer surplus, $DWL/\Delta PS$), falls with cheating. Put in a different way, when enforcement is costly and exporting firms cheat on the program, the transfer efficiency of export subsidies is lower than is traditionally believed. The transfer efficiency of export subsidies under costly and imperfect enforcement is given by:

$$\frac{DWL^{cie\_f}}{\Delta PS^{cie\_f}} = \frac{DWL^{pce} + (1 + d)\Phi(\delta_0) + dEB_c}{\Delta PS^{pce}} \left(> \frac{DWL^{pce}}{\Delta PS^{pce}} \right) \tag{5}$$

where the superscripts *pce* and *cie_f* stand for 'perfect and costless enforcement' and 'costly and imperfect enforcement of subsidies paid to private firms', respectively.

2.3 Optimal enforcement by the government

Facing export subsidies as income redistributional measures, the objective of the government can be seen as the implementation of (any) income

[9] Note that while the analysis focuses on the welfare consequences of cheating on export subsidies in the large country case, the main results of this section apply for a small open economy as well. More specifically, in the case of a small open economy export subsidies have no effect on the world price of the commodity in question. Since the world price remains unaffected, both taxpayer costs and *DWL* from export subsidies are reduced relative to the large country case by the surplus transfer to foreigners adjusted to account for deadweight losses from taxation.

redistribution in the most efficient manner. In other words, the problem of the government can be seen as the determination of the enforcement level that maximises the efficiency of the policy instrument in transferring income to producers. Given that penalties are usually set by the legal system, the government can be seen as seeking δ_0 that minimises $\frac{DWL^{cie\_f}}{\Delta PS^{cie\_f}}$. Since, however, for any given subsidy v, the level of enforcement has no effect on the welfare of producers and consumers of the subsidised commodity, minimising $\frac{DWL^{cie\_f}}{\Delta PS^{cie\_f}}$ is equivalent to minimising the welfare losses from enforcement and cheating: $CC = dEB_c + (1 + d)\Phi(\delta_0)$.

Assuming, without loss of generality, that $\Phi(\delta_0) = \frac{1}{2}\psi\delta_0^2$ (where ψ is a strictly positive scalar depending on the number of the trading firms exporting the subsidised commodity),[10] the problem of the government can be written as:

$$\begin{aligned}\min_{\delta_0} CC &= dEB_c + (1 + d)\Phi(\delta_0)\\ &= d[v - (\delta_0 + \delta_1' Q_m)(v + \rho)]Q_m + (1 + d)\frac{1}{2}\psi\delta_0^2 \end{aligned} \tag{6}$$

$$\text{s.t. } Q_m = \frac{v - \delta_0(v + \rho)}{2\delta_1'(v + \rho)}$$

where all variables are as previously defined.

Optimisation of the government's problem yields the following first order condition for a minimum:

$$\frac{\partial CC}{\partial \delta_0} = 0 \Rightarrow \frac{dv}{2\delta_1'} - \frac{d(v + \rho)}{2\delta_1'}\delta_0 = (1 + d)\psi\delta_0 \tag{7}$$

Equation (7) indicates that the optimal audit probability is determined by the equality of the marginal costs of monitoring and enforcement, $MC_e = (1 + d)\psi\delta_0$, with the marginal benefits from investigation, $MB_e = \frac{d[v - \delta_0(v + \rho)]}{2\delta_1'}$. The MB_e include benefits from penalties collected on detected misrepresentation and also benefits from induced compliance of the firms to the program provisions (i.e., reduction in the surplus transferred from taxpayers to private

[10] Obviously, the greater the number of trading firms, the greater the costs associated with any positive audit probability. For instance, the costs of raising the audit probability to, say, 50 per cent are quite different when there are 50 firms in the market than when there are five hundred exporters of the subsidised commodity.

exporting firms and thus, reduction in the *DWL* from taxation). Solving the first order condition in equation (7) for δ_0 gives the optimal audit probability as:

$$\delta_0^* = \frac{v}{(v + \rho) + \left(\frac{1 + d}{d}\right) 2\delta_1' \psi}. \tag{8}$$

Substituting δ_0^* into equation (5), we get the equilibrium level of output misrepresentation as:

$$Q_m^* = \frac{(1 + d)\psi v}{(v + \rho)[(1 + d)2\delta_1'\psi + d(v + \rho)]}. \tag{9}$$

