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State Trading versus Export Subsidies: The Case of Canadian Wheat

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Canada and the United States have used different trade policies to support their wheat industries. Canada conferred sole export powers to the Canadian Wheat Board, allowing it to price discriminate among markets. The U.S. government has funded transfers to its wheat producers from taxpayers, instead, through export subsidies. This study compares these two ways of supporting producers in terms of their transfer efficiency and overall deadweight losses, the incidence on different domestic interest groups, and their consequences for third-party traders. In the analysis we consider the implications of market power of wheat marketing firms for the comparison of policy alternatives in the context of the Canadian wheat industry.

Key words: Canadian Wheat Board, export subsidies, imperfect competition, state traders, transfer efficiency

Introduction

In the wake of the Uruguay Round Agreement adopted in 1995, the attention of many economists has shifted from the analysis of traditional trade-distorting policies toward less-traditional topics such as state-trading enterprises (STEs). As documented by Dixit and Josling, STEs are important in agricultural commodity trade and might enable member countries to circumvent their Uruguay-round commitments. In this study, we suggest that the creation of an STE can be viewed usefully as a policy designed to redistribute income toward domestic producers. On that basis, we can compare STEs with other redistributive policies in terms of their effects on total economic welfare and its distribution among domestic producers, consumers, middlemen, and taxpayers, as well as, perhaps, their overseas counterparts.

In the analysis below, we develop a model of the type used by Gardner to compare policy alternatives in terms of their redistributive efficiency. We compare a statutory authority with sole export powers, like the Canadian Wheat Board (CWB), and an export subsidy program, like the U.S. Export Enhancement Program (EEP).[1] The theoretical analysis is cast in general terms, but we illustrate the basic ideas and derive

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[1] For a description of the EEP, see Ackerman, Smith, and Suarez. Export subsidies have been used extensively in the United States and Europe for grains. Marketing boards with sole export powers have been popular in Australia, Canada, New Zealand, and Argentina, covering commodities such as wheat, barley, dairy products, eggs, and sugar.

specific results using a simulation model of the Canadian wheat market, and we explore the implications of the form of competition in the wheat marketing sector. In both the theoretical and empirical work, we maintain several simplifying assumptions implicitly. Importantly, like almost all work of this type, we make no allowance for costs of administration, enforcement, or compliance with policies. This omission may distort the comparison if the statutory marketing authority is less efficient (e.g., as suggested by Carter, Loyns, and Berwald) or more efficient (e.g., as suggested by Kraft, Furtan, and Tyrchniewicz) than its private-sector counterparts, or if the administrative costs of export subsidies are significant.

Sole Export Powers versus Export Subsidies in a Competitive Market

A Small-Country Exporter

The simplest case to consider is one of a small-country exporter that faces a downward-sloping domestic demand and a perfectly elastic export demand. In figure 1, D_d represents domestic demand, D_e represents export demand at the world price (P_w), and S represents supply. The undistorted equilibrium results in consumption of C_0, production of Q_0, and exports of $E_0 = Q_0 - C_0$. When a subsidy on exports (t per unit) is introduced, production increases to Q_1, consumption falls to C_1, and exports rise to $E_1 = Q_1 - C_1$. Producers gain $(A + B + C + D)$, domestic consumers lose $(A + B + C)$, and, assuming taxpayer losses are equal to the amount of subsidy expenditure, taxpayers lose $(C + D + E)$, with a deadweight loss of $(C + E)$. If, alternatively (as modeled by Gardner and by Alston and Hurd), a dollar of government spending costs $(1 + \delta)$ dollars of taxpayer surplus (where δ represents the marginal excess burden), the taxpayer cost becomes $(1 + \delta)(C + D + E)$ and the total deadweight loss from the export subsidy is $(1 + \delta)(C + E) + \delta D$.

An alternative way to finance the same benefit to producers is to collect a tax from domestic consumers of $P_d - P_w$ per unit and to use the revenue raised by this tax to finance an output subsidy of $P_p - P_w$ per unit.[2] Or, equivalently, a consumption tax of $P_d - P_p$ per unit could be used to finance an export subsidy of $P_p - P_w$ per unit (e.g., Alston and Freebairn; Sieper). Another way to achieve exactly the same outcome is to establish an authority that can price discriminate between the domestic and export markets, and which pools the proceeds to return a weighted average price (P_p) to producers. (It is assumed that the domestic market can be separated from the world market by transport costs or some other policy that prevents arbitrage from completely equalizing prices.) Although the producer welfare effect of these alternatives is the same as for an export subsidy (of $P_p - P_w$ per unit) financed from general revenues, the effects on other groups are different since the price-pooling scheme involves a loss to consumers but no cost to taxpayers.

The welfare effects of the two policies are summarized and contrasted in table 1. In terms of overall deadweight losses for the given transfer to producers, if $\delta = 0$, the export

[2] Figure 1 is constructed so that the subsidy exactly exhausts the tax, which is also true for any other point along the pooled-price line D_p, given the domestic price (P_d) and the world price (P_w). These relationships are developed in detail by Alston and Freebairn for both the large- and small-country cases.

