Understanding the Production Effects of European Union Direct Payments for Acres Planted and Diverted

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1. Introduction

Agricultural support programs designed to protect farmers have undergone major reforms worldwide since the inception of the Uruguay Round of trade negotiations in the mid 1980s. The impetus for these reforms included the economic inefficiencies and budget costs generated by these programs, in addition to international pressures to minimize trade distortions. United States major field crops policy has undergone significant changes since the 1985 Farm Bill were program yields were ‘frozen’, thereby starting the trend towards decoupling of the target price that was finalized in the 1996 FAIR Act. Likewise in the European Union, partially decoupled programs for major agricultural sectors were implemented through supplementary direct income payments. This program was initiated in the McSharry reforms of the early 1990s, and deepened and broadened in the EU’s Agenda 2000 of the recent Berlin Accord. Canadian agricultural policy has also undergone major changes for a subset of the protected sectors, terminating several programs, and replacing them with direct income support payments through the net income stabilization act (NISA).

The effect of domestic subsidy programs on world trade has become an important policy issue, not least for the current agricultural trade negotiations. In an unprecedented act, WTO disciplines on agricultural support include domestic programs that encourage production. ‘Amber’ and ‘green’ policy ‘boxes’ are used to differentiate those policies that seriously distort trade from those with minimal trade effects. A key issue in the current WTO negotiations on agriculture will be the domestic support reduction commitments for the amber box (measured by the “aggregate measure of support” or AMS) and the blue box. Payments in the blue box are defined as though with supply control measures like base

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1 The loan rate remains fully coupled, however, through ‘loan deficiency payments’.

2 For example, the Agricultural Stabilization Act (ASA), the Western Grain Stabilization Act (WGSA) and subsidies under the Western Grain Transportation Act (WGTA) have been terminated, and the National Tripartite Stabilization Program (NTSP) and the Gross Revenue Insurance Program (GRIP) are being phased out.
acreage constraints and acreage set-asides. The blue box escaped reduction commitments in the Uruguay Round and there is no time limit on the validity of the blue box (the peace clause is limited to 2004 so the particular status of the blue box is likewise limited). The EU has staked the center of their negotiating proposals in the current negotiations on agriculture in the WTO on the maintenance of the blue box while the US and the CAIRNS group have called for its elimination.

Given this controversy and the reform efforts of governments in agricultural policies for efficiency concerns and the ongoing trade negotiations, it has become increasingly important to understand the effect of farm programs on output response. This is particularly true when the degree of decoupling has become murky. Many policies involve transfers from consumers or taxpayer financed income payments that are partially decoupled like fixed payment yields, and payments based on both acreage planted and acreage diverted. Previously, agricultural policies were rather straightforward and fully coupled with import barriers, open ended price supports or export subsidies. But the current trend is towards varying degrees of decoupled policies.

The purpose of this paper is to identify the impacts of direct income or ‘compensatory’ payments for both acres planted and diverted by cereal producers in the European Union. Commentators argue that these payments fulfill several criteria of Annex 2 in the URAA defining non-trade-distorting subsidies in that they are taxpayer financed and do not provide price support to producers. However, payments are based on acres planted and farmers are obligated to produce cereals in order to receive the payments for those acres planted. Because payments are made on a fixed base acreage by region, economists thus far have assumed that the effects are like infra-marginal production subsidies (Cahill; FAPRI; Guyomard, Baudry and Caroentier; Moro and Sckokai).³

To illustrate, payments are fully de-coupled in the traditional sense in Figure 1 if the level of production X induced by the prevailing world market price p is greater than output corresponding to base

³ “Infra-marginal” means the marginal cost for output receiving income payments is below the world price.
Figure 1: An Infra-marginal Production Subsidy

acreage B, upon which the payment per acre planted $s_o$ is determined.\textsuperscript{4} The analysis in Figure 1 ignores complicated factors like diverted acres and yield per acre decisions, but will be incorporated in the analysis to follow.

Compensatory payments cause over-planting because proportional reductions in $s_o$ are effectively applied to each farmer if total acres planted in the region exceeds its base area. The literature to date has ignored this important consideration. In this paper, we develop a model to analyze the implications of the

\textsuperscript{4} The per unit subsidy so includes the fixed EU ‘payment’ yield per acre.
mechanism by which compensatory payments are made. We augment the analysis to include the complicating effects of mandatory and voluntary acreage diversion (with payments per acre that can differ from compensatory payments per acre), and of “extra-ordinary set aside” that is applied to any regional base area in the marketing year following an overshoot.\(^5\) We begin by outlining a model with constant costs per acre planted that is amended later to allow for yield per acre declining with the level of acres planted and diverted.

