HELMBERGER AND CHAVAS

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9

Analysis of Farm Programs: Part I

Although the models of farm markets in previous chapters draw heavily on competitive price theory, the fact remains that government intervention in farm markets is pervasive in most of the developed and developing countries of the world. Competitive processes are still at work, but government intervention causes these processes to generate noncompetitive market results. The gun still works, but the hand of government points it at a different target. The analysis of farm programs is therefore imperative if we are to understand how agricultural prices and other performance dimensions are often determined.

The broad objectives of this and the next chapter are to describe the major policies governments use to solve farm price and income problems and to analyze their likely economic effects. In this chapter, we first examine the effects of a direct payment program under certainty and in the absence of international trade. Then, in Section 9.2, we center on both direct payments and market price supports, allowing for agricultural exports. Models that allow for imports will be considered in Chapter 10. Drawing on Chapter 6, Section 9.3 analyzes direct payments and market stabilization schemes under conditions of uncertainty. It will be seen that proper analysis of stabilization schemes must be based on a theory that takes explicit account of dynamics, uncertainty, price expectations, and commodity storage.

9.1 DIRECT PAYMENTS UNDER CERTAINTY

A direct payment program is important not so much because of its widespread use, but because it is often recommended by economists as having several advantages over other approaches, a recommendation politicians have been loath to accept. In a direct payment program, the government announces a target price P_f^* for a farm commodity, food, say, and makes direct payments to farmers to assure that the real prices they receive will not fall below P^*. More specifically, under a direct payment program, the farmer's output is sold at the market price P. If the market price equals or exceeds the target price P^*, the government does nothing. If the market price falls below P^*, the government sends a check to the farmer equaling $(P^* - P)q$, where q equals the farmer's output. The direct payment per unit of output equals $(P^* - P)$. In real-world applications, it is important that the direct payment be based on the market price, an average for the nation, say, as opposed to the actual price a farmer receives. This encourages the farmer to search for the highest price.

Price and Quantity Effects

We begin by focusing on the domestic market, abstracting from international trade and uncertainty, complications that will be taken up later. The domestic demand curve DD and supply curve SS are given in Fig. 9.1. They can be interpreted as either short- or long-run curves. In either case, the intersection of these curves gives the competitive price P_c and the competitive output Q_c. (The student should ignore for the time being the areas in the diagram denoted by lowercase letters.)

To find the market equilibrium with a direct payment program in effect, we note that, for any market price less than the target price P_0^* in Fig. 9.1, farmers receive a per-unit direct payment that brings the price they effectively receive up to P_0^*. For all such market prices the effective farm price equals P_0^*, and, in the aggregate, farmers produce Q_g. For market prices in excess of P_0^*, the market price becomes the effective price. Thus the supply curve that shows how much farmers would be willing to produce at alternative market prices is given by the darkened curve SS_g, kinked at P_0^*, in Fig. 9.1. The new equilibrium price P_g and output Q_g are given by the intersection of DD and SS_g. In equilibrium, buyers are able to buy what they want at the market price P_g; farmers sell as much as desired at the effective farm price P_0^*. Market participants are in equilibrium because they could not further their goals by changing their decisions. The farmer receives a government check equal to $(P_0^* - P_g)q$, with the direct payment per unit equaling $(P_0^* - P_g)$. Government expenditure equals $(P_0^* - P_g)Q_g$.

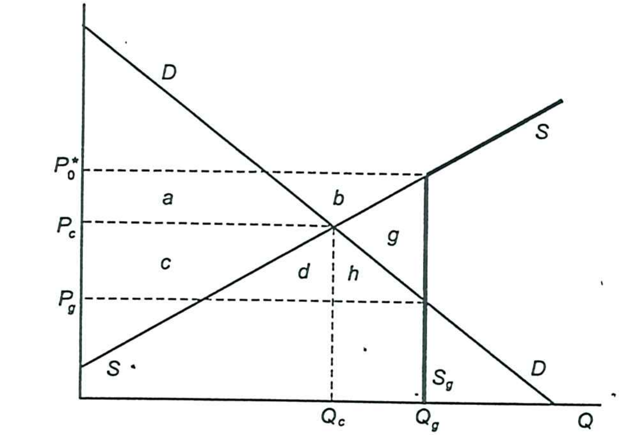

Figure 9.1 Demand and supply curves under perfect competition and a direct payment program, with program costs and benefits.

Equilibrium in the product market is linked to equilibria in the input markets. By increasing the revenue per unit of output produced, direct payments increase the demands for factors of production. (This assumes that none of the inputs is inferior.) In both the short and long run, increased input demands increase the levels of inputs (except for exogenous land), which drives up prices of all inputs with upward sloping supply curves.

Welfare Effects

Because a direct payment program lowers the market price, consumers are program beneficiaries. The aggregate gain in consumer welfare is given by area $(c + d + h)$. The increase in producer surplus is given by area $(a + b)$, but, again, we must be careful how this surplus is interpreted. With constant input prices in the short run, area $(a + b)$ measures the aggregate increase in quasi-rents to farmers. With endogenous input prices in the short run, area $(a + b)$ measures the increased quasi-rents to farmers plus the increases in surpluses to input suppliers. With endogenous input prices in the long run, area $(a + b)$ measures the increases in the input surpluses only. (Our convention is to call the long-run quasi-rents to fixed family labor family labor surplus.)

The efficiency gain (loss) needed to effect the preceding redistribution of market benefits through direct payments can be measured graphically. From the benefits to producers (including input suppliers) and consumers, we subtract the tax needed to finance the payments. Letting NB equal net benefits, we have

$$NB = \text{area } (a + b) + \text{area } (c + d + h) - \text{area } (a + b + c + d + h + g)$$
$$= -\text{area } (g) \qquad (9\text{-}1)$$

Area (g) is therefore a graphic representation of the efficiency loss.

