Impacts and Incidence of Agricultural Commodity Programs

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Abstract

This paper analyzes the incidence of agricultural commodity programs. Producers advocate commodity programs and receive price subsidies, but free entry and perfectly elastic supplies of nonland inputs ensure that landowners extract the entire surplus from price subsidies. Moreover, an increase in the target price raises the land rent more than proportionately. Although landless producers benefit from commodity programs in the short run, they do not in the long run. Roughly 60 percent of program benefits go to producers who own land, and the remainder to landowners.

IMPACTS AND INCIDENCE OF AGRICULTURAL COMMODITY PROGRAMS

"The only farm resource whose price or annual use value is significantly affected by government programs, either through higher output prices or deficiency payments, is land." (D. Gale Johnson, 1986, p. 22)

1. Introduction

Since the passage of the Agricultural Adjustment Act of 1933, commodity programs have had a major impact on resource use and returns to factors in U.S. agriculture. Farm price supports are often justified as a means of redistributing income from consumers to commodity producers (Harberger; Gardner, 1983, 1987). An important issue is whether producers are the ultimate beneficiaries of commodity programs.

Floyd, Paul R. Johnson, Wallace, Rausser and Freebairn, and Alston and Hurd investigated social costs of commodity programs. These studies are based on comparison of producer and consumer surpluses that depend on price elasticities of demand and short run supply curves. For example, Floyd employed linearly homogeneous production functions and demonstrated that in the short run farm price supports benefit landowners more than producers.[1] Recently, D. Gale Johnson (1986) focused on long run distributional consequences of commodity programs and argued that in the long run landowners are the recipients of all commodity program benefits. If they do not benefit in the long run, why do producers advocate price support programs for agricultural commodities? The puzzle is resolved (i) if rent adjustment is slow and producers gain in the short run, or (ii) if producers are also landowners. Although the short run incidence of the benefits of commodity programs will be influenced by the speed of rent adjustment, the long run incidence will be determined by the proportion of farmland owned by producers.

This paper investigates the short run and long run incidences of commodity program benefits. We assume that nonland inputs are supplied by competitive firms so that the long run supplies of the nonland inputs are perfectly elastic. Free entry insures that in long run

equilibrium all benefits accrue to landowners. This increase in the rental price of land permits landowners to extract the entire producer surplus.[2] Moreover, long run equilibrium land rent rises more than proportionately with increases in the target price.

2. Price Supports and Land Demand

Our analysis is based on a stylized scenario of agricultural production with the following assumptions.

(a) Timing of Input Decisions: The target prices are announced at the beginning of the annual production period. Producers then make land use decisions which depend upon the target price and observed input prices. Once land is allocated, it becomes fixed ex post. Other nonland input decisions, however, can be made after the land is allocated.

(b) Modified Competition: Product and factor markets are assumed to be competitive. At the beginning of the period producers have free entry and exit.[3] However, perfect competition is modified by government intervention through target prices.

(c) Price Subsidy: To study the long run impacts of commodity programs, target prices are assumed to be maintained by a price subsidy, rather than by a buffer stock.

(d) Identical Producers: Producers are assumed to use identical production technology.

(e) Two Primary Inputs: Producers obtain output q by using two primary inputs, land L and the nonland input X. The nonland input X is a composite input including labor, chemicals and capital equipment used in agriculture, but exclusive of land.

Assumption (c) eliminates the complications arising from buffer stocks and attendant storage cost problems.[4] In practice, the government may hold some inventories in long run equilibrium.[5] For example, an equilibrium buffer stock may be established such that its size does not change from period to period. However, the government will not alter the size of buffer stock when the market is in stationary long run equilibrium. For this reason buffer stocks are not included in the analysis.

Producers may differ in farm size and production cost. The sole purpose of assumption

(d) is to investigate the behavior of the representative producer.[6] Thus, all producers are assumed to participate in the commodity program. The total land A eligible for program benefits is assumed to be fixed in the short run, but is positively related to land rent in the long run.

Ex Post Composite Input Decision

Because land is a primary input whose supply is relatively inelastic, we distinguish land from other nonland inputs. Important nonland inputs include a primary factor, labor, and a host of intermediate inputs such as combines, specialized machinery, chemicals, and raw materials purchased from other competitive industries. These nonland inputs are lumped together and are treated as a composite input X for two reasons.[7] First, the proportion of the labor force employed in the agricultural sector is relatively small in most developed countries. For example, increases in labor demand in the agricultural sector are not likely to significantly affect the wage rate in the United States. Thus, the wage rate is assumed to be exogenous. Second, the intermediate inputs used in agriculture are supplied by competitive firms in other sectors, and their prices are assumed to be given. For instance, increases in demand for farm chemicals may raise the prices of chemicals in the short run, but because they are produced by competitive firms, the long run supply of the intermediate inputs is perfectly elastic.