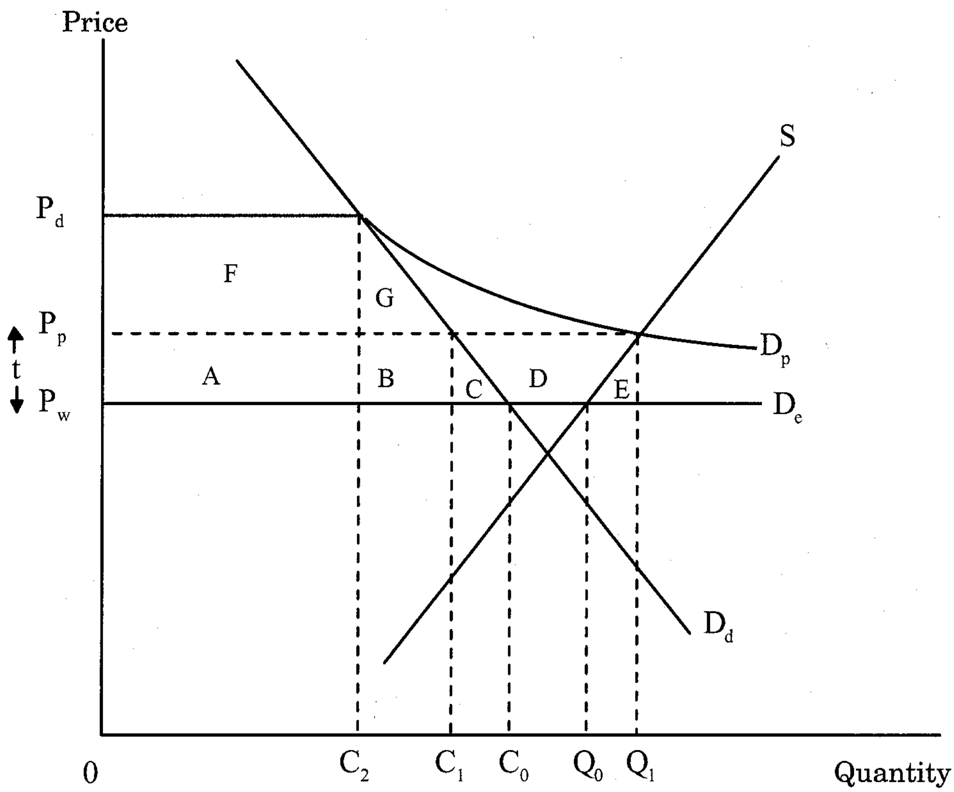

Figure 1. A small-country comparison of pooling and export subsidies

Table 1. Welfare Effects of Export Subsidy versus Price Pooling in a Small Open Economy

Policy	Consumer Cost	Taxpayer Cost	Net Social Cost
Price-Pooling Scheme	$(A+B+C+F+G)$	0	$(B+C+G+E)$
	<-------------------	**$\delta = 0$**	------------------->
Export Subsidy	$(A+B+C)$	$(C+D+E)$	$(C+E)$
Difference	$(F+G)$	$-(C+D+E)$	$(B+G)$
	<-------------------	**$\delta > 0$**	------------------->
Export Subsidy	$(A+B+C)$	$(1+\delta)(C+D+E)$	$(C+E)+\delta(C+D+E)$
Difference	$(F+G)$	$-(1+\delta)(C+D+E)$	$(B+G)-\delta(C+D+E)$

Notes: The entries in this table correspond to the areas of surplus changes in figure 1 associated with an increase of producer surplus of area $(A+B+C+D)$. The alphabetical letters refer to areas in the figure, and δ represents the marginal deadweight cost per dollar of government spending. The net social cost is equal to the consumer cost plus the taxpayer cost minus the benefit to producers. By construction, $F = B + C + D + E$.

subsidy is clearly more efficient than the pooling scheme; however, if $\delta > 0$, the pooling scheme might be more efficient. The comparison hinges on the relative sizes of the two deadweight losses: $(B+C+G+E)$ under the pooling scheme versus $(C+E)+\delta(C+D+E)$ for the export subsidy. To compare these areas, we use the fact that, in figure 1, $(A+F) = (A+B+C+D+E)$. It can be seen that the export subsidy will tend to be favored for scenarios with (*a*) a larger transfer to producers, (*b*) a larger domestic share, (*c*) a more elastic domestic demand, and (*d*) a smaller value of the deadweight losses from general taxation, δ.[3]

A Large-Country Exporter

Next, we compare a price-discrimination and pooling scheme with an export subsidy that has the same effect on producer welfare, but in a case where export quantity affects the export price. Like Alston, Carter, and Smith, we hold producer benefits, output, and the output price constant, and focus on the implications of the different instruments for the allocation of the given output (Q_1) between domestic and export markets, and the associated price wedges, and we assume export demand is more elastic than domestic demand.

Suppose a total quantity of Q_1 (greater than the competitive quantity) is produced at a producer price of P_p and allocated between domestic and export markets. In figure 2, D_d measures domestic consumption quantities relative to the origin at 0, while D_e measures export quantities relative to the origin at Q_1, so that any point along the quantity axis defines a quantity of exports and a corresponding quantity of domestic sales that together exhaust Q_1.

Output of Q_1 could be achieved by providing an output subsidy of $P_p - P_c$ per unit, which would yield a producer price of P_p, a domestic and export consumer price of P_c, exports of E_1, and domestic consumption of C_1. With an output subsidy, domestic consumer and export prices are equal, and the domestic and export allocation is given by the intersection of the two demands. In contrast, the policies being studied here involve price wedges between domestic and export markets. For instance, a pure export subsidy would raise the domestic consumer price to P_p and would reduce domestic sales from C_1 to C_2, requiring exports of E_2 to clear the market. In order to induce exports of E_2, the export price must be reduced to P_e, and this requires an export subsidy of $P_p - P_e$ per unit (see Alston, Carter, and Smith). Alternatively, consider a price-pooling scheme that achieves the same outcome for producers. The unique domestic consumption price that will achieve this outcome is P_d, which would further reduce domestic sales to C_3, requiring even more exports (of E_3) to clear the market. In order to induce exports of E_3, the export price must be reduced to P_e', and this requires an implicit export subsidy of $P_p - P_e'$ per unit.