Equations (8) and (9) show that as long as monitoring compliance is costly (i.e., when $\psi > 0$), the optimal audit probability is below the level that completely deters cheating, $\delta_0^{nc} = \frac{v}{v + \rho}$. The greater are the monitoring costs, the lower is the equilibrium δ_0, and the greater is the level of misrepresentation by the private trading firms.[11]

The efficiency gains from not completely deterring output misrepresentation when enforcement is costly can be seen graphically in the interest groups' surplus space. Figure 1 shows the Surplus Transformation Curves (*STC*) for export subsidies under the different scenarios considered in this section.[12] More specifically, STC^{nc} is the relevant *STC* when enforcement is costly and cheating is completely deterred by setting δ_0 equal to δ_0^{nc}. STC^{cie_f} represents the situation where (costly) enforcement is at its optimal level (i.e., $\delta_0 = \delta_0^*$ in equation (8)), while the curve labelled STC^{pce} corresponds

[11] Note that while the analysis assumes increasing marginal enforcement costs, the marginal costs from enforcement can in fact be constant (e.g., $MC_e = (1 + d)\psi$). Whereas the nature of the monitoring cost function affects the level of optimal enforcement, the qualitative nature of the results remains unaffected – the greater are the enforcement costs, the lower is the optimal enforcement.

[12] A surplus transformation curve depicts the trade off between producer surplus and the surplus of the other interest groups (i.e., consumers, taxpayers and private trading firms in this case) under an export subsidy (Gardner 1983). The slope of the *STC*, denoted as $s = \frac{\partial PS}{\partial(CS + TS + TF)}$, is the marginal rate of surplus transformation. It shows the efficiency of the policy in redistributing income to producers at the margin; how much of an extra dollar raised by other interest groups is received by producers. One minus the absolute value of s shows the *DWL* per dollar transferred at the margin.

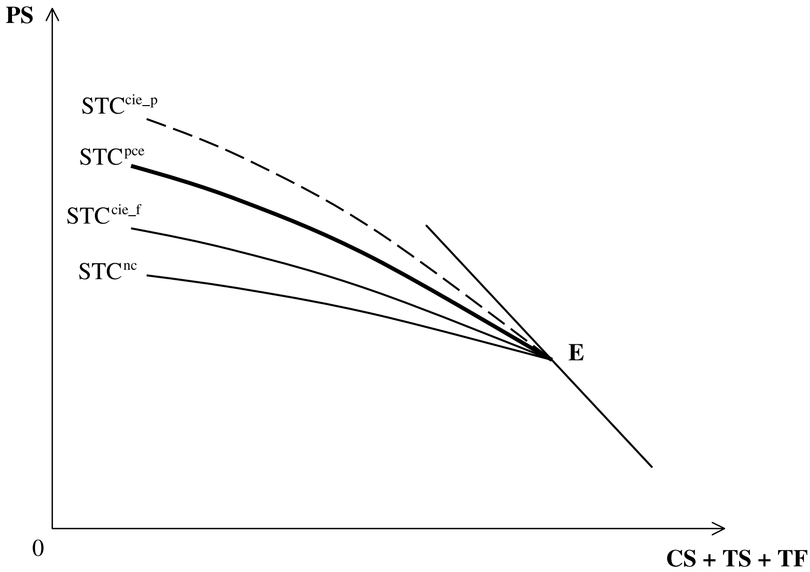

Figure 1 Surplus transformation curves for export subsidies with misrepresentation

to a situation where enforcement is perfect and costless and is the *STC* proposed by the traditional analysis of the policy (Gardner 1983; 1987).

Figure 1 shows that STC^{nc} lies underneath STC^{cie_f} which, in turn, lies underneath STC^{pce} everywhere to the left of E – the point of no-intervention. The horizontal distance between the *STC* reflects the difference in *DWL* associated with a given surplus transfer to producers of the subsidised commodity. Specifically, the horizontal difference between STC^{cie_f} and STC^{pce} equals $dEB_c + (1 + d)\Phi(\delta_0^*)$ while the distance between STC^{nc} and STC^{pce} is given by $(1 + d)\Phi(\delta_0^{nc})$; the resource costs required to completely deter cheating. Since δ_0^{nc}, δ_0^* and dEB_c increase with an increase in v, the greater is the level of intervention (i.e., the further left from E we move), the greater is the horizontal distance between the *STC*, and the greater are the efficiency losses from cheating by the private trading firms.