Let p^* be the target price of output, and let w and r be the price of the nonland composite input and the rental price of land, respectively. At the beginning of the period ($t = 0$), the representative producer chooses the amount of land L to cultivate. Ideally, farm size can be measured by capacity or output level. A farm with 600 acres and one worker is not necessarily larger than a farm with 500 acres and 10 workers. Because producers are assumed to use identical technology, land is a useful proxy for "farm size" or capacity. Land is a quasi-fixed input; it is a variable input at the beginning of the production period, but once land is allocated the producer can only alter nonland inputs.

Output is realized at the end of the period ($t = 1$). The total output generally depends on the distribution of the composite input over the production period. For simplicity, we assume that the total quantity of the composite input X is applied to land at a constant rate during the unit production period between time 0 and 1.[8] Then the output depends on the total amounts of X and L employed, and is given by a concave production function,

$$q = F(X,L).$$

The competitive producer's problem at the end of the period is to choose X to maximize profit,[9]

$$\pi = p^*F(X,L) - wX - rL,$$

where w and r are prices of X and L, respectively, and rL is the cost of land rent which is fixed ex post. Because the composite input X is supplied by competitive industries, w is assumed to be fixed. The first order condition is $p^*F_L(X,L) - w = 0$. Concavity of the production function insures that the composite input demand, $X = X(p^*,w,L)$, is inversely related to its price ($\partial X/\partial w = 1/p^*F_{XX} < 0$) and that an increase in the output price shifts the composite input demand schedule to the right ($\partial X/\partial p^* = - w/p^{*2}F_{XX} > 0$). If L and X are complements ($F_{XL} > 0$), then an increase in farm size L shifts the composite input demand schedule to the right ($\partial X/\partial L = - F_{XL}/F_{XX} > 0$). On the other hand, if they are substitutes ($F_{XL} < 0$), an increase in L shifts demand for X to the left.

The ex post or short run supply function is written as

$$q(p^*,w,L) = F[X(p^*,w,L),L]. \tag{1}$$

By concavity of the production function, we obtain $\partial q/\partial w = w/p^{*2}F_{XX} < 0$, $\partial q/\partial p^* = - w^2p^{*3}F_{XX} > 0$, and $dq/dL = F_L - F_X(F_{XL}/F_{XX}) > 0$. It is straightforward to show that $dq/dL > 0$ if land L is a normal factor.[10]

Ex Ante Land Decision

The representative firm incorporates the composite input demand function $X(p^*,w,L)$ when making a land decision. The producer chooses L at the beginning of the period to maximize profit[11]

$$\pi = p^*F[X(p^*,w,L),L] - wX(p^*,w,L) - rL. \tag{2}$$

The first order condition is $p^*F_L - r = 0$. The land demand function derived can then be written as $L = L(p^*,w,r)$. From the first order condition,

$$\partial L/\partial p^* = -\beta F_{XX}/p^*\Delta > 0 \tag{3a}$$

$$\partial L/\partial w = -F_{XL}/p^*\Delta \tag{3b}$$

$$\partial L/\partial r = F_{XX}/p^*\Delta < 0, \tag{3c}$$

where $\Delta = F_{LL}F_{XX} - (F_{XL})^2 > 0$ by concavity of the production function, and $\beta = F_L - F_X(F_{XL}/F_{XX}) = dq/dL > 0$ if land is a normal factor.

Substituting $L(p^*,w,r)$ into (1) yields the ex ante supply function:

$$q = q[p^*,w,L(p^*,w,r)]. \tag{1'}$$

Differentiating (1') with respect to p^* yields

$$dq/dp^* = (\partial q/\partial p^*) + (dq/dL)(\partial L/\partial p^*).$$

Thus, if L is a normal factor, the ex ante supply is more elastic than the ex post supply, i.e., $dq/dp^* > \partial q/\partial p^*$.[12]

3. Free Entry, Farm Size and Factor Returns

Free entry implies that equilibrium adjustments in factor returns occur at the beginning of the period when the government announces the target price. In reality, changes in the target price may not trigger instantaneous entry or exit of producers, and it may take several

periods before the equilibrium number of firms is restored. The simplifying assumption of free entry at the beginning of the production period is used to investigate the long run responses in factor returns and farm size. The plausibility of this assumption is discussed later by comparing the price elasticities of current rent and the long run equilibrium rent.