A Closer Look at Farm Labor

If the welfare effects for a particular input are of interest, it becomes necessary to study the market for that input; the concept of producer surplus is too aggregative for such a purpose. Take agricultural labor as an important example. For this example, we assume that family and hired labor are identical and that the long-run supply function for farm labor is upward sloping. A direct payment program would in the long run generate benefits to labor, but what determines whether the benefits would amount to much? More generally, what conditions determine whether a direct payment program is an effective means for generating benefits to farm labor?

To answer this important question, we hark back to the aggregative farm sector model of Chapter 4. Abstracting from uncertainty and dynamics, we assume an aggregate production function as follows:

$$Q = \alpha_0 A^{\alpha_1} K^{\alpha_2} L^{\alpha_3}$$

where L is here defined as the sum of family and hired labor. The t subscripts that appeared in Chapter 4 are dropped because we abstract from lags in production. It is assumed that the supply functions for land A and producer goods K are perfectly inelastic and perfectly elastic, respectively. Let the farm labor supply be given by

$$L = aW^b \tag{9-2}$$

where W equals the return (wage) to labor, b is the elasticity of the labor supply function, and a is a multiplicative constant. Think of a graphic representation of this supply function with L on the vertical axis. If W increases from the competitive value W_c to the new level W_g under a direct payment program, the benefit to farm labor, that is, the change in worker surplus, is given by the area under the labor supply curve and between W_g and W_c. Applying integral calculus, this area equals

$$WS = \frac{1}{b+1}\left(W_g L_g - W_c L_c\right) \tag{9-3}$$

where WS equals the change in worker surplus. Recall that with a Cobb–Douglas production function and assuming profit maximization $WL = \alpha_3(PQ)$, where α_3 is labor's production elasticity. Thus

$$WS = \frac{\alpha_3}{b+1}\left(P_0^* Q_g - P_c Q_c\right) \tag{9-4}$$

where the product P_cQ_c equals total receipts to farmers under competition and $P_0^*Q_g$ equals total receipts to farmers including total direct payments. Other things being equal, if the elasticity of labor supply is large (b is large) and/or if labor is a relatively minor farm input (α_3 is small), a direct payment program tends to be an ineffective means for elevating returns to farm labor.

To gain a rough idea of the quantitative magnitudes involved, we take as plausible estimates $b = 1.9$ and $\alpha_3 = 0.124$ (see Helmberger, 1991). If a direct payment program elevates the total receipts to agriculture by \$4 billion, then the increase in worker surplus would equal \$172 million, which amounts to 4.3 percent of the increase in receipts. Judging from past trends, farm labor is becoming less important with each passing decade relative to land and capital. In addition, the labor supply function appears to be elastic. These considerations lead us to believe that a direct payment program is likely an ineffective means for generating benefits to farm labor. Much the same applies to other farm programs as well.

9.2 DIRECT PAYMENTS AND MARKET PRICE SUPPORTS (TWO-PRICE PLAN) WITH INTERNATIONAL TRADE

Up to this point, our analysis has centered on a direct payment program assuming no international trade. We now relax this assumption, assuming instead that the country of interest is a food exporter. (As noted, the case of a food-importing country is taken up in Chapter 10.) In addition, we describe and analyze a market price support program and compare its effects with those generated under direct payments. Market price support programs are of great importance in the United States as well as in many other countries, including those comprising the European Community.

The domestic competitive demand and supply curves for the output of food in the United States are given by D and SS in panel b, Fig. 9.2; the demand and supply

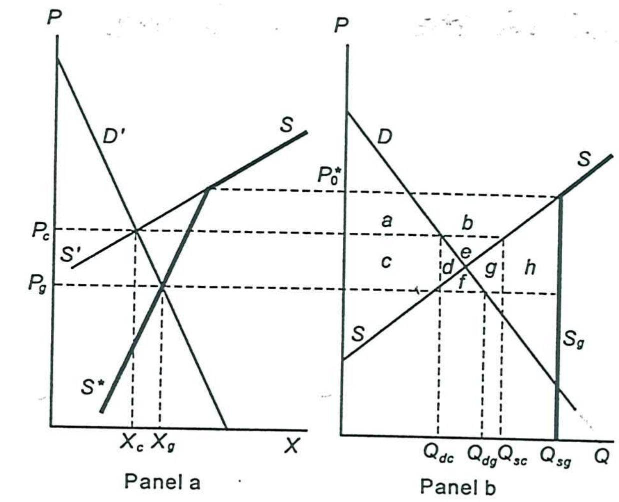

Figure 9.2 U.S. domestic demand and supply curves and the demand and supply curves for U.S. exports under perfect competition and a direct payment program, with program costs and benefits.

curves for U.S. exports X in the international market are given by D' and SS' in panel a. (At this stage, the student might like to review Chapter 5, which shows how the demand and supply for exports are derived.) Under competition and free trade, the equilibrium world price and the U.S. price both equal P_c, U.S. production and consumption equal Q_{sc} and Q_{dc} in panel b, and exports equal Q_{sc} minus Q_{dc}, which by construction equals X_c in panel a.

Direct Payments

A direct payment program is introduced in the United States with the target price P^* set equal to P_0^*. Direct payments are not, of course, given to foreign producers. The direct payment program shifts the U.S. supply curve from SS to the kinked curved SS_g. To find the new world equilibrium, we need first derive the new supply for U.S. exports. This can be done by simply subtracting laterally the demand curve D from the kinked supply curve SS_g. The resulting kinked supply for exports is given by SS^* in panel a. The intersection of the demand for U.S. exports D' and the new U.S. supply for exports SS^* determines the new world equilibrium price P_g, and U.S. exports equal $(Q_{sg} - Q_{dg})$, which, by construction equals X_g. The direct payment program lowers world price, increases U.S. output and world consumption, and decreases rest-of-world (ROW) production.