Holding the effects on producers constant, relative to the output subsidy of $P_p - P_c$, an export subsidy of $P_p - P_e$ involves losses to foreign exporters that are outweighed by

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[3] Let $\tau_C = (P_d - P_w)/P_d$, $\tau_Q = (P_p - P_w)/P_p$, and the domestic quantity share be $k_d = C_2/Q_1$. By construction, $\tau_C = \tau_Q(P_p/P_d)k_d$ (such that $A+F = A+B+C+D+E$). As shown in table 1, the deadweight loss from pooling is greater than the deadweight loss from the equivalent export subsidy if $(B+G) > \delta(C+D+E)$. $B+G$, as a fraction of the total revenue to producers (P_pQ_1), is $(B+G)/(P_pQ_1) = ½\eta\tau_C\tau_Q(1-k_d^2)$, where η is the absolute value of the elasticity of domestic demand evaluated at C_2. Similarly, $\delta(C+D+E)$, as a fraction of the value of production, is $\delta(C+D+E)/(P_pQ_1) = \delta\tau_Q(1-k_d)(1-k_d\tau_C)$. Thus, the export subsidy is more efficient than pooling if $½\eta\tau_C\tau_Q(1+k_d) > \delta\tau_Q(1-k_d\tau_C)$; that is, if $½\eta\tau_C(1+k_d)/(1-k_d\tau_C) > \delta$. Equivalently, the export subsidy is more efficient if $½\eta\tau_Q P_p/k_d(P_d - \tau_Q P_p) > \delta$.

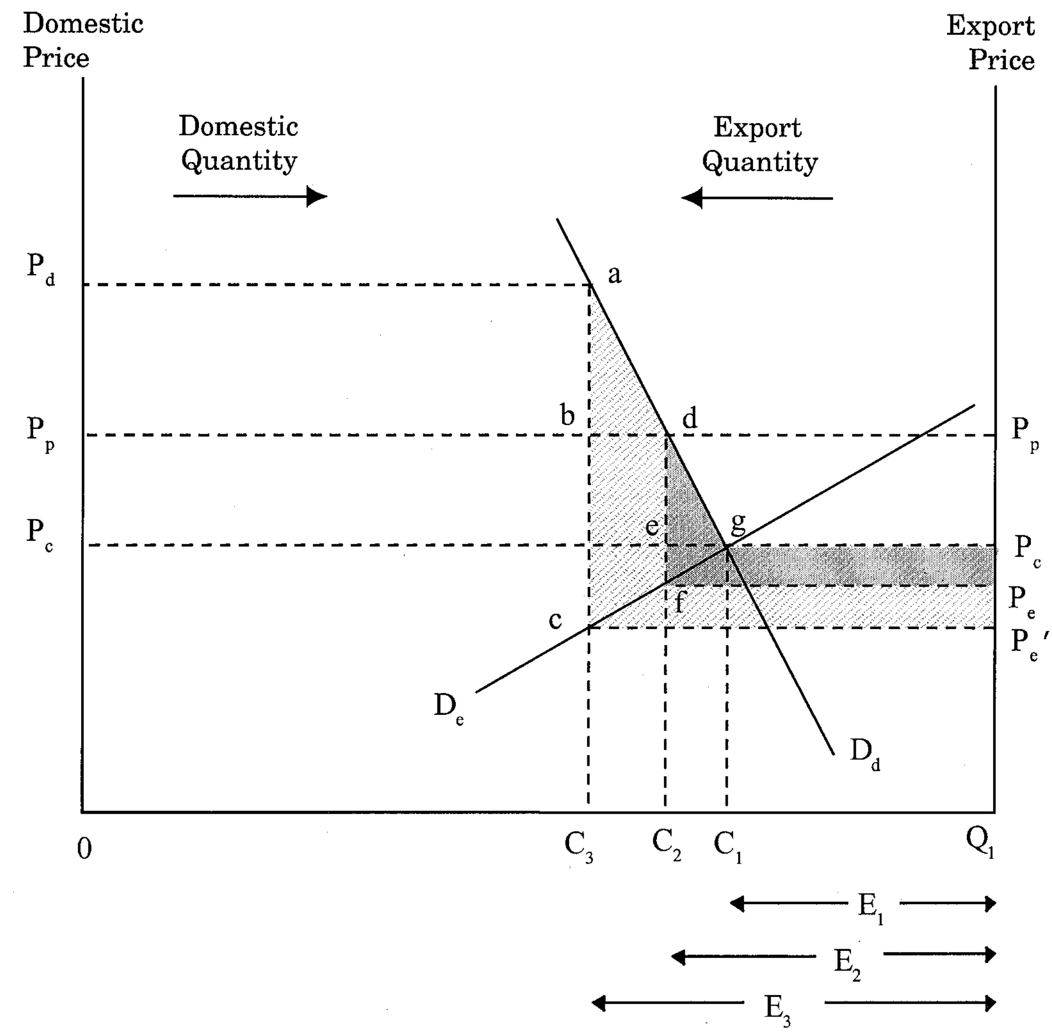

Figure 2. A large-country comparison of pooling and export subsidies

benefits to foreign importers. This results in a net benefit to foreigners. In the country of interest, the same comparison involves a loss of consumer surplus, savings to taxpayers, and a domestic deadweight loss equal to the shaded area dgP_cP_efe. This ignores deadweight losses from taxation. Relative to the output subsidy, the export subsidy saves $\delta(P_p - P_c)Q_1$ but adds $\delta(P_p - P_e)E_2$ in deadweight losses from taxation. The movement to a pooling scheme can be viewed as a further movement in the same direction: a further reduction in the burden on taxpayers and a further increase in the required implicit tax on domestic consumers in order to achieve the given gain for producers. Relative to the export subsidy, the pooling scheme saves deadweight losses from taxation elsewhere in the economy equal to $\delta(P_p - P_e)E_2$ in exchange for an increase in the deadweight losses from implicitly taxing domestic consumers and subsidizing exports, by an amount equal to the shaded area $agP_cP_e'c$ (which is similar in shape to the corresponding area for the pure export subsidy).

It can be seen from figure 2 that the pooling scheme is less likely to be a more efficient transfer mechanism than an equivalent export subsidy, when export demand is less elastic, when δ is greater, and when the domestic market share is greater. A further difference is that the pooling policy involves a larger per unit (implicit) subsidy on exports, and this will have greater negative effects on third-country exporters (hidden in the aggregate export demand) than the simple export subsidy policy.