The land demand function $L(p^*,w,r)$ must satisfy an additional condition that profit be nonnegative. Substituting $L(p^*,w,r)$ into (2) yields the indirect profit function

$$\pi(p^*,w,r) = p^*F[X(p^*,w,L(p^*,w,r)),L(p^*,w,r)] - wX(p^*,w,L(p^*,w,r)) - rL(p^*,w,r).$$

For the farmers to survive, the output and factor prices must be such that $\pi(p^*,w,r)$ is greater than or equal to zero. If $\pi(p^*,w,r)$ is negative, then potential producers simply do not enter the market and some of the incumbent producers will exit from the market since zero profit is guaranteed by exiting from the market. Moreover, if $\pi(p^*,w,r)$ is positive, then entry of new producers will be triggered. The number of producers is stable and the market is in long run equilibrium if the representative producer earns zero profit,

$$\pi(p^*,w,r) = 0. \tag{4}$$

The zero profit condition states that for any target price p^*, there exist many input price combinations that yield zero profit. We now derive the input price frontier in the (w,r) space that satisfies the zero profit constraint in (4). Let $a_L \equiv L/q$ and $a_X \equiv X/q$ be the amounts of land and the composite input used per unit of output produced, respectively. Note that profit maximization requires cost minimization. The least cost combinations of inputs to produce one unit of output generally depend on the input prices. Thus, the input-output ratios can be written as $a_L = a_L(w,r)$ and $a_X = a_X(w,r)$. The unit cost is

$$g(w,r,q) = a_L(w,r,q)r + a_X(w,r,q)w. \tag{5}$$

The zero profit condition in (4) can be rewritten

$$p^*q - g(w,r,q)q = 0,$$

where $c(q,w,r) = g(w,r,q)q$ is total cost. The first order condition for optimal output is

$$p^* - g_q q - g = 0, \tag{6}$$

where $g_q q - g = c_q$ is marginal cost. Dividing the zero profit condition by q gives

$$p^* - g(w,r,q) = 0, \tag{7}$$

which defines a unit cost frontier in (w,r) space along which unit cost is equal to the target price p^*. In view of (6), we have $g_q = 0$. In other words, long run equilibrium is characterized by the minimum of unit production cost.

Three Propositions on Long Run Equilibrium

There are two ways to assess the long run impacts of a change in the target price on land rent. If agriculture accounts for a large fraction of gross national product, a general equilibrium production model with two sectors, agriculture and manufacture, can then be developed to assess the impacts of changes in the target price. For example, if the price of the composite input is significantly affected, the two sector model is relevant and the well known Stolper-Samuelson theorem can then be used to assess the impacts on rent of a change in the support price.

If agriculture accounts for a small fraction of total output, as in many developed countries, a partial equilibrium model is more appropriate in which land is a specific factor in agriculture. Specifically, if agriculture uses inputs such as labor and intermediate inputs commonly used in other industries, and if agricultural input demands account for a small fraction of aggregate input demands in these markets, then the increased demand for the composite input in agriculture will not significantly raise the price of the nonland composite input. D. Gale Johnson (1986) argued that rising target prices are unlikely to raise the

returns to farm labor. Even earlier D. Gale Johnson (1973, p. 186) also observed that the prices of "most inputs purchased from the non-farm sector of the economy, such as fertilizers, tractors, fuel and insecticides, and feeds and feedstuffs" are affected little by the level of farm output prices. Thus, the price of the composite nonland input is assumed constant and insensitive to changes in the output price.

In contrast, land is specific to agriculture, and the quantity of land supplied is fixed in the short run. Burt (p. 11) maintains that "the amount of farmland available may change gradually over time, but these changes are relatively insensitive to farm prices because they emanate from government appropriations" such as reclamations, highway developments and urban growth. Moreover, to control program cost, the government often limits annually the quantity of land "eligible" for price subsidy programs.[13] Thus, the supply of land is likely to be relatively inelastic even in the long run.

Because the supply of land is not perfectly elastic, new producers can enter the market only by bidding up the rental price of land. Subsequent to an increase in the target price, producer surplus increases and rental price of land increases. However, this induced increase in land rent causes the representative producer to use nonland inputs more intensively. If the long run equilibrium farm size L^* decreases (increases) with p^*, then entry (exit) of firms continues until a new market equilibrium is restored at a higher land rent. It is shown shortly that, under reasonable conditions, an increase in the target price only raises land rent and does not affect the long run equilibrium farm size L^*. In this case an increase in the target price initially raises entry pressure, but the latter is completely offset by the rise in rental rate and no entry actually occurs.