Turning to the welfare effects, we note that U.S. consumer surplus goes up by area $(c + d + f)$ in panel b. Producer surplus rises by area $(a + b)$. Since U.S. taxes rise by area $(a + b + c + d + e + f + g + h)$, the efficiency loss to the United States is given by area $(e + g + h)$.

By drawing a diagram showing how D' is derived for the ROW, the student can easily show that a direct payment program in the United States generates an increase in the ROW consumer surplus that exceeds the loss of ROW producer surplus. Therefore, the U.S. program results in a net efficiency gain to the ROW. Obviously, the ROW farmers will be displeased by U.S. policy, and those exporting nations that compete with the United States in the world market for food can be expected to complain, whether or not they themselves subsidize their farmers.

Market Price Support

We now consider a market price support program for food in the United States. Under this program, the government stands willing to purchase food in whatever quantity farmers wish to sell at the support price P^+. Exports from the rest of the world (ROW) to the United States are not allowed. What the U.S. government purchases in the domestic market is sold in the world market for whatever price can be obtained. Thus the market price support program under consideration is a two-price plan, involving a high support price in the domestic market and a low price in the international market. (Price support operations often result in large government stocks, but we abstract from storage for the moment.)

The competitive demand and supply curves are shown in Fig. 9.3. The government's demand for output becomes perfectly elastic at the support price P_0^+. The U.S. domestic demand DD, in panel b, shows how much private buyers would be willing to purchase at various prices. At the support price P_0^+, the quantity demanded equals Q_{dg}. The lower part of the demand, for prices less than P_0^+, never comes into play because the government does not allow the domestic price to fall below P_0^+. The total demand for farm output, for both private buyers and the government, is given by the darkened curve DD_g, kinked at $P = P_0^+$.

To derive the U.S. supply for exports, we horizontally subtract the supply SS from the demand DD_g. Then U.S. prices less than P_0^+ are no longer relevant. The export supply for the United States changes from SS' under competition (in panel a) to SS^+ under the price support program. The perfectly inelastic part of SS^+ can be explained as follows: As the world price falls below P_0^+, the U.S. price remains fixed at P_0^+. At the support price, exports equal Q_{sg} minus Q_{dg}, which equals X_g in panel a.

Equilibrium in the U.S. market is given by the intersection of DD_g and SS. The domestic price is elevated from P_c to P_0^+; domestic output grows from Q_{sc} to Q_{sg}. Domestic consumption falls from Q_{dc} to Q_{dg}. United States exports increase from $(Q_{sc} - Q_{dc}) = X_c$ to $(Q_{sg} - Q_{dg}) = X_g$. Letting P_0^* equal P_0^+, price supports increase U.S. exports more than do direct payments ceteris paribus. The reason for this is that U.S. output is the same under both programs if $P_0^* = P_0^+$. But price supports decrease do-

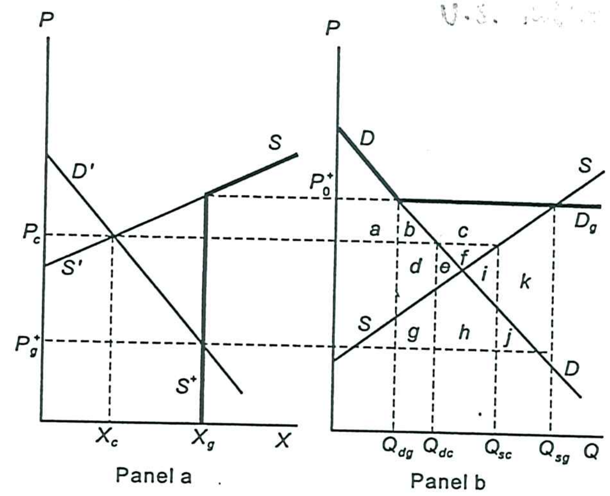

Figure 9.3 U.S. domestic demand and supply curves and the demand and supply curves for U.S. exports under perfect competition and a price support program, with program costs and benefits.

mestic consumption, whereas direct payments do just the opposite. The welfare impacts of a market price support program are left to the student as an important exercise.

Figure 9.4 allows a comparative analysis of direct payments and price supports on the assumption that the U.S. domestic demand is perfectly inelastic, an assumption that is probably realistic. The support level under price supports P_0^+ is set equal to the target price P_0^* under direct payments. Thus U.S. farmers produce the same level of output Q_{sg} under either program. Since demand is perfectly inelastic, U.S. exports are the same in either case. Foreign consumers and producers are affected in exactly the same way by the two programs.

The only differences in the economic effects of the two programs occur in the U.S. market. The student should understand that in either case the gain to the farm sector equals area $(a + b)$ and that the efficiency loss equals the area $(d + e + f)$. Consumer surplus falls by area (a) under price supports, but rises by area (c) under direct payments. Taxes under price supports are less than taxes under direct payments by the area $(a + c)$. Thus the choice between direct payments and price supports depends on how the government prefers to finance a given level of benefits to the farm sector. If the government prefers a higher food bill and a lower tax bill, it chooses price supports. If the government prefers a lower food bill and a higher tax bill, it chooses direct payments. Income taxes are painfully apparent; food taxes are hidden in higher food prices. Guess which approach politicians prefer.