Many Export Markets

The analysis above has allowed for only a single export market with a single price for all exports regardless of their destination. The same basic ideas may be extended readily into a setting with multiple, separable export markets and possibilities for discriminatory pricing. The relevant comparison now is between a marketing board that price discriminates among markets (and equates marginal revenues among domestic and export markets to maximize profits) and a discriminatory (or targeted) export subsidy, where different rates of export subsidy apply to different overseas destinations. The latter policy can be viewed as being equivalent to an output subsidy combined with a set of discriminatory taxes. Equating marginal revenues among markets can be optimal for this policy, too (e.g., Abbott, Paarlberg, and Sharples). Again, the essential difference is that the discriminatory export subsidy involves taxpayer costs, whereas the marketing board must finance *implicit* subsidies of some markets by *implicit* taxes on others. This is achieved through price discrimination.

As in the case of a single export market, to achieve the same result for producers with a marketing board requires a larger effective rate of price discrimination. If domestic demand happens to be less elastic, this means a larger implicit export subsidy under pooling (i.e., since the domestic market necessarily absorbs less when it is being taxed to finance export subsidies, more exports and a higher average rate of export subsidy are required to clear a given total quantity produced). The open border with the United States means that the domestic Canadian market is not the least elastic among all markets for Canadian wheat. Hence, a higher rate of price discrimination under pooling might not mean lower export prices generally, although it will mean lower prices on the most elastic export markets.

Implications of Imperfectly Competitive Marketing Firms

Some say that the grain trade is highly concentrated, and that, in the absence of the Canadian Wheat Board, middlemen would take excessive profits out of income that is currently being returned to growers by the CWB.[4] The potential for substantial distortions from the exercise of market power in grain merchandising is uncertain, but even a small amount of market power might have important qualitative and quantitative implications for our analysis.

[4] For instance, Scoppola (p. 13, table 1) reported four-firm concentration ratios in the U.S. and EC wheat export markets of 70% and 90%, respectively, based on 1985–88 data. Thursby reported a comparable U.S. figure of 61% based on 1974–75 data. More recent data would suggest that the wheat trade has become more concentrated over time.

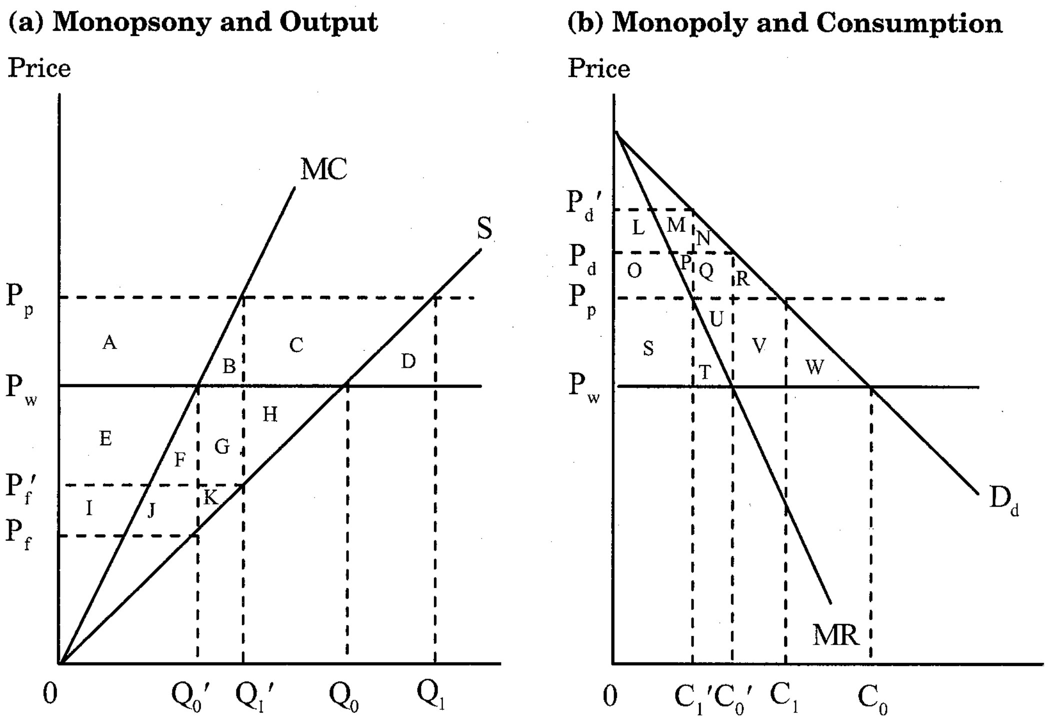

Figure 3. Monopoly-monopsony and pooling versus export subsidies by a small exporter

A Small-Country Exporter

To illustrate the likely directions of the effects of market power of middlemen, we begin with a small-country exporter, and an extreme form of competition: a single marketing firm that is a monopsonist on the buying side and a monopolist on the selling side. The small-country assumption allows us to consider domestic demand and supply independently—so, in figure 3, panel (b) represents domestic consumption and panel (a) represents domestic production.

In figure 3, Q_0 represents competitive output at the world price (P_w), which would increase to Q_1 given an export subsidy of t per unit that would raise the incentive price to producers to P_p. In contrast, in a monopsony market, middlemen would sell Q_0' at P_w and would return P_f to producers, keeping $(P_w - P_f)Q_0'$ as monopsony profit. Then, the introduction of the same export subsidy would result in an increase in production to Q_1' and an increase in the producer price to P_f'. The same per unit subsidy would entail a smaller gain to producers than under competition, and a corresponding subsidy-induced increase in monopsony profit and in the deadweight loss from monopsony would be observed.