Recall from (7) that a given target price p^* defines a factor price frontier $g(w,r,q)$ or a locus of input prices (w,r) that are consistent with the long run equilibrium. If the price of the composite input w is fixed, however, there exists a unique rent $r^* \equiv r^*(p^*,w)$ that yields zero profit. Let the asterisk (*) denote that the variable is evaluated in long run

equilibrium, corresponding to target price p^*.

Let q_i^* denote the long run equilibrium output associated with the target price p_i^*. For given w, the long run equilibrium rent r_1^* is obtained at point A, the intersection of the unit cost frontier $g_1(w,r,q_1)$ and the vertical line w in Figure 1. Consider now the effect of an increase in the target price from p_1^* to p_2^*. This increase in the target price shifts the unit cost frontier from $g_1(w,r,q_1)$ to $g_2(w,r,q_2)$. The new equilibrium can be established at point B, at the intersection of the vertical line w and $g_2(w,r,q_2)$. If the factor prices do not change as in the short run, an increase in the target price will benefit every producer, i.e., $\partial\pi/\partial p^* = q^* > 0$. At p_2^* every producer expects to earn a positive economic profit, and hence entry pressure exists. If the rental price of land is fixed at r_1^* or rises below the new equilibrium level r_2^*, entry occurs. Free entry assures that, in the long run, the producer surplus vanishes and the market rental price rises to the equilibrium level, r^*. Thus, <u>if the supply of the composite input is perfectly elastic and free entry is guaranteed, then in the long run higher target prices cannot benefit landless producers</u>.[14] The landowners eventually exact the entire surplus from the higher target price that would accrue to producers if rent were fixed.

Price Elasticity of Equilibrium Rent

We now investigate how the long run equilibrium rent $r^*(p^*,w)$ responds to a change in the target price. Observe that the zero profit condition does not directly depend upon the aggregate land supply. Thus, (4) or (7) contains sufficient information to determine how r^* will respond to a change in p^* for given w. Accordingly, long run equilibrium rent $r^*(p^*,w)$ is independent of whether the aggregate land supply A(r) is vertical or positively sloped. Totally differentiating (4) yields

$$dr^*/dp^* = -\pi_p/\pi_r = q^*/L^*,$$

where (q/L) is the average product of land. The price elasticity of equilibrium rent is

$$e \equiv (dr^*/dp^*)(p^*/r^*) = p^*q^*/r^*L^* = 1/\Theta_L > 1,$$

where $\Theta_L \equiv r^*L^*/p^*q^*$ is the distributional share of land or the proportion of revenue spent on rent, which is less than unity.[15]

In the short run the eligible land is controlled by government. The eligible land can increase with the rent in the long run.[16] Let $A(r)$ be the total land supply, $A'(r) \geq 0$, and let $R^* = r^*A(r^*)$ denote the total rental income of the landowners in long run equilibrium. The elasticity of rental income with respect to price is

$$\tilde{e} \equiv (dR^*/dp^*)(p^*/R^*) = e(1 + \epsilon_L) > 1,$$

where $\epsilon_L \equiv (dA/dr)(r/A)$ is the rent elasticity of land supply, $\epsilon_L \geq 0$. If the land supply is fixed, ϵ_L is zero and $\tilde{e}$ reduces to e. If $A'(r) \geq 0$, then rental income rises faster than rent.

PROPOSITION 1: Assume that entry is free and that the supply of the composite input is perfectly elastic. Then the price elasticity of long run equilibrium rent is $e \equiv (dr^*/dp^*)(p^*/r^*) = 1/\Theta_L > 1$, and the price elasticity of long run equilibrium rental income is $\tilde{e} \equiv (dR^*/p^*)(p^*/R^*) = (1 + \epsilon_L)/\Theta_L > e$.

If the rental price of land were perfectly flexible or entry free, then the equilibrium adjustment would occur within a single production period. If the market adjustment of rent is slow, the price elasticity of <u>current</u> rent will be less than e, and can be less than unity. Let ϵ^* be the long run price elasticity of rent, and let $\epsilon_t \equiv (\partial r_t/p_t)(p_t/r_t)$ be the elasticity of "current" rent with respect to the target price, and where r_t and p_t are the land rent and the target price in the current period. Then the index $E_t \equiv \epsilon_t/\epsilon^*$ provides an indirect measure of "ease" of entry.[17] If $E_t = 1$, entry is free, and $E_t = 0$ represents the situation where entry is blocked as in a monopoly.