3. Export subsidies paid to producers

Consider next the situation where subsidies are paid directly to the producers of the subsidised commodity. Maintaining similar assumptions regarding the policy variable, the enforcement parameters, and the objective of the government, this section of the present paper derives the equilibrium enforcement and cheating and examines the welfare effects and the transfer efficiency of export subsidies when those are paid to producers.

Similar to the case where subsidies are paid to private trading firms, when export subsidies are paid to producers of the supported commodity[13] there are economic incentives for producers to cheat and collect government payments on phantom output. The problem of the representative producer is similar to that described in equation (1) and the market and welfare effects of the policy are mainly those discussed in Sections 2.1 and 2.2. The difference in this case is that, when cheating occurs, the expected benefits from misrepresentation accrue to producers rather than to private trading firms; that is, cheating by producers increases producer surplus by an amount equal to EB_c. The implication of this is that the efficiency in redistribution of export subsidies when those are paid to producers is given by:

$$\frac{DWL^{cie\_p}}{\Delta PS^{cie\_p}} = \frac{DWL^{pce} + (1+d)\Phi(\delta_0) + dEB_c}{\Delta PS^{pce} + EB_c} \tag{10}$$

where the superscript *cie_p* stands for 'costly and imperfect enforcement of subsidies paid to producers.'

3.1 Optimal enforcement by the government

Similar to the case where export subsidies are paid to trading firms, it is assumed that the objective of the government is to transfer income to producers in the most efficient way; that is, to determine the level of policy enforcement that maximises the efficiency of the transfers to producers. Maintaining that penalties are set elsewhere in the legal system, the problem of the government can be seen as the determination of the audit probability δ_0 that minimises the DWL per dollar transferred to producers. More specifically, the problem of the government can be written as:

$$\begin{aligned} \min_{\delta_0} \frac{DWL^{cie\_p}}{\Delta PS^{cie\_p}} &= \frac{DWL^{pce} + (1+d)\Phi(\delta_0) + dEB_c}{\Delta PS^{pce} + EB_c} \\ &= \frac{DWL^{pce} + \frac{1}{2}(1+d)\psi\delta_0^2 + d[v - (\delta_0 + \delta_1'' Q_m)(v+\rho)]Q_m}{\Delta PS^{pce} + [v - (\delta_0 + \delta_1'' Q_m)(v+\rho)]Q_m} \end{aligned} \tag{11}$$

[13] Producers can export the excess domestic supply employing trading services supplied by a (perfectly competitive) trading sector.

$$\text{s.t. } Q_m = \frac{v - \delta_0(v + \rho)}{2\delta_1''(v + \rho)}$$

$$\delta_0 \geq 0$$

where $\delta_1'' = \frac{\delta_1}{K}$ with K being the number of producers of the subsidised commodity. All other variables are as previously defined.

The problem of the government specified in equation (11) is a simple, static optimisation problem with both equality and nonequality constraints. The equality constraint reflects producers' best response function, while the nonequality constraint requires the optimal audit probability to be non-negative. Solving the optimality (Kuhn-Tucker) conditions shows that the optimal δ_0 depends on the efficiency of export subsidies relative to lump-sum transfers under 'perfect and costless enforcement.' Specifically, if export subsidies are less efficient income redistributional measures than lump-sum transfers to producers when policy enforcement is perfect and costless (i.e., the usual case, see Gardner (1983; 1987), Alston and Hurd (1990), Alston *et al.* (1993)), the transfer efficiency of the policy is maximised when policy enforcers do not investigate the producers.