In contrast, the introduction of a marketing board with powers of acquisition and pooling would eliminate the monopsony. Thus, producers would gain not only from the subsidy $(A+B+C)$ but also from the elimination of the monopsony $(E+F+G+H+I+J+K)$. Further, the reduction in the deadweight loss from monopsony $(G+H+K)$ may be greater than the loss from the subsidy-induced distortion in production (D). Of course, the full social costs would count distortions in consumption as well. In figure 3, panel (b), consumption would be C_0 at the world price, and C_1 at the domestic price given an export subsidy of t per unit. On the other hand, a monopolist would restrict domestic sales to C_0', given an export price of P_w, or C_1', given an export return of $P_p = P_w + t$. The consumer burden from the export subsidy is smaller under monopoly (which had already caused a reduction in consumption). Consumers lose the area $(L + M + N)$ when their price increases from P_d to P_d', which is less than the area $(S + T + U + V + W)$. In addition, the subsidy reduces monopoly profits, from $(O + P + Q + S + T + U)$ to $(L + M + O + P)$, and reduces the deadweight loss from monopoly, from $(R + V + W)$ to $(R + Q + N)$.

While a marketing board would replace the monopoly, it might not act much differently from a monopoly. Thus, the introduction of a marketing board with a mandate to raise the effective producer returns to P_p can be seen as serving to preserve the domestic market monopoly and change the disposition of the monopoly profit. Indeed, if P_d (the price that maximizes monopoly profits) happened to be the unique domestic price that would yield a pool price of P_p, then the introduction of a board would leave the domestic consumption price and quantity unaffected. More generally, the two prices will not coincide, and the introduction of the marketing board could lead to a reduction or an increase in the domestic consumer price and in the social cost of distortions in consumption.

These comparisons have not considered the implications of the deadweight losses from taxation to finance export subsidies. A complete comparison of the alternatives would also consider $\delta > 0$.

Extensions to Other Market Settings

We can also allow for monopoly-monopsony power in settings where the exporting country can determine price in one or more export markets (i.e., a large-country exporter). The implications here will be similar to those in the small-country case. That is, introduction of a marketing board can benefit producers and society as a whole if it serves to eliminate distortions from the exercise of market power on the buying side by middlemen. Moreover, if monopsony power exists in the market, the transfer efficiency of export subsidies is reduced because some of the subsidy is captured as additional monopsony profit and the subsidy leads to an exacerbation of deadweight losses from monopsony. In contrast, an export subsidy diminishes distortions from the exercise of monopoly power on the selling side and, as a result, the existence of a monopoly enhances the transfer efficiency of an export subsidy. On the demand side, the switch from a pure monopoly to a marketing board that sets the same price amounts to a lump-sum transfer of monopoly rents from middlemen to producers—a highly efficient transfer mechanism. More generally, the marketing board's price (for a given transfer to producers) will not be the same as the monopoly price. Nevertheless, for similar reasons, the transfer efficiency of the introduction of a marketing board should be much increased when the board replaces a domestic monopoly.

A further dimension for extensions is to consider in-between cases of market power, using oligopoly-oligopsony models. A tractable representation can be achieved by assuming a fixed number of symmetric (identical) marketing firms, so that we can represent their actions with market power parameters that play the same role as conjectural variations parameters. Thus, following Huang and Sexton, in a closed economy with a consumer price (P), a farm product price (W), and a fixed per unit marketing cost (c), the market clearing conditions become:

$$P\left(1 - \frac{\xi}{\eta}\right) = W\left(1 + \frac{\theta}{\varepsilon}\right) + c, \tag{1}$$

where η is the absolute value of the demand elasticity, ε is the supply elasticity, ξ is an index of oligopoly power, θ is an index of oligopsony power, and the units are chosen so that the farm and retail quantities are identical. The same equation can be written, alternatively, as

$$\xi MR(Q) + (1 - \xi)D(Q) = \theta MC(Q) + (1 - \theta)S(Q) + c, \tag{2}$$

which shows that the equilibrium is given by the intersection of one curve, i.e., a weighted average of the demand curve $D(Q)$ and the marginal revenue curve $MR(Q)$, and another curve, i.e., a weighted average of the supply curve $S(Q)$ and the marginal cost curve $MC(Q)$. The weights are the market power parameters: $0 \le \xi,\ \theta \le 1$. In addition, the same view of competition can be used to represent multiple sources of supply with multiple destinations.

A Simulation Model

To investigate the issues raised above, we developed an empirical regional model of Canadian wheat production, consumption, policy, and trade. Implicitly it is assumed that Canadian wheat is differentiated from other countries' wheat, so that we do not model the world wheat economy; instead, we restrict attention to the markets for Canadian wheat. The model includes eight specific importer markets, defined by distinguishing among food aid, the U.S. market, three other classes of commercial markets, and three classes of markets in which Export Enhancement Program subsidies applied in the year of interest, 1991/92.

General Form of Model

The supply and demand equations are represented by linear approximations with elasticities at the point of approximation (the "base" case of the observed policy, prices, and quantities) used to parameterize the curves. The model is closed with a set of quantity-clearing identities and price-policy rules that define the behavior of the Canadian Wheat Board and the Canadian government. The model was defined and solved using the *Solver* option of *Microsoft EXCEL.*

The simulation model requires a demand elasticity (η_i) for each of the importing countries and Canada, and a supply elasticity (ε) for Canada. These elasticities and initial market data on prices and quantities allow specification of the linear model under competition. When we wish to model imperfect competition, we need to define oligopoly power parameters (ξ_i) for each of the importing countries and Canada, and an oligopsony power parameter (θ) for Canada. Finally, it is necessary to define the CWB policy. The

CWB has sole export powers and theoretically can discriminate among export markets. To simplify the analysis, the CWB is modeled as though the agency maximizes gross revenue from the sale of the crop, by equating marginal revenues across markets, and returns producers an incentive price that is equal to the average revenue thus obtained.[5]

Specification of the Underlying Market Parameters

To establish the specific effects of various export-marketing structures is largely an empirical problem. We need information regarding the demand conditions that prevail and the extent to which the markets are separable and price discrimination is possible. Given that price discrimination is possible only for noncompetitive sellers, obtaining relevant data is difficult. To define the demand parameters, we used data derived from CWB sales for the 1991/92 crop year by Kraft, Furtan, and Tyrchniewicz [(KFT), p. 42, figure 4.3.2], which were provided to us by the CWB for this purpose. This was a period in which the U.S. Export Enhancement Program was in effect, and the resulting estimates of parameters of demand for Canadian wheat, facing the CWB, are conditioned by the prevailing U.S. policy of discriminatory export subsidies and its implications for premiums and discounts. More specifically, the potential for price discrimination by Canada was influenced by the U.S. EEP policy, so that our estimates should not be interpreted as applying in a world without the U.S. EEP in effect.