Teigen (1987, p. 37) reported the price elasticity of farm family income by sales class for 1983. Farm family income is the sum of farm income and nonfarm income of farm

families. For producers with sales of more than $40,000 in 1983, the elasticity of current farm family income with respect to the target price exceeded 3, whereas the elasticity was a little above unity for producers with sales below $10,000.[18] A very small fraction of farm family income in the latter group is likely to come from rental income, while a higher proportion of farm family income of producers in the former group is from owning land. The elasticity of rental income would be even higher than that of farm family income if farm families have non-rental income sources, including off-farm income.

Short Run and Long Run Incidences of Program Benefits

Scott has compared the net rent and the average price of corn per bushel in Illinois between 1959 and 1982. The average price of corn was roughly $1.00 between 1959 and 1962, rose to $1.26 in 1970, $2.00 in 1973, and $3.00 in 1974, and fell to $2.50 in 1982. The net rent to landowners was roughly $23 between 1959 and 1962, rose to $33 in 1970, $85 in 1973, and $107 in 1974, and then declined to $90 in 1982. Ordinary Least Square estimates for parameters of a linear model relating "current" rent to the average corn price imply an elasticity of 1.35.[19]

If it takes more than one period for the rent to reach the long run equilibrium value r^*, the elasticity of "current" rent with respect to the target price, $\epsilon_t = (\partial r_t/\partial p_t)(p_t/r_t)$, will be less than the long run equilibrium price elasticity of rent, ϵ^*. If the target price is raised and maintained for many periods, ϵ_t will approach its limiting value $\epsilon^* \equiv p^*q^*/r^*L^*$ as t approaches ∞. Because the average land share rL/pq for corn in Illinois between 1959 and 1982 was about 30 percent, the implied value of ϵ^* was 3.33. Since $\epsilon_t/\epsilon^* = 0.41$, roughly 40 percent of the equilibrium rent adjustment was made within a year.

Scott's data also show that sizable profits accrue in the short run to producers who do not own the land. In the short run, the zero profit condition does not hold, and hence $p^*q^* = rL + wX + \pi$, or

$$p^* = a_L r + a_X w + \rho, \tag{8}$$

where $a_L = L/q$ and $a_X = X/q$ are the input-output coefficients, and $\rho = \pi/q$ is per unit profit. In terms of proportional changes, (8) can be rewritten

$$1 = \alpha_L(\hat{r}/\hat{p}^*) + \alpha_X(\hat{w}/\hat{p}^*) + \alpha_\rho(\hat{\rho}/\hat{p}^*), \tag{8'}$$

where $\alpha_L = rL/p^*q$, $\alpha_X = wL/p^*q$ and $\alpha_\rho = \rho/p^*$ are the distributional shares of land, the composite input and short run profit, respectively. The land share α_L was 0.3, so the combined share of the composite input and farm entrepreneurial input was 0.7, and the elasticity of their combined return with respect to the target price was 0.86.[20]

If all producers were owner-operators they would be the single beneficiaries of price subsidies. Proposition 1 indicates that the long run incidence of benefits of commodity programs depends on landownership of producers. In actuality, however, there is no clear-cut demographic division of producers and landlords, because some producers also are landowners and some owners are part owners. For our purpose, however, an operational distinction can be made between the land operated and the land leased. Bernat (p. 20, Table 13) reported that of the 932 million acres operated in 1982, 377 million acres were rented and operated in 1982.[21] That is, about 40 percent of the operating land was rented to other producers. Similarly, the USDA (1988) reports that the total land in farms was 987 million acres in 1982. Full owners operated 34.7 percent and part owners operated 53.8 percent of land in farms. If we assume that part owners owned 50 percent of land owned, the total land owned by producers would be 61.6 percent. These land ownership patterns imply that approximately 40 percent of program benefits in the long run went to landowners who were not producers.

Target Price and Equilibrium Farm Size

Inasmuch as landless producers can benefit from price subsidies in the short run,

prospects of higher profits will affect land demand in the current period. Landless owners reap windfall gains or losses in the short run until a new long run equilibrium is established. If a change in the target price is permanent, no benefits accrue to landless producers once the new long run equilibrium is established. However, because the induced change in land rental alters the factor proportions to minimize production cost, a permanent change in the target price may increase or decrease the long run equilibrium farm size L^*.

We now investigate how an increase in the target price affects the long run farm size and the number of farmers. Let L^* and N^* respectively denote long run equilibrium farm size and the number of farmers corresponding to target price p^*. Then long run equilibrium farm size is equal to land demand when $r = r^*$. Thus L^* can be written $L^* = L(p^*,r^*,w)$. The equilibrium number of farmers N^* can be obtained by dividing the aggregate land supply $A(r^*)$ by L^*, i.e., $N^*(p^*,r^*,w) \equiv A(r^*)/L(p^*,r^*,w)$.