Put in a different way, if $\frac{DWL^{pce}}{\Delta PS^{pce}} \geq d$ the optimal δ_0 equals zero,[14]

$$\delta_0^* = 0 \tag{12}$$

and the equilibrium (total) output misrepresentation is:

$$Q_m^* = \frac{v}{2\delta_1''(v + \rho)}. \tag{13}$$

The reasoning of these results is as follows. If $\frac{DWL^{pce}}{\Delta PS^{pce}} \geq d$, the decoupled transfer from taxpayers to producers through cheating increases the average transfer efficiency of the policy – the greater are the producer benefits from cheating, the greater is the transfer efficiency of export subsidies. Since both the extent of misrepresentation and the transfer to producers through cheating are inversely related to the level of enforcement, the lower is the level of enforcement, the greater is the transfer efficiency of the policy. The efficiency of export subsidies in redistributing income to producers is

[14] A zero audit probability does not mean that cheating goes undetected. Since δ_1 is assumed strictly positive, a zero δ_0 means that policy enforcers will not actively spend resources to deter cheating over and above that which would occur otherwise.

maximised when policy makers spend no resources to deter misrepresentation; that is, when $\delta_0 = 0$.[15]

When $\delta_0 = 0$ the monitoring and enforcement costs, $\Phi(\delta_0)$, are zero, and the transfer efficiency of the policy instrument (equation 10) can be re-written as:

$$\frac{DWL^{cie\_p}}{\Delta PS^{cie\_p}} = \frac{DWL^{pce} + dEB_c}{\Delta PS^{pce} + EB_c}. \quad (14).$$

Equation (14) shows that when $\frac{DWL^{pce}}{\Delta PS^{pce}} > d$, the transfer efficiency of export subsidies paid to producers when enforcement is costly is greater than is traditionally believed; that is, $\frac{DWL^{cie\_p}}{\Delta PS^{cie\_p}} < \frac{DWL^{pce}}{\Delta PS^{pce}}$. The relevant *STC* of the policy instrument (shown as the dashed STC^{cie_p} curve in figure 1) lies above the *STC* proposed by the traditional analysis of export subsidies (i.e., curve STC^{pce}) for any level of government intervention (i.e., everywhere to the left of E).

The above results change when export subsidies are more efficient than lump-sum transfers to producers in a world where policy enforcement is perfect and costless $\left(\text{i.e., when } \frac{DWL^{pce}}{\Delta PS^{pce}} < d\right)$.[16] Obviously, in this case misrepresentation

[15] An alternative way to rationalise the above results is as follows. Assume that the government wants to transfer some given surplus to producers and uses export subsidies to achieve the desired income redistribution. When cheating occurs, the total transfer to producers consists of the transfer through the market effects of the policy (i.e., increased price and production) and the (decoupled) transfer through cheating. The lower is the level of policy enforcement, the greater is misrepresentation and the greater is the transfer to producers through cheating. The increased transfer through cheating means that the government can reduce the subsidy payment so that the total transfer to producers (transfer through the market plus transfer through cheating) is the desired one. Reduced enforcement means reduced monitoring costs while reduced subsidy payments imply reduced resource costs from misallocation of productive resources (and reduced transfer to foreigners in a case where the exporting country faces a downward sloping export demand curve). Reduced enforcement costs and distortionary costs of market intervention means reduced *DWL* associated with a given transfer to producers and increased transfer efficiency of the policy instrument. The transfer efficiency is maximised when enforcement is zero. Put in a different way, the efficiency of the transfers to producers increases with cheating since misrepresentation allows the government to substitute distortionary transfers through the market with (more efficient) decoupled transfers through cheating.

[16] In order for export subsidies to be more efficient than lump-sum transfers under perfect and costless enforcement, the following conditions should be met: (i) a relatively small part of domestic production is exported (so that the major part of the transfer to producers originates from domestic consumers); (ii) the domestic demand and supply curves are very inelastic (so that the *DWL* from consumption and production distortions are low); and (iii) the *DWL* from taxation are relatively high (Alston *et al.* 1993).

reduces the average transfer efficiency of export subsidies since it generates relatively less efficient transfers to producers who cheat on the program. In view of this fact, policy makers will always find it optimal to spend resources to deter misrepresentation (i.e., $\delta_0^* > 0$). However, policy enforcement will be imperfect because of the resource costs of monitoring producers' actions $\left(\text{i.e., } \delta_0^* < \delta_0^{nc}\left(= \frac{v}{v+p}\right)\right)$. Since policy enforcement is imperfect, some cheating will occur and the relevant STC for export subsidies paid to producers when $\frac{DWL^{pce}}{\Delta PS^{pce}} < d$ will lie in between STC^{nc} and STC^{pce} everywhere to the left of E in figure 1.