The data indicate the quantity sold and the premium (or discount) relative to commercial prices for all grade 1 Canadian Western Red Spring (#1 CWRS) wheat exported into non-EEP markets during the 1991/92 crop year.[6] The premium was calculated for each sale as the difference between the actual transacted price and the commercial asking prices for similar grades on the day when the sale was made. (We also conducted simulations after cutting each premium and the observed EEP subsidies in half, with correspondingly much more conservative possibilities for price discrimination, since the KFT results have been controversial.) Note that all premia and prices reported are in U.S. dollars.

The quantity of exports to the United States, 580,000 tonnes, appears in the CWB annual report. KFT report that, during the 1991/92 crop year, "many of the 1991/92 sales with low or no premiums were to U.S. buyers" (p. 39). The CWB provided a separate listing of U.S. sales, which allowed us to calculate an average premium of $0.19 per tonne sold into the U.S. market. The premium for each of the three segments of the (non-U.S.) commercial market was calculated by first ordering sales on the basis of premium, then dividing the data into three equal parts on the basis of volume, and then calculating the average premium earned for the high-, medium-, and low-premium commercial markets. The average premium was $27.21 per tonne for the highest third of sales, $8.28 per tonne for the middle third, and $1.67 per tonne for the lowest third. KFT provide very little data on price premia for sales into EEP-affected markets. Lacking specific data for the EEP markets, we assumed that the price premia in the high-,

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[5] Full details on the simulation model and results from sensitivity analysis are available from the authors upon request.

[6] In the crop year 1991/92, 75% of all wheat production fell within the #1 grade. As reported by KFT, the average premium obtained for #1 CWRS was $12.42 per tonne, only slightly greater than the average premium obtained for all grades of $10.10 per tonne.

medium-, and low-premium EEP markets were the same as in the high-, medium-, and low-premium commercial markets. The premia were applied to an average f.o.b. farm price of $100 per tonne.[7]

By assuming that observed price discrimination reflects revenue-maximizing behavior, we are able to calculate an implicit linear demand curve the CWB faced in each market. This required an additional assumption about the demand elasticity in one of the markets. We assumed the elasticity of demand for Canadian wheat in the low-premium market was –20. (We also tried a value of –5, which changed the empirical results but not the qualitative findings.) Using this elasticity and the price and quantity in that market, we calculated the marginal revenue as well as the slope and intercept of the demand curve in that market. Then, assuming the same marginal revenue in every other market, given the prices and quantities, we could derive the elasticities and slopes and intercepts of all the other demand curves as well. The results of these calculations are presented in table 2. Note that domestic demand is very elastic, reflecting the lack of border restrictions and the potential for imports from the United States.

The Simulations

The actual export policies of the CWB and hypothetical export subsidies are compared under the demand conditions for Canadian wheat that prevailed in the 1991/92 crop year. More specifically, we examine the economic effects of providing the same producer income as under the CWB, but through a targeted or nontargeted export subsidy instead. In each non-CWB scenario, we examine the influence of market power of middlemen.

A "free-market solution" with no intervention is used as the benchmark for comparison of export policies. A different benchmark is derived under each of three alternative scenarios defined in terms of market power of middlemen: (*a*) a base scenario, with modest market power; (*b*) a competitive scenario, with no market power of middlemen; and (*c*) a less-competitive scenario, with greater market power of middlemen.

In the base scenario, middlemen are assumed to possess both oligopoly and oligopsony market power within the Canadian wheat industry, and the market power indexes are defined as $\xi_i = \theta = 0.05$, reflecting a very modest amount of market power on both the buying and selling sides. In the competitive case, the market power indexes are zero, and the supply price and the selling price converge to a single value, reflecting the law of one price. In the less-competitive case, the market power indexes are increased to 0.10, in order to reflect an increase in market power.

In each scenario (base, competitive, or less-competitive) we simulate the market outcomes for four policy cases: (*a*) a free market (with no CWB or any other intervention), (*b*) the CWB, (*c*) a targeted export subsidy, and (*d*) a flat, nontargeted export subsidy. The CWB simulation serves merely to reproduce the prices and quantities reported in table 2. It is implicitly assumed that the marketing costs, including all farm-to-port handling costs, are equal under the CWB and both the free-market solution and the

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[7] This reflects the actual realized farm price in the 1991/92 crop year, although the slopes of the demand curves are independent of the pricing point chosen.

Table 2. Parameters of Supply and Demand for CWRS Wheat, 1991/92 Crop Year

Description	Price ($/t)	Quantity (000s t)	Market Parameters		
			Elasticity	Intercept	Slope
Demand:					
Canada	112.33	1,343	-2.54	156.5	-0.03289
United States	112.81	582	-2.53	157.5	-0.07671
Food Aid	153.00	382	-1.80	237.8	-0.22218
Commercial High-Premium	140.21	2,436	-1.95	212.3	-0.02957
Commercial Medium-Premium	121.28	2,365	-2.28	174.4	-0.02246
Commercial Low-Premium	114.67	2,614	-2.47	161.2	-0.01779
EEP High-Premium	97.29	4,217	-3.34	126.4	-0.00691
EEP Medium-Premium	78.36	4,094	-7.68	88.6	-0.00249
EEP Low-Premium	71.75	4,524	-20.00	75.3	-0.00079
Supply:	100.14	22,557	1.00	0.0	0.00444

Source: Calculated based on estimates from Kraft, Furtan, and Tyrchniewicz (p. 42, figure 4.3.2).
Notes: EEP = $42.92/tonne; prices are in U.S. dollars per metric tonne; and quantities are in metric tonnes.

export subsidy.[8] The costs of occasional CWB deficits are also ignored as no deficit occurred in the 1991/92 crop year. Because the CWB sets both the purchase price and the selling price in each market, market power in the grain industry does not play a role in the CWB solution.