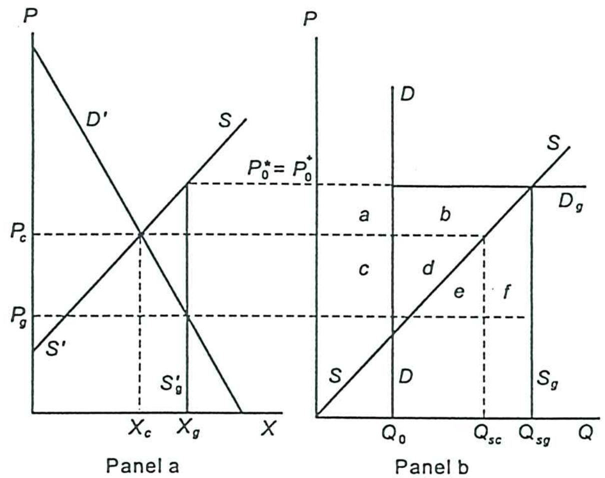

Figure 9.4 U.S. domestic demand and supply curves and the demand and supply curves for U.S. exports under perfect competition, direct payments, and price supports, with program costs and benefits.

9.2. The U.S. food demand and supply are $D_u = 10 - P_u$ and $S_u = 4P_u$. The ROW food demand and supply are $D_w = 15 - 0.5P_w$ and $S_w = (1.0)P_w$. Find price, production, consumption, and exports (imports) for both regions for the following regimes.

a. Perfect competition.

b. The United States starts a direct payment program with the target price P^* set equal to 4.

c. The United States starts a price support program with the support price P^+ set equal to 4. The U.S. surplus is dumped in the world market.

9.3. The aggregate production function is $Q = L^{0.5}A^{0.5}$. Suppose land is fixed at 16. The supply for labor is $L = 0.5W^3$. Food demand is $Q = P^{-0.2}$. The target price P^* equals 0.2 under a direct payment program. Calculate the increase in the total rent to land owners and the benefits to labor.

REFERENCES

Glauber, Joseph, Peter Helmberger, and Mario Miranda, "Four Approaches to Commodity Market Stabilization: A Comparative Analysis," *American Journal of Agricultural Economics*, 71, no. 2 (May 1989), 326–337.

Helmberger, Peter G., *Economic Analysis of Farm Programs*. New York: McGraw-Hill, Inc., 1991.

Houck, James P., *Elements of Agricultural Trade Policies*. New York: Macmillan Publishing Co., 1986.

Lowry, Mark, Joseph Glauber, Mario Miranda, and Peter Helmberger, "Pricing and Storage of Field Crops: A Quarterly Model Applied to Soybeans," *American Journal of Agricultural Economics*, 69, no. 4 (November 1987), 740–749.

10

Analysis of Farm Programs: Part II

Chapter 9 analyzed the use of direct payments and market price supports by a food exporting nation as alternative means for elevating farm prices and incomes (income redistribution) and as alternative means for stabilizing farm markets. It was shown that domestic prices can be supported through government removals of food from the domestic market and the dumping of surpluses in the international market. This, of course, results in high domestic prices relative to world prices. We begin this chapter by showing, in Section 10.1, that high domestic prices relative to world prices can also be achieved in food importing countries through import quotas and tariffs. Direct payments will again be seen to be of interest.

Following Section 10.1, this chapter returns to farm program analysis for food exporting nations. As we have seen, if price supports are used to stabilize markets, the support levels must be set below the market price expected under competitive conditions. Otherwise, governments stocks will grow endlessly. Even so, the governments of the United States and of many foreign nations have often used commodity acquisitions to elevate farm prices above competitive levels. One result has been vast commodity stocks of numerous commodities held in many parts of the world. Another has been the widespread dumping of surpluses in world markets. To avoid surpluses and/or dumping, governments have often turned to production control programs, and it is these programs that will occupy our attention in the latter parts of this chapter.

In Section 10.2, we analyze government-sponsored cartels as one such program. Section 10.3 centers on theoretical tools of use in Section 10.4. The latter section analyzes programs that offer farmers inducements to idle land as a means for decreasing production and increasing prices. Such programs have been the dominant approach to farm price and income problems in the United States since the early 1960s, and they are becoming increasingly popular in the European Community.

10.1 IMPORT QUOTAS, TARIFFS, AND DIRECT PAYMENTS: A COMPARATIVE ANALYSIS

Consider a country that ordinarily imports a substantial proportion of the food it consumes. As in the case of an exporting country, direct payments could be used to elevate farm prices and incomes, although, presumably, steps would need to be taken to ensure that payments are not made to foreign farmers. Unlike the case of an exporting country, however, import quotas and tariffs, often called *border measures*, could also be used to elevate domestic prices and incomes. In what follows we analyze the economic effects of quotas, tariffs, and direct payments under both the small- and large-country assumptions. According to the small-country assumption, the importing country's imports are small relative to world exports. Variation in its imports have no appreciable effect on world prices. Variation in a large country's imports, on the other hand, do affect world prices. The world price is exogenous in the case of a small country or importer, but endogenous in the case of a large importer. In what follows, we shall take the United States as an example of an importing country. The reader may think of sugar as an example of a commodity for which border measures are employed both in the United States and elsewhere.

Small-country Assumption

The demand and competitive supply for sugar in the United States are given by *D* and *SS* in panel b, Fig. 10.1. Abstracting from transportation costs and multiple currencies, the U.S. competitive demand for imports, given by *DD'* in panel a, is derived by subtracting laterally the supply curve *SS* from the demand curve *D* in panel b. The intersection of the demand for imports and the rest of the world supply of imports, the latter given by the flat curve labeled *S'* in panel a, determines the competitive level of U.S. imports M_c. By construction, M_c equals Q_{dc} minus Q_{sc}.