4. Extensions of the model

4.1 Quality misrepresentation

The framework of analysis developed in the previous two sections can also be used to examine the effects of quality (rather than quantity) misrepresentation when an export subsidy scheme is in place. In this case, private trading firms and/or producers misrepresent the quality of the exported commodity to collect payments on higher value product than what is actually exported. Interestingly, the main results of the analysis remain unaffected (see Appendix).

Specifically, when subsidies are paid to private trading firms enforcement will be imperfect (i.e., $0 < \delta_0^* < \delta_0^{nc}$) and firms will find it optimal to cheat on the program by misrepresenting the quality of the commodity they export. Quality misrepresentation results in surplus transfers from taxpayers to private trading firms and DWL. Because of the increased resource costs associated with cheating, quality misrepresentation by the private exporting firms results in efficiency losses relative to the 'perfect and costless enforcement' case; the relevant STC will be similar to the STC^{cie-f} shown in figure 1 and will lie underneath STC^{pce} for every positive level of intervention.

On the other hand, when subsidies are paid to the producers of the regulated commodity, quality misrepresentation results in decoupled transfers from taxpayers to producers and increased transfer efficiency of the policy. The relevant STC is similar to STC^{cie-p} in figure 1 and lies above STC^{pce} for every positive level of intervention; quality misrepresentation by producers increases the transfer efficiency of export subsidies.

4.2 Endogenous penalties

The previous analysis and results are based on the assumption that penalties are set by the legal system and are therefore exogenous to policy makers. For completeness of exposition, the current section relaxes this assumption and examines the incidence of export subsidies in an environment where policy makers have control over both audit probability and penalties charged on detected misrepresentation.

Assuming that there are no economic costs associated with the establishment of fines for cheating on subsidy programs, when penalties are endogenous to policy makers policy enforcement is potentially costless. More specifically, since both audits and penalties result in reduced cheating $\left(\text{i.e., } \frac{\partial Q_m}{\partial \delta_0} < 0 \text{ and } \frac{\partial Q_m}{\partial \rho} < 0\right)$, policy makers can substitute costly audits with costless penalties; they can set δ_0 arbitrarily close to zero and increase penalties to the level at which misrepresentation is completely deterred. Therefore, the reason for imperfect enforcement in the case of (quantity and quality) misrepresentation by the private trading firms, namely, the cost of monitoring firms' actions, is no longer valid when penalties are endogenous to policy makers.

The implication of this is that when subsidies are paid to private traders and penalties are endogenous, cheating will be completely deterred through the establishment of (almost) zero audit probability and huge fines on firms caught misrepresenting the quantity they export or the quality of their exports (i.e., solving the problem of the government specified in equation (6) with respect to both δ_0 and ρ shows that the transfer efficiency of export subsidies is maximised when $\delta_0 \rho = \infty$ with $\lim_{\rho \to \infty} \delta_0 = 0$). Since cheating is perfectly and costlessly deterred when enormous fines are set, the welfare effects and the transfer efficiency of export subsidies paid to private trading firms are those derived by the traditional policy analysis (i.e., the relevant STC coincides with STC^{pce} in figure 1). Thus, one interpretation of the assumption of 'perfect and costless enforcement' that is implicit in the traditional analysis of export subsidies, is that enormous fines can be costlessly levied on firms caught cheating on the program.

The optimal combination of enforcement parameters is quite different when subsidies are paid to the producers of the subsidised commodity. Solving the government's problem specified in equation (11) with respect to both δ_0 and ρ shows that, when penalties are endogenous, the transfer efficiency of export subsidies is maximised when $\delta_0 = \rho = 0$. The reasoning is as follows. When both enforcement parameters equal zero (quantity and/or quality) misrepresentation is maximised. Increased misrepresentation means increased producer benefits from cheating. The greater is the decoupled transfer to producers through cheating, the more closely export subsidies approximate a lump-sum transfer program and the greater is the transfer efficiency of the policy instrument (the relevant STC would lie above STC^{cie_p} everywhere to the left of E in figure 1).[17]

5. Implications for international trade

Before concluding the present paper it is interesting to note that, in addition to affecting the transfer efficiency of the policy mechanism, enforcement costs and misrepresentation have important ramifications for the trade effects of export subsidies – the consequences of the policy for the world market of the subsidised commodity. In particular, when the government faces restrictions on either the volume or the value of export subsidies (as is the case with countries/members of the WTO), phantom quantities receiving subsidies in the presence of cheating substitute one-to-one for actual exports in the world market.