The simulation for the targeted export subsidy program solves for the least-cost set of targeted export subsidies to provide the same support to producers as under the CWB. These subsidies are modeled as shifts in the demand curves perceived by firms selling into the targeted markets. Market power of the grain industry continues to operate in these simulations. The simulation for the flat export subsidy solves for the amount of a common export subsidy that would be required to support producers at the CWB prices. In this case, all export demand curves are shifted by a common amount.

The economic effects of each policy are analyzed using standard measures of producer surplus, domestic (Marshallian) consumer surplus, marketing firm profits, and taxpayer costs. Taxpayer costs are assessed using a 20% marginal deadweight loss from taxation ($\delta = 0.2$). Transfer efficiency is measured as the total gain in producer surplus divided

[8] The assumption that marketing costs would be equal between the CWB and free-market scenarios is dubious. For instance, Carter and Loyns contend that the CWB costs Canadian farmers an additional CAN$31.65 per tonne of wheat, which, if true, would more than outweigh any likely benefits from price discrimination (see Schmitz, Furtan, and Baylis). It is not our purpose to compare the CWB and free trade, but rather to compare the CWB and export subsidies as mechanisms for supporting wheat producers. In making this comparison, we do not count the costs of administration and so forth associated with either the CWB or the hypothetical export subsidy alternative. In both our theoretical analysis and the application to the CWB, we do not account for additional marketing costs and other X-efficiency losses arising from the elimination of competition by the creation of an STE, which we suspect might be significant in the case of the CWB. This means our analysis is biased in favor of the STE relative to the export subsidy; on the other hand, neither do we count the additional costs associated with the administration of an export subsidy scheme, including administration and rent seeking.

by the total loss in taxpayer and consumer surplus and in profits to middlemen (i.e., the amount transferred to producers divided by the cost of the transfer borne by other domestic groups).

Simulation Results

The results of the simulations are reported in table 3. The first three numeric columns in table 3 represent the different market scenarios in terms of market power of middlemen, and the fourth (labeled "reduced price spread") shows the effects of cutting the premia and EEP values in half, relative to the base, but maintaining the assumption of modest market power, as in the base case. The first block in the table shows the increase in producer price, relative to free trade, required to achieve the same protection as under the actual CWB, under each market scenario; the corresponding increases in production and producer surplus are also shown. To achieve the same producer price *level* requires a different price *increase* given the different market power scenarios. It can be seen that relative to the free market, the CWB provides the largest transfer to producers when the middlemen possess the greatest market power. The gains to producers from the CWB are \$431 million when the market power indexes are 0.1 versus \$220 million when there is no middleman market power. This reflects the result that the introduction of the CWB not only allows price discrimination among markets, but it also eliminates middleman profits.

Holding these producer benefits constant within each column, the next three blocks in table 3 show the outcomes for prices and welfare of consumers, taxpayers, and middlemen, and thus transfer efficiency, under each of the three alternative policies. We measure Canadian surplus and transfer efficiency, assuming that the middlemen are Canadians. A second measure of transfer efficiency, denoted (b), does not count middlemen as Canadians, and is discussed at the end of this section.

The CWB policy does not involve any taxpayer losses, but does involve modest losses to domestic consumers. The transfer efficiency of the CWB is greater than one because the gain to producers exceeds the cost to domestic consumers and middlemen combined. Transfer efficiency is highest where middlemen possess no market power. This is at first surprising, but can be understood in terms of the role of middlemen. Losses to middlemen add to the denominator of the measure of transfer efficiency. These losses are zero in the competitive case, but in the less-competitive or base cases, middlemen are able to exploit foreign consumers—so some of the middleman profits represent net domestic gains. Since these preexisting benefits from market power are foregone in the transition to the CWB case, the national gains from introducing the capacity to price discriminate are commensurably reduced. Even when the market power indexes are as low as 0.05, over half of the producer surplus gain from the CWB comes from the loss in middleman profits. In contrast, the export subsidy programs increase middleman profits.

Now consider the targeted export subsidy. This policy implicitly taxes some export markets by subsidizing others. Thus, there is potential for a net gain in domestic welfare as a result of the selective subsidization of export markets. It can be seen that introducing the targeted export subsidy, relative to free trade, would achieve such a net gain, and hence the transfer efficiency is again greater than 1.0, even with a 20% deadweight loss from general taxation ($\delta = 0.2$), except in the less-competitive case.

Table 3. Simulation Results: Changes from Free-Market Scenario

Description	Market Scenario Base	Less-Competitive	Perfectly Competitive	Reduced Price Spread
Producer Effects, All Policies:				
Producer price increase ($/t)	13.63	17.56	9.31	11.16
Increase in production (000s t)	3,071	3,957	2,097	2,513
Change in producer surplus ($000s)	328,381	430,843	219,767	265,759
CWB Simulation:				
Consumer price increase ($/t)	18.37	15.53	21.50	11.02
Change in consumption (000s t)	-559	-472	-654	-602
Change in consumer surplus ($000s)	-19,536	-17,192	-21,844	-11,483
Change in middleman surplus ($000s)	-154,913	-282,300	0	-129,525
Change in Canadian surplus ($000s)	159,931	131,352	197,932	124,751
Transfer efficiency (a)	1.88	1.44	10.06	1.88
Transfer efficiency (b)	16.81	25.06	10.06	23.14
Targeted Export Subsidy:				
Consumer price increase ($/t)	13.63	17.56	9.31	11.16
Change in consumption (000s t)	-415	-534	-283	-609
Change in consumer surplus ($000s)	-15,477	-18,895	-11,186	-11,590
Change in taxpayer surplus ($000s)	-291,361	-460,448	-146,694	-184,101
Change in middleman surplus ($000s)	13,919	44,021	0	8,818
Change in Canadian surplus ($000s)	21,543	-48,499	61,887	70,068
Transfer efficiency (a)	1.12	0.99	1.39	1.42
Transfer efficiency (b)	1.18	1.03	1.50	1.52
Flat Export Subsidy:				
Consumer price increase ($/t)	13.63	17.56	9.31	11.16
Change in consumption (000s t)	-415	-534	-283	-609
Change in consumer surplus ($000s)	-15,477	-18,895	-11,186	-11,590
Change in taxpayer surplus ($000s)	-527,414	-707,216	-350,652	-382,350
Change in middleman surplus ($000s)	38,220	95,386	0	38,862
Change in Canadian surplus ($000s)	-214,510	-295,267	-142,071	-128,181
Transfer efficiency (a)	0.65	0.68	0.61	0.75
Transfer efficiency (b)	0.60	0.59	0.61	0.67