Suppose that the U.S. government seeks to elevate the domestic price to the target level given by P_0^*. One way to do this is to place a quota on imports equal to $(Q_{dg} - Q_{sg})$. This has the effect of raising the domestic price to P_0^*. At this price the total available supply, given by domestic production Q_{sg} plus imports $(Q_{dg} - Q_{sg})$, just equals consumption. A smaller quota would raise the U.S. price above P_0^*; a larger quota would leave the price below P_0^*. Exporting countries will be eager to ship as much as possible to the United States to take advantage of the high U.S. price. For the sake of fairness, the import quota might be apportioned among foreign suppliers on a proportionate basis. In other words, a foreign country's share of the quota might be set equal to that country's share of competitive imports. Notice that if the U.S. demand for imports is inelastic in the relevant range the total receipts to exporters will actually rise with the imposition of import quotas. Unfortunately for exporting nations, the demands for imports of many food products tend to be elastic.

As an alternative to an import quota, the United States could place a per unit tariff *T* on the commodity, with $T = (P_0^* - P_c)$. The importer must pay P_c to gain pos-

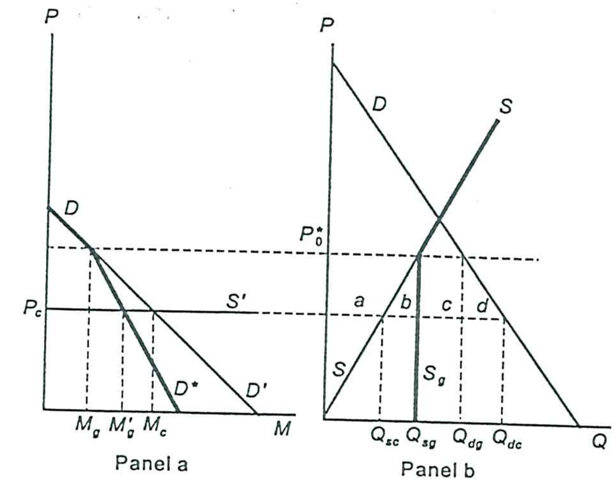

Figure 10.1 U.S. domestic demand and supply curves and the demand and supply curves for imports under the small-country assumption, with costs and benefits for import quotas, tariffs, and direct payments.

session of the commodity in the world market plus the per unit tariff $(P_0^* - P_c)$, which goes to the U.S. government, for the privilege of selling in the U.S. market. Under these circumstances, the importer can only earn normal profit if the domestic price rises to P_0^*. At this price, $(Q_{dg} - Q_{sg})$ will be imported, as in the case of the quota. Greater imports would drive price below P_0^*. Smaller imports would allow excess profit to be earned from importing sugar for U.S. consumption. Tariff revenue, which could be used to lower taxes, equals $(P_0^* - P_c)(Q_{dg} - Q_{sg})$.

Turning to direct payments, we note that if the target price is set equal to P_0^*, with a direct payment to U.S. sugar producers equaling $(P_0^* - P_c)$, then the U.S. supply curve shifts from *SS* to the kinked curve SS_g in panel b, Fig. 10.1. Subtracting horizontally the new supply curve from U.S. demand yields the kinked demand for imports DD^* in panel a. The intersection of the demand DD^* and the supply for imports *S'* determines the equilibrium level of imports, which equals M_g'. By construction, M_g' equals Q_{dc} minus Q_{sg}. Importantly, the U.S. domestic market price remains equal to the world price P_c. The tax required to finance the program is given by $(P_0^* - P_c)Q_{sg}$.

Turning to an analysis of welfare in the United States, we note that under an import quota U.S. consumers lose area $(a + b + c + d)$, and producers gain area (a); the efficiency loss equals area $(b + c + d)$. The consumer loss and producer gain are the same under a tariff, but a tariff lowers taxes by the area (c). Hence the efficiency loss falls to the area $(b + d)$. From the point of view of U.S. interests, a tariff is much to be preferred to an import quota.

Under direct payments, producers again gain area (a), but consumers lose nothing. The tax required to finance the payments equals area ($a + b$). The efficiency loss equals area (b). Obviously, direct payments is the most efficient means for effecting a given transfer of benefits to farmers under the present assumptions.

Large-country Assumption

We now analyze the case of a large importer. Here, variation in imports causes noticeable variation in world prices. Many of the results derived in the case of the small importer carry over to this one, but there is at least one surprising difference. Tariffs and direct payments might generate efficiency gains to the importing country!

The U.S. domestic demand and supply are given by D and SS in panel b, Fig. 10.2. The competitive demand for imports is given by DD' in panel b. For a large importer, the competitive supply curve for imports, given by SS', is upward sloping. Competitive equilibrium is given by the intersection of the supply for imports SS' and the demand for imports DD'. The competitive world price equals P_c. At this price, U.S. farmers produce Q_{sc}, U.S. consumers buy Q_{dc}, and $(Q_{dc} - Q_{sc})$ is imported. Also, $(Q_{dc} - Q_{sc}) = M_c$, by construction.

If the U.S. government sets an import quota equal to $(Q_{dg} - Q_{sg})$, the U.S. price rises from P_c to P_0^*. The world price drops to P_g. Exporters will be eager to sell as

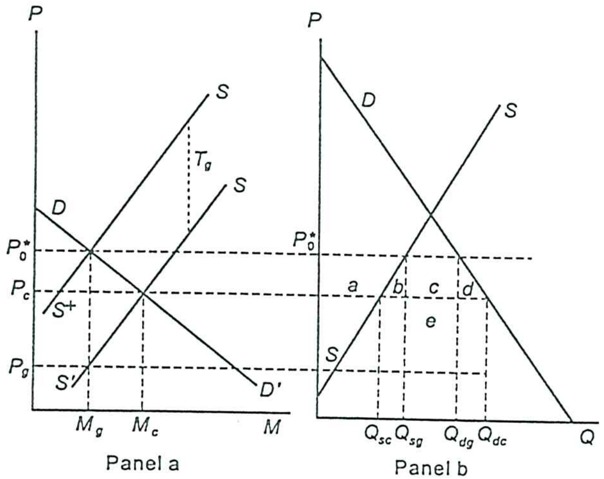

Figure 10.2 U.S. domestic demand and supply curves and the demand and supply curves for imports under the large-country assumption, with costs and benefits for import quotas and tariffs.

much as possible in the high-priced U.S. market, and we may again suppose that an exporter's share of the quota is, for reasons of equity, set equal to that country's share of competitive exports.