Recall that profit $\pi(p^*,w,r)$ is zero and the optimal value of land L^* is the farm size in long run equilibrium. To obtain the equilibrium farm size, we use $\rho = 0$ and solve for L in (8). An increase in the target price affects the equilibrium farm size L^* directly, holding rent constant, and also indirectly via the adjustment in the equilibrium rent r^*. The total effect on the equilibrium farm size is

$$dL^*/dp^* = \partial L/\partial p^* + (\partial L/\partial r)(dr^*/dp^*),$$

where the first term on the right side is the direct effect, and the second term is the indirect effect. Using (3a) and (3c), we obtain

$$dL^*/dp^* = (q^*/L^* - dq/dL)F_{XX}/p^*\Delta = (1 - \delta)qF_{XX}/p^*\Delta L^*, \qquad (9a)$$

where $\delta = (dq/dL)(L/q)$ is the land elasticity of output.

PROPOSITION 2: Assume that the total land supply is fixed and entry is free, and consider an increase in the target price p^*. Then

(i) L^* decreases, increases or remains constant according to whether δ is less than, greater than or equal to unity, and

(ii) N^* increases, decreases or remains constant according to whether δ is less than, greater than or equal to unity.

This proposition indicates that the land elasticity of output plays a key role in determining the impacts of price supports on the industry structure. It is widely believed that land yield (q/L) is independent of farm size.[22] In this instance, changes in the target prices have no impact on the long run equilibrium farm size L^*.

D. Gale Johnson (1986), Gardner (1987), and Teigen have reported subsidies and the numbers of producers participating in major U.S. commodity programs. Price subsidies declined for most of the commodities, remained stable for rice and barley, and increased for milk between 1968 and 1978 (Gardner, 1987).[23] The number of producers, however, declined in all commodity groups between 1949 and 1978. If land yield is independent of farm size, then the continued decline in the number of commodity producers must be attributed to other factors (e.g. technological advance), and not to declining target prices as has been suggested.[24]

Target Price and Supply Response

We now examine how the aggregate supply responds to changes in the target price. Assume that the land elasticity of output δ is unity and the aggregate land supply is fixed. The long run equilibrium output of the representative producer is obtained by substituting $L(p^*,w,r)$ into (1):

$$q^*(p^*,w,r) = q[(p^*,w,L(p^*,w,r)].$$

Differentiating q^* with respect to p^* yields

$$dq^*/dp^* = \partial q/\partial p^* + (dq/dL)(dL^*/dp^*) = \partial q/\partial p > 0.$$

Recall that the equilibrium farm size L^* and the number of firms N^* are not affected by changes in the target price. But long run equilibrium output q^* rises with the target price, because the representative producer uses the nonland input more intensively as the equilibrium rental price r^* rises. Note that $\delta = 1$ implies that $dN^*/dp^* = (A'/L^*)(dr/dp^*) \geq 0$. Thus, the long run equilibrium industry output $Q^* = N^*q^*$ also increases with the target price ($dQ^*/dp^* > 0$).

PROPOSITION 3: Assume that $\delta = 1$. Then the long run equilibrium firm output q^* and the aggregate supply of output Q^* increase with the target price.

Gardner (1987) reported the "long run" supply elasticities of 17 commodity groups for three years (1927, 1953, and 1978). For all commodity groups the long run supply elasticities rarely exceeded unity, except for dairy in 1927. These data indicate that the long run supplies of these commodities are generally price inelastic.

4. Concluding Remarks

In the case of net rent in Illinois between 1959 and 1982, the current price elasticity of rent exceeded unity, and about 40 percent of long run rent adjustment was made within a year. This example shows that equilibrium rental adjustments may not be fully made within a single year. This empirical evidence is consistent with Gardner's position that landless producers gain from commodity programs in the short run. But the theory supports D. Gale Johnson's (1973, 1986) observation that commodity programs mainly benefit landowners in the long run. Although producers receive price subsidies, free entry and perfectly elastic supply of the composite input insure that landowners eventually extract the entire benefits from price subsidies and that landless producers do not benefit from commodity programs in the long run. Inasmuch as about sixty percent of the U.S. farmland is owned by operating producers, roughly sixty percent of the benefits of commodity programs goes ultimately to U.S. commodity producers in the form of "rent."