Notes: Taxpayer surplus costs are calculated as 1.2 times subsidy expenditure. Transfer efficiency (a) is the producer benefit divided by the sum of costs borne by taxpayers, consumers, and middlemen (benefits are negative costs); transfer efficiency (b) leaves middleman effects out. In the "base" case, the market power parameters are 0.05.

Transfer efficiency decreases as the market power of middlemen increases, and in the less-competitive case the introduction of the targeted export subsidy implies a net welfare loss, a transfer efficiency less than 1.0. As with the introduction of the CWB, the domestic gains from government action are lower when Canadian firms are already exploiting the potential to price discriminate among markets. Finally, it was suggested earlier that, for a given amount of transfer to producers, the CWB might tax domestic consumers more than export subsidies. This is true for the case of competitive middlemen and for the base case, but not with increased market power.

The transfer efficiency of the flat subsidy policy is much lower than that of either of the policies that involve price discrimination among markets, and the ranking is reversed. With the flat subsidy, transfer efficiency is higher the less competitive is the market.

Some further reversals of rankings arise when we consider the alternative measure of transfer efficiency, denoted (b) in table 3, which excludes benefits and costs to middlemen. The most striking effect is the increase in transfer efficiency under the CWB in the cases with imperfect competition. These and the other changes in results are interesting and are likely to be explicable in terms of the implications for deadweight losses from market power when powerful firms and policies interact. Understanding the specifics is difficult, however, since the transfer to producers (among other things) changes when we change the degree of assumed market power of middlemen.

Conclusion

Theoretical analysis suggests that export subsidies are similar in many ways to a policy of creating a marketing board with sole export powers. First, both policies result in producers receiving a single price for all sales that is greater than the competitive price. Second, both policies result in higher prices being charged to consumers in countries where demand is relatively inelastic, typically including the domestic market. Third, both policies would be optimized by equating marginal revenues among the markets but, because of pooling (and effective output subsidies), marginal revenue is less than marginal cost. Fourth, both policies involve a burden on domestic consumers—at least when the domestic demand is relatively inelastic, which is likely to be a common case.

Some important differences lie in the sources of funds and the implications of the different sources of funds for the incidence of costs and benefits. The export subsidy involves taxpayer funds, and, if these funds involve a large enough marginal excess burden ($\delta > 0$), the export subsidy could be a less efficient way of supporting producers; if $\delta = 0$, the export subsidy is clearly more efficient. Since taxpayer funds are not involved, if a marketing board is to achieve the same benefit for producers, it must raise revenue from consumers.

In the case where price discrimination among foreign markets is not possible, and domestic demand is less elastic than foreign demand, the marketing board will tax domestic consumers more heavily, and this means exports must be subsidized at a greater rate, on average, compared with the export subsidy. In turn, this means the burden on third-country exporters is greater from the marketing board than from the export subsidy. Relative to the marketing board, the transfer efficiency of export subsidies can be higher or lower, in terms of benefits to producers per dollar of harm to domestic consumers and taxpayers, but it cannot be lower in terms of benefits to producers per dollar of harm to third countries.

At first, this new result may appear to be somewhat surprising. However, countries with wheat marketing boards (Australia, Canada, and, in the past, Argentina) have tended to offer lower rates of producer protection than countries using export subsidies (notably the United States and the European Union). This may have masked the fact that, for a given rate of protection to producers, the marketing board requires a higher effective rate of export subsidy. It is also true that those countries using export subsidies did so in the context of a range of policies for supporting producer incomes, including domestic price supports.

In the more general case, where price discrimination among international markets is possible, the effects are more ambiguous. The extent to which domestic price discrimination can be used to achieve a particular support level is a function of the relative elasticities and the sizes of the various markets. Our simulation results showed that, compared with targeted export subsidies (and even more so, compared with a flat export subsidy), price discrimination and pooling is a much more efficient mechanism for supporting Canadian wheat producers. The comparison among the different policies does not depend qualitatively on the degree of competition in the wheat marketing industry, but that is partly because we have assumed middleman profits are part of Canada's benefits. If we were to attach no weight to middleman profits, the CWB option would be even more attractive in terms of transfer efficiency.

The simulation model illustrates and reinforces the theoretical results, but the particular results are dependent on additional modeling assumptions and the specific values used for parameters. In recent years there has been some contention over the extent to which the CWB can price discriminate among markets, and whether the potential revenue gains to producers from the exercise of sole export powers would outweigh the additional cost from restricting competition in wheat marketing (e.g., see Carter, Loyns, and Berwald, and studies they cite).

Our analysis has not allowed for any effects of an STE on marketing costs, nor for any differences in costs of administration, enforcement, compliance, and other costs among the policies; hence, our illustrative estimates overstate the net benefits from the CWB relative to no policy, and (probably) relative to export subsidies. Further, while our estimates of the benefits from price discrimination are based on the only published estimates of CWB price premia, the estimated premia are large and have been challenged. To address this concern, we also report results with more conservative estimates of the premia, and it can be seen that our results are robust with respect to this aspect. Finally, previous work in this area has generally presumed that the relevant alternative to an STE is a market with perfect competition, even though a primary justification for statutory marketing authorities has been countervailing market power. Our results show that even quite mild departures from perfect competition can have important implications for the evaluation of the economic effects of an STE and for the comparison with alternative policies for transferring income to producers, such as export subsidies.

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