To analyze a tariff, we note that a per unit tariff shifts the supply for imports up in a parallel fashion. In panel a the per unit tariff is set at T_g such that the price of imports to U.S. consumers is driven up to the target price P_0^*. As in the case of the import quota analyzed previously, U.S. consumption falls from Q_{dc} to Q_{dg} and production increases from Q_{sc} to Q_{sg}. Imports drop to $(Q_{dg} - Q_{sg})$. Because the United States is a large buyer, the decreased imports drive the world price of sugar down from P_c to P_g.

Turning to benefit–cost analysis, we see that both the quota and the tariff generate a consumer loss in the United States equal to area ($a + b + c + d$); U.S. farmers gain area (a). The efficiency loss to the United States caused by the quota equals area ($b + c + d$).

To measure the efficiency loss in the case of the tariff, we need to calculate government revenue. Since the per unit tariff shifts the supply up linearly, we have in equilibrium $T_g = P_0^* - P_g$. Therefore, the tariff take equals $(P_0^* - P_g)(Q_{dg} - Q_{sg})$ or area ($c + e$). To measure the efficiency loss, we have

$$\text{efficiency loss} = \text{area } (a + b + c + d) - \text{area } (a + c + e) = \text{area } (b + d - e) \qquad (10\text{-}1)$$

It is clear from the graph, however, that area (e) exceeds area ($b + d$). Hence the efficiency loss indicated by Eq. (10-1) is negative, meaning that there is an efficiency gain in this particular instance. A gain is not the inevitable consequence of a tariff. Much depends on the shape of the import supply. The steeper it is, the more likely that a tariff results in an efficiency gain.

We expect that large importing nations would rush to impose tariffs were it not for the likelihood of retaliation. This explains why the nations of the world from time to time arrange international clambakes under GATT (General Agreement on Tariffs and Trade) to negotiate lower trade barriers. Life would be much simpler for the negotiators if countries relied on border measures only to protect their domestic industries, but many other approaches are possible, including direct payments. As we have already seen, a direct payment program is more efficient than tariffs as a means of elevating price to the target level where the importing nation is small. We now show this result might not hold if the importing nation is large.

Figure 10.3 has been drawn to facilitate a comparative analysis of tariffs and direct payments. Both programs raise the price to U.S. producers from the competitive price (not shown in the figure) to the target P_0^*. The analysis for tariffs is the same as before. Notice that the tariff T_g lowers imports to M_g and the world price falls to P_g. A direct payment program shifts the U.S. supply from SS to SS_g. Therefore, the demand for imports shifts from DD' to DD^*. The world and U.S. consumer price is lowered to P_g^*.

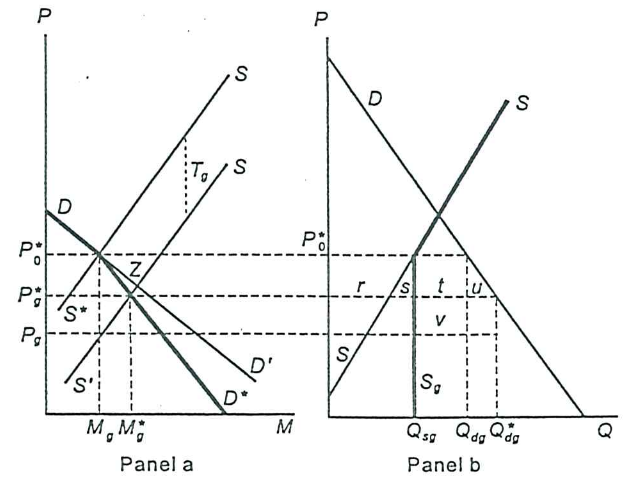

Figure 10.3 U.S. domestic demand and supply curves and the demand and supply curves for imports under the large-country assumption, with costs and benefits for tariffs and direct payments.

Turning to welfare analysis, the gain to U.S. producers is the same for either program. Under direct payments, the consumers gain area $(r + s + t + u)$ relative to the outcome under tariffs. Whereas the tariff generates government revenue equal to area $(t + v)$, direct payments cost the taxpayer area $(r + s)$. To measure the efficiency gain from direct payments *relative to the tariff*, we have

$$\text{efficiency gain} = \text{area } (r + s + t + u) - \text{area } (r + s + t + v) = \text{area } (u - v) \qquad (10\text{-}2)$$

Figure 10.3 is drawn to assure that area (v) exceeds area (u). Therefore, a direct payment program is less efficient in this particular instance than is a tariff in generating the same level of benefits to U.S. producers. Since we already know that direct payments are more efficient than a tariff if SS' is perfectly flat, as in the case of the small-country assumption, we are led to believe that whether a tariff is more efficient than direct payments as a device for supporting U.S. producers turns on the steepness of the supply for imports. And this is exactly the case. To see this, consider a clockwise rotation of the SS' curve in panel a through the point Z, all the time keeping the target price at P_0^*. As SS' approaches perfect elasticity, area (u) shrinks somewhat, but area (v) vanishes. Thus, if SS' is sufficiently flat, a direct payment program is more efficient than is a tariff in generating benefits to the U.S. producers.