The reduced quantity exported in the presence of misrepresentation translates into reduced distortionary effects of the policy on the world market of the subsidised commodity. This is true irrespective of whether subsidies are paid to trading firms or to producers. Thus, when policy enforcement is costly and imperfect, the effect of export subsidies on the world price and the welfare of foreign producers and consumers is less significant than is traditionally believed.

6. Summary and concluding remarks

The present paper builds on the published literature on agricultural policy analysis under costly and imperfect enforcement by introducing enforcement costs and misrepresentation into the theoretical analysis of export subsidies. Analytical results on the economic consequences of cheating on export subsidies bolster the contention that the ramifications of misrepresentation and cheating on farm programs are highly policy-specific.

The introduction of enforcement costs and cheating is shown to change the welfare effects of export subsidies and their efficiency in redistributing income to producers. The analysis also reveals that, contrary to what is traditionally believed, it matters a great deal whether the subsidies are paid to

[17] Notice that this result holds for the (usual) case where export subsidies are less efficient than lump-sum transfers to producers under perfect and costless enforcement. If $\frac{DWL^{pce}}{\Delta PS^{pce}} < d$ misrepresentation will be completely and costlessly deterred through the establishment of huge penalties for detected cheaters.

producers or to private trading firms – when enforcement is costly, the incidence of export subsidies depends on the way the policy is implemented.

Misrepresentation of the quantity exported and/or the quality of exports results in direct transfers from taxpayers to the group that receives the subsidies. Deterring misrepresentation eliminates these transfers and requires monitoring costs that are *DWL*. Because of these costs, complete deterrence of cheating is not economically optimal even when misrepresentation has the adverse effect of transferring income to private exporting firms. The extra taxpayer costs that arise when enforcement is costly and subsidies are paid to private traders (i.e., enforcement costs and transfer to exporting firms through cheating), result in reduced efficiency of the policy in redistributing income to producers.

On the other hand, when subsidies are paid directly to producers of the exported commodity cheating increases the transfer efficiency of export subsidies; the efficiency of the policy instrument in redistributing income is greater than is traditionally believed. The reason is that the direct surplus transfers to producers through misrepresentation result in a subsidy scheme that approximates more closely a lump-sum transfer policy.

In addition to re-examining the transfer efficiency of export subsidies, the present paper highlights the conditions under which cheating is likely to be an issue. The section on endogenous penalties shows that if subsidies are paid to private trading firms and it is possible to costlessly levy enormous fines, then cheating will be effectively deterred. In short, the ability to levy very large fines essentially means that enforcement of export subsidies paid to private traders can be made both perfect and costless.

This result, however, raises the question as to whether disproportionate fines for cheating on export subsidies are reasonable. The published literature on the economics of crime provides some guidance and evidence on this issue. More specifically, it has been argued that severe punishment for minor law violations (i.e., Becker's (1968) 'optimal fine' result) is neither costless nor feasible; the punishment does not fit the crime (Stigler 1970; Carr-Hill and Stern 1977; Stern 1978; Shavell 1987; Cowell 1990).

If induced compliance through the establishment of enormous and costless fines is indeed infeasible, then cheating on export subsidies will always be an issue and should be incorporated into economic analysis. The present paper shows that cheating has important effects on income redistribution, effects that vary with the way the policy is implemented.

In addition to affecting the transfer efficiency of export subsidies, enforcement costs and misrepresentation have important ramifications for the trade effects of this policy instrument. In particular, when the government faces restrictions on either the volume or the value of export subsidies, phantom quantities receiving subsidies in the presence of cheating substitute for actual exports in the world market. The reduced quantity exported in the presence of cheating translates into reduced distortionary effects of the policy on the world market of the subsidised commodity. This is true irrespective of whether export subsidies are paid to trading firms or to producers of the subsidised commodity.