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FOOTNOTES

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1. Floyd's model can be viewed as either short or long run, depending on the value of factor supply elasticities. If factor supplies are perfectly elastic, then in the absence of government intervention the long run supply curve should be horizontal. Floyd used a positively sloped industry supply curve, which implies that some nonland inputs are fixed. While acknowledging that the long run supply of labor is almost perfectly elastic and that of capital even more elastic, Floyd assumed that the elasticities of these inputs were between 1 and 3, indicating that he was dealing with short run.

2. In some commodity programs (e.g., tobacco) output is controlled by production quotas. In this case potential entrants bid up the rental price of quota rights, rather than inputs.

3. Here free entry means unrestricted entry, not costless entry. New entrants must purchase or rent eligible land in the government program. If an incumbent farmer is replaced by a new entrant, they may incur transactions cost even though the number of farmers remains the

same. This transaction cost is ignored. Entry of a single firm does not raise the cost of entry. At the market level entry of many firms raises the cost of fixed inputs such as land.

4. Obviously, if price is maintained by buffer stocks, an alternative model is required to take the welfare losses from storage cost into account.

5. Here we are considering long run equilibrium of the industry consistent with a given target price, and not describing competitive equilibrium in a general equilibrium context.

6. Obviously, production costs may differ among producers, and the intent of the assumption is not a realistic description of the agricultural commodity market.

7. Although breaking down the nonland inputs into labor and other intermediate inputs may make the model more general and the analysis more complex, little additional insight is obtained.

8. Thus, the changes in output arising from nonuniform application of the composite input are not captured by the production function. This simplification is employed for practical purposes. For instance, corn yields can be fairly accurately predicted by total plant-available nitrogen and soil moisture in late spring (Blackmer et al.).

9. Here, the distinction between ex ante and ex post refers to the beginning and end of the period. Land decision made at $t = 0$ is called an ex ante decision. The composite input X is continuously applied to fixed land between time 0 and 1. Because the total application of X is completed at $t = 1$, the composite input decision is termed an ex post decision.

10. Consider the problem of minimizing cost $C = wX + rL$ to produce a given output, $\bar{q} - F(X,L) = 0$. The cost minimizing combination of inputs depends on the relative factor price, w/r, and the output constraint $\bar{q}$. Land is considered a normal factor if the cost minimizing level of L increases with output ($dL/d\bar{q} > 0$), and is considered an inferior factor if it decreases with output ($dL/d\bar{q} < 0$). It can be shown that L is a normal factor if $F_L - F_X(F_{XL}/F_{XX}) \geq 0$. Complementarity of land and the composite input is a sufficient condition for both L and X to be normal factors.

11. In the absence of acreage restriction, the representative producer rents if he does not own land, and the implicit rent is included in the production cost if he owns the land.

12. Since land can only be adjusted ex ante, the ex ante supply will generally be more elastic than the ex post supply. Although an increase in the target price p^* increases the ex ante land demand ($\partial L/\partial p^* > 0$), the increased land demand may decrease output supplied if $dq/dL = F_L - F_X(F_{XL}/F_{XX}) < 0$ (i.e., when land is an inferior input).

13. This limit applies to the current production period. Obviously, it can be raised over time.

14. If the supply of the composite input X is not perfectly elastic, some of the surplus will go to the suppliers of X.

15. Floyd used a linearly homogeneous production function and factor supplies with constant elasticities and showed that $e > 1$ if land supply is less elastic than the other input.

16. The size of the eligible land L is politically determined in the short run. However, as the rent increases, there will be increased pressure to allow more land in the commodity program.

17. Price expectations may retard the market adjustment of rent. For example, if the target price increases temporarily, the market adjustment of rent would be slower than for a permanent increase in the target price.

18. Because the nonfarm income component of farm family income is independent of the support price, the price elasticity of the farm income component of farm family income is higher than the reported elasticity.

19. The OLS result is:

$$r_t = -19.6568 + 44.7856P_t;\ R^2 = 91.$$
$$\quad (5.5457)\ \ (2.9873)$$

The coefficient of the corn price was statistically significant at the 1 percent level, with t-statistic equal to 15.0.

20. An analogy can be made between the short run gainers of price supports and the "early birds" in the treadmill theory. See Cochrane, Chapter 19. As the support price increases existing farmers gain in the short run. As land rent increases, however, both the existing producers and entrants receive zero profit. If the target price declines, the exiting farmers become the early birds.

21. Of course, the rented farmland is in large part owned by other producers who play dual roles as landowner and operator. Bernat conveniently defines the total land operated (932 million acres) as the sum of the land operated by owner (555 million acres, 60 percent) and the land owned and rented out (377 million acres, 40 percent), which also is equal to the land rented and operated. Of the land rented and operated, the land operated by (landless) tenants was 111 million acres (12 percent), and the rest (266 million acres, 28 percent) is rented and operated by producers who not only cultivate their own land but also the rented land.