10.2 GOVERNMENT-SPONSORED CARTELS

Because price support programs often lead to government-owned surpluses, with all the problems that they entail, governments often link production controls to price supports. One approach to production control is a government-sponsored cartel. Important examples include the U.S. programs for tobacco and peanuts. Although considered in Chapter 8, a government cartel is now analyzed in more detail.

The government embarks on a program to control production through issuing certificates that give farmers the right to sell output. It is made illegal for the farmer to sell a unit of output, a bushel, say, without surrendering a certificate. Like money, certificates are issued in various denominations. They are distributed in an equitable manner as follows: Each farmer is assigned a production base q_c that equals his or her level of output in competitive equilibrium prior to the initiation of the program. The farmer's share of total competitive output, q_c/Q_c, determines his or her share of allowable production and his share of issued certificates. Take an example. In competitive equilibrium, a farmer produces 40,000 bushels of corn. This sets the farmer's base. The government decides to limit production to 80 percent of the competitive level. The farmer therefore receives 32,000 certificates. The base is an asset that entitles the farmer to a flow of certificates in future years. In the short run, we assume that the distribution of production bases and certificates among farmers is fixed. In the long run, we allow bases and certificates to be bought and sold. In the long run, buying certificates is akin to renting base; buying base amounts to the purchase of an asset.

Short-run Analysis

A production control program along the lines spelled out certainly can be used to raise quasi-rents of farmers in the short run. Suppose, for example, that demand is inelastic in the relevant range. Total revenue rises with decreased production at the same time that aggregate variable costs fall.

To model the program's effects more carefully, let λ be the proportion of base production each farmer is allowed to market, where $0 < \lambda \leq 1$. Letting q_i equal the allowable quantity of production (marketings) and q_{ci} equal base or competitive production, both for the ith farmer, we have $q_i = \lambda q_{ci}$, $i = 1, 2, \ldots, N$. Aggregate quasi-rent QR to the industry is given by

$$QR = P\sum_i q_i - \sum_i C_i(q_i) \qquad (10\text{-}3)$$

where $C_i(q_i)$ is the ith farmer's total variable cost function. Letting the inverse output demand be $P = D(Q)$, we have

$$QR = D(Q)Q - \sum_i C_i(q_i) = D(\lambda Q_c)\lambda Q_c - \sum_i C_i(\lambda q_{ci}) \tag{10-4}$$

where $Q = \sum_i q_i$ and $Q_c = \sum_i q_{ci}$.

Clearly, the government's decision or control variable in this program is λ. Of interest are the effects of a program in which the government's objective is to maximize QR through the optimal choice of λ. The first-order condition for a maximum of QR is

$$\frac{dQR}{d\lambda} = Q_c\left[\frac{dP}{dQ}Q + P\right] - \sum_i \frac{dc_i}{dq_i} q_{ci} = 0 \tag{10-5}$$

The first-order condition implies that

$$MR = \sum_i MC_i \frac{q_{ci}}{Q_c} \tag{10-6}$$

where MR equals industry marginal revenue and MC_i equals the marginal cost of the ith producer.[1] The optimum aggregate output can be found by equating the marginal revenue with the weighted sum of the marginal costs of farmers, where the ith weight equals the ith farmer's share of aggregate competitive output. Letting Q_g equal the optimum output, the government sets λ equal to Q_g/Q_c. This fixes the level of aggregate output together with its distribution among the N farmers.

If we assume that all marginal cost functions are identical, then $q_{ci} = q_c$ and $MC_i = MC$ for all i and, since $Q_c = Nq_c$, Eq. (10-6) implies that $MR = MC$. Here we need merely sum horizontally the MC curves of all N farmers and locate the point where the resulting aggregate MC curve intersects the industry marginal revenue curve. This solution is the same as that for a multiple-plant monopolist when the plants are identical. (We ignore the special case when some farms or plants must be shut down.) Under the assumption of identical costs, market performance under a government cartel dedicated to the maximization of aggregate quasi-rents is identical to that for a profit-maximizing monopolist.

The preceding short-run analysis may be modified in a significant way by supposing that certificates may be bought and sold. With negotiability, the production of whatever level of output is permitted will be distributed among farmers in a manner that equates the marginal costs of all farmers. The easiest way to see this is to consider an example. Suppose that Farmer Smith's and Farmer Big's marginal costs

[1]The second-order condition for a maximum is satisfied if the marginal revenue curve for the industry is downward sloping and the marginal cost curves of farmers are all upward sloping.

equal, respectively, 20 and 15 prior to the exchange of certificates. The value of Farmer Big's right to sell a unit of output exceeds that for Farmer Smith by 5. Hence Farmer Big buys the right to sell (a certificate) from Farmer Smith. As production shifts from Farmer Smith to Farmer Big, the former's marginal cost declines, while the latter's marginal cost increases. The trading of production rights (certificates) will continue until marginal costs are equated. This assumes that a perfect market develops for the buying and selling of certificates, an assumption that seems reasonable with a large number of relatively small farmers.

With negotiability of certificates, the government can engineer the perfect cartel solution even with nonidentical marginal cost curves of producers. Imagine a diagram in which the marginal cost curves of all farmers are summed horizontally. Let the level of output associated with the equating of marginal revenue and aggregate marginal cost be given by Q_m. The government sets λ equal to the ratio Q_m/Q_c. The buying and selling of certificates lead to the equation of the marginal costs of production among farmers. By setting λ equal to the ratio Q_m/Q_c and through allowing the buying and selling of certificates, the government is able to maximize the aggregate quasi-rents of farmers, but the benefits to farmers are distributed in a particular manner. The greater q_{ci}/Q_c is, for example, the greater will be the ith farmer's share of the production rights.