There are limitations in the current study. As was posed at the outset, the objective of the present study has been to introduce enforcement costs and cheating into the economic analysis of export subsidies. Morality and culture, though significant determinants of individual behaviour, are not incorporated into this analysis (for a discussion of the role of social conscience as a general deterrent to crime see Grasmick and Green (1980)). Perhaps most importantly, there are costs associated with cheating that have not been considered in this analysis. Specifically, widespread cheating (which was suggested as optimal when penalties are endogenous and subsidies are paid to producers) could become epidemic, creating a culture of dishonesty in the society and a public disrespect for both the government and community rules (Lea *et al.* 1987; Cowell 1990). The expected social costs of such a situation might outweigh the economic efficiency gains from producer misrepresentation and make induced compliance the optimal choice of policy makers. Clearly, more research is required to analyse and better understand these issues.

Interesting extensions of this work could also include the study of enforcement issues when export subsidies are used in conjunction with other policies such as import barriers and various forms of supply controls, as well as the determination of the empirical importance of cheating on 'real world' export subsidy schemes. Believing that the theoretical results of the present paper can be proved useful in examining these issues, we leave this query open to future research.

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Appendix

Quality misrepresentation

The modification of the basic models to capture the possibility for quality misrepresentation is quite straightforward. Suppose that the grading system in the exporting country is structured such that there are two qualities in the market: a low quality, l, and a high quality, h. Assume also that the high quality produce receives a greater export subsidy that the low quality one (i.e., $v^h > v^l$). In the simplest case, consider an agent trading commodity of low quality. Similar to the case of quantity misrepresentation, the trader is assumed to know the subsidies v^h and v^l, the per unit penalty in case it is caught misrepresenting the quality of the product it trades, ρ, and the detection probability, $\delta\ (= \delta_0 + \delta_1 q_m)$.

The problem of the representative agent that trades low quality product can be seen as the determination of the quantity to export, q_x^l and the quantity of the exported commodity whose quality will misrepresent, q_m. Assuming neutrality towards risk, the problem of the trader can be written as:

$$\begin{aligned} &\max_{q_x^l, q_m} E[\pi] = (v^l + p_w^l - p_d^l)q_x^l - c(q_x^l) + (1 - \delta)v^c q_m - \delta\rho q_m \\ &\qquad \text{s.t. } q_m \le q_x^l \end{aligned} \tag{15}$$

where p_w^l and p_d^l are the world price and the domestic market price of the low quality product, respectively, and v^c is the difference in subsidies received for the export of high and low quality products; that is, $v^c = v^h - v^l$. This subsidy differential reflects the trader's marginal benefits for misrepresentation that goes undetected; the trader receives v^l for the entire quantity of the low quality commodity that is exported, and v^c for the quantity of exports whose quality is misrepresented, q_m. Expressed differently, the trader receives v^l for the quantity that is reported as being low quality and $v^h\ (= v^l + v^c)$ for q_m. All other variables are as previously defined.

Solving the optimality conditions for q_x^l and q_m shows that the quantity of the low quality produce exported by the representative trader is determined by the equality:

$$p_w^l + v^l = p_d^l + c'(q_x^l) \tag{16}$$

while, whenever $\delta_0 < \delta_0^{nc}\left(= \dfrac{v^c}{v^c + \rho}\right)$, the quantity misrepresented by the representative trader is given by:

$$q_m = \frac{v^c - \delta_0(v^c + \rho)}{2\delta_1(v^c + \rho)}. \tag{17}$$

Notice that the optimality conditions in equations (16) and (17) are equivalent to those under output misrepresentation. The rest of the analysis and results are also similar to those derived under output misrepresentation. Specifically, the level of enforcement that solves the problem of the government (i.e., maximises the transfer efficiency of export subsidies) under quality misrepresentation by private trading firms equals:

$$\delta_0^* = \frac{v^c}{(v^c + \rho) + \left(\frac{1+d}{d}\right)2\delta_1'\psi} \tag{18}$$

and the total output whose quality is misrepresented is given by:

$$Q_m^* = \frac{(1+d)\psi v^c}{(v^c + \rho)[(1+d)2\delta_1'\psi + d(v^c + \rho)]}. \tag{19}$$

Finally, when subsidies are paid to producers the equilibrium δ_0 and Q_m are:

$$\delta_0^* = 0 \tag{20}$$

and

$$Q_m^* = \frac{v^c}{2\delta_1''(v^c + \rho)}. \tag{21}$$