22. If the production function is linearly homogeneous, then land yield is independent of L. But in this case the equilibrium farm size is indeterminate.

23. These twelve commodities are wheat, rice, corn, sorghum, barley, oats, cotton, tobacco, peanuts, sugar, milk, and wool.

24. Teigen also reports that the total number of farmers for all groups has declined from 2.7 million in 1969 to 2.3 million in 1978.

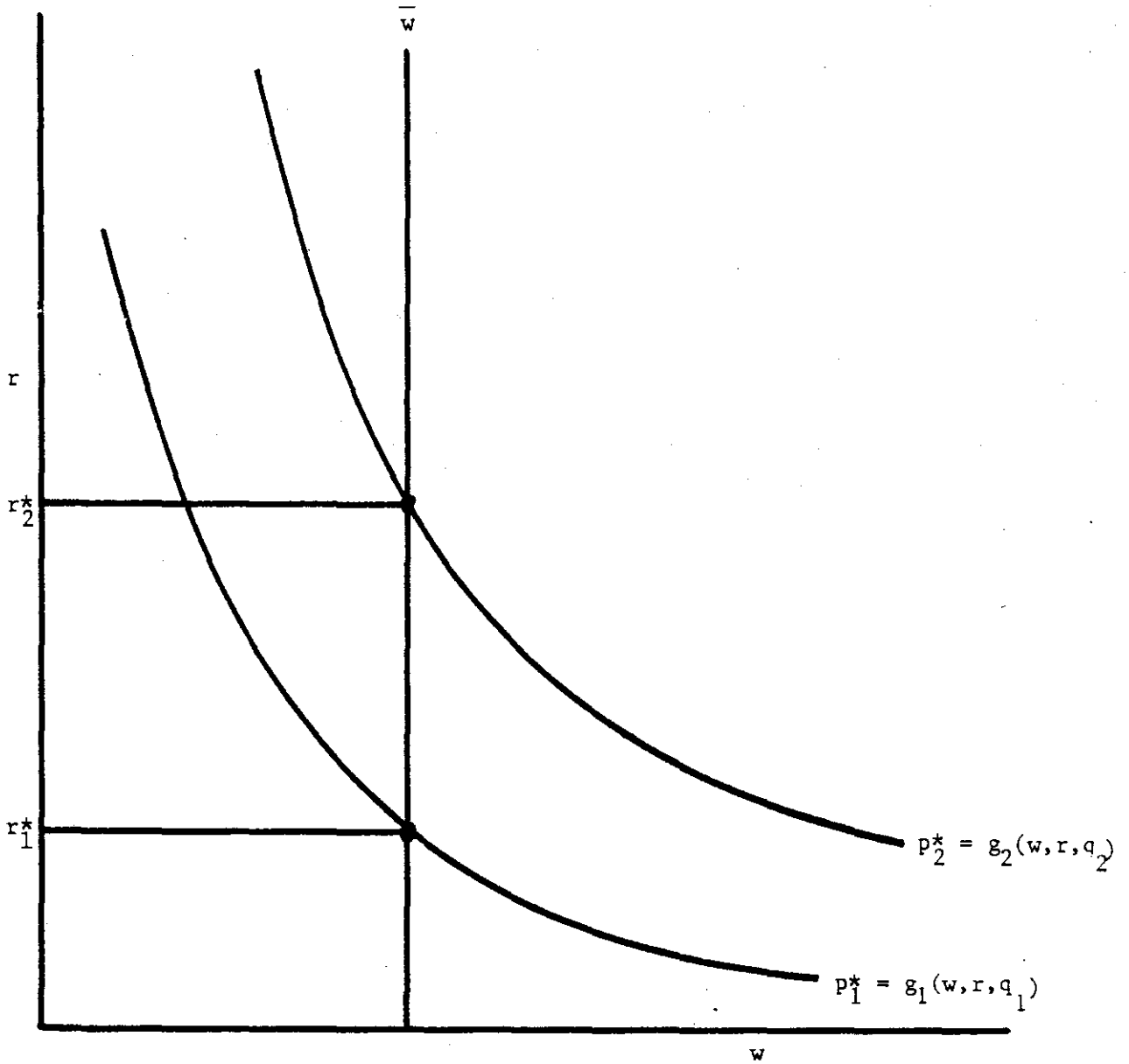

Figure 1. Target Price and Long Run Equilibrium Rent