Clearly, the government need not operate its cartel in such a manner as to maximize aggregate short-run quasi-rents. Notice that quasi-rents can be elevated to whatever level is desired, subject, of course, to the maximum level by choosing λ such that $Q_m \le Q \le Q_c$. The extent to which the government desires to create short-run benefits to farmers at the expense of consumers is a policy decision involving value judgments.[2]

Long-run Analysis

In long-run analysis, we seek first to model the pricing of certificates on the assumption that all production bases are owned by nonfarmers. To farm, the family must buy certificates (i.e., rent base). (We will show later that this assumption is not as restrictive as it might at first seem.) We let r equal the level of certificates purchased by the representative farmer and P_r equal the price per certificate.

The farmer's profit function in the long run is

$$\pi = P_q q - C(q) - TE - P_r r \tag{10-7}$$

where $C(q)$ is the production cost function and, as before, TE equals the family's transfer earnings. Because $q = r$, we have

[2]In the present context, a value judgment is a statement that expresses a preference for one set of market results over another. Rational policy choices presumably involve choosing the policy alternative that delivers the most preferred market results.

$$\pi = (P - P_r)q - C(q) - TE \qquad (10\text{-}8)$$

where $(P - P_r)$ equals the real or net price received per unit of allowable output. Profit maximization implies that $(P - P_r)$ equals the marginal cost of production, given by $C'(q)$, subject to the proviso that $(P - P_r)$ be not less than the average total cost of production AC. (To assure a maximum, $C''(q) > 0$.)

Entry and exit, on the other hand, imply that, for the marginal family farm, $\pi = 0$. This implies that

$$P - P_r = AC \qquad (10\text{-}9)$$

Hence $P_r = P - AC$. The price per certificate equals the difference between output price and the average cost of production for the marginal farm.

Armed with these results, we turn to a graphic analysis with the aid of Fig. 10.4. The demand and long-run competitive supply for output are given by D and S. The marginal revenue curve is given by MR. Let $P = S(Q)$ be the supply function. Since long-run supply shows the minimum average cost of production for various levels of output, we have $AC = S(Q)$. The total industry cost of output TC is therefore given by

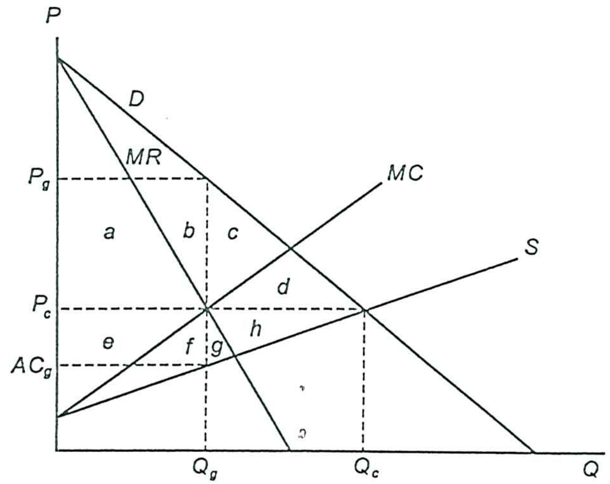

Figure 10.4 Demand and long-run supply curve and industry marginal revenue and marginal cost curves, with costs and benefits for a government cartel.

$$TC = S(Q)Q = C(Q) \qquad (10\text{-}10)$$

The industry marginal cost of production is given by $C'(Q)$. A graphic expression for industry marginal cost is given by MC in Fig. 10.4. Now assume that the government's long-run objective is to maximize what we will call the cartel residual, equaling the difference between industry total revenue and industry total cost of production, excluding the outlay on certificates. The cartel residual is maximized by equating marginal revenue and marginal cost in the spirit of a monopolist, setting output equal to Q_g in Fig. 10.4. With $Q = Q_g$, $P = P_g$, and $AC = AC_g$. The price of certificates equals $P_g - AC_g$.

A benefit–cost analysis points up the myopia behind this approach to farm policy. Relative to competitive equilibrium, consumers lose area $(a + b + c + d)$. Long-run producer surplus falls by area $(e + f + g + h)$. The owners of production bases (i.e., the long-run rights to produce) receive area $(a + b + e + f)$, but, of course, they must pay for this annual source of rent. In a perfect market for assets, the initial owners of the production rights, received gratis from the government, enjoy a capital gain CG as follows:

$$CG = \frac{(P_g - AC_g)Q_g}{i} \qquad (10\text{-}11)$$

Subsequent owners get what they pay for and receive no surplus or benefit. Thus the consumers and farm input suppliers are all made worse off in the long run so that initial farmers may be given the ownership of a monopoly.

Our analysis is based on the assumption that the government wishes to maximize the cartel residual. This need not be the case, but no matter. Whatever feasible level of cartel residual the government seeks to generate can be analyzed using Fig. 10.4. The closer Q_g is to the competitive output Q_c, the lower the residual.

Finally, our analysis assumes that all farmers rent base (i.e., buy certificates). The impact of the program on the farmer who buys base, thus receiving the certificates directly from the government, can be analyzed in two stages. As a producer, the farmer pays $(P_g - AC_g)$ per certificate. As an asset owner, he receives from himself $(P_g - AC_g)$ per certificate. Through inheritance, of course, future generations of farmers could benefit from the capital gains that their ancestors received free of charge from the government in some earlier epoch.

10.3 THE INDIRECT PROFIT FUNCTION

A voluntary program that offers farmers inducements of various kinds to idle farmland has been the dominant approach to farm policy in the United States since the 1960s. An