With compensatory payments alone, we show that each farmer has an incentive to plant beyond where marginal cost equals the world price. This results in a reduction in the effective payment per acre planted because it is determined by the ratio of total regional acreage planted to the fixed regional base area. In other words, each farmer faces the same proportional global reduction in compensatory payments for acres planted. There is no individual farmer data before the 1992 reform, and thus the EU selected policy tools with a regional differentiated global compensatory payment per acre, calculated from fixed payment yields (output per acre) and global acreage. The implications is that, if one farmer exceeds his or her base and all other farmers do not, then the former gains because the decrease in \(s_o\) is insignificant. However, if all farmers over-plant, then the question is how much does aggregate output increase. Are all of the rents \(R\) in Figure 1 wasted in rent seeking? By how much will acres planted exceed that corresponding to output level \(X\) in Figure 1? In the rent seeking literature, the theory of contests suggests that in a competitive environment, the entire rent may be dissipated or over dissipates in the effort to capture the rent. These contests involve politically contestable rents, where outlays are made for lobbying for the rent or a part of it. The present analysis uses the same game theoretical approach to arrive at equilibrium, however, involves rent dissipation in terms of decreasing subsidy per acre as total overproduction increases.

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\(^5\) Extra-ordinary set-aside has no payments attached to it but is complicated because the European Commission considers certain options that could lead to the arrangements in force being amended, such as not taking voluntary set-aside into account in the calculation of the overshoot, and the introduction of a maximum rate for extra-ordinary set-aside.
This paper is organized as follows. The next section derives the results of planting decisions with compensatory payments for planted acres only, but with proportional reductions if the base area has been exceeded. Section 3 then augments the analysis to include the effects of payments for both mandatory and voluntary acreage diversion requirements. Section 4 generalizes the model where the amount of non-land inputs per unit acre decreases with the number of acres planted. The final section offers some concluding remarks and implications.

2. The Economics of Acreage Decisions with Compensatory Payments

A key characteristic of the EU compensatory payment scheme for cereals is that there is no constraint on the total acres planted. Only the level of base acres is fixed along with the corresponding level of compensatory payment per acre planted, provided total regional acreage planted does not exceed total regional base acres. However, each farmer applies for direct payments on the actual area planted, and is not constrained to limit his or her acreage to any specific level. Indeed, a farmer may consider to plant a level of acreage such that marginal cost equals to the market price plus the per unit subsidy on acres planted. If only one farmer does so, then the total regional acreage will only exceed the total regional base by a small amount, and so will be prorated down slightly. But other farmers will see the excess profits made by that one farmer, and so will increase their plantings as well. The purpose of this paper is to determine the extent to which over-planting occurs and resulting effects on producer welfare, with alternative assumptions on the details of acreage set-aside programs and yield per acre. The model is then augmented to include three acreage set-aside features: compensated mandatory and voluntary set-asides, and the extra-ordinary set-aside requirement if acres planted exceeds the regional base acreage.

Let us first consider the case of no acreage diversion. The European Union chooses a base $B$ and per acre planted subsidy $s_o$ for that planted within the base. This determines the total payments to producers denoted by $R = Bs_o$. But actual payments received by farmers per acre planted may be prorated down if total regional acres planted exceed the total regional base acreage. Hence, denote the
actual compensatory payment per acre planted by $s_i = s_0 \cdot (B/Q)$ where $Q = \sum_{i=1}^{N} q_i$ is the total regional acres planted.

We focus attention on COP crops, which we take as a single commodity (ignoring for now specific features of EU programs that would require multi-commodity analysis - e.g., a flexible base program introduced by Euro 2000 in the Berlin Accords) and let $q$ and $y$ represent, respectively, planted acres and yield per acre of COP. At the absence of per acre payments, farmer $i$'s profit is

$$\pi_i(y_i, q_i) = pq_i y_i - q_i C_i(y_i) + \pi_i^c(a - q_i)$$

where $p$ is COP market output price, $C_i$ is per acre variable cost function of producing $y$, and $\pi_i^c$ is the profit from other activities, taken as a function of acres devoted to other activities with $a_i$ representing farm size. Common production properties imply that $C_i$ is increasing and convex and $\pi_i^c$ is increasing and concave.

Let $b_i$ denote farmer $i$’s “base” COP acreage (the average of 1989-91 COP plantings), with the aggregate base given by $B = \Sigma_i b_i$. To induce farmers to plant their COP acreage base without price support, a per-acre subsidy $s_0$ was introduced, under which profit is given by

$$\begin{cases} 
\pi_i(y_i, q_i) + s_0 q_i & \text{if } q_i \leq b_i \\
\pi_i(y_i, q_i) + s_0 b_i & \text{otherwise}
\end{cases}$$

The profit maximizing per-acre output is the level $y^*$ satisfying $\partial \pi_i / \partial y_i = 0$ or

$$C'(y_i^*) = p.$$

Notice that $y_i^*$ in (3) is independent of the acreage decision. The profit maximizing COP acreage, $q_i^*$, satisfies

$$p y_i^* - C(y_i^*) + s_0 - \pi_i^c(a_i - q_i^*) \geq 0,$$

equality holding when $p y_i^* - C(y_i^*) + s_0 \leq \pi_i^c(a_i - b_i)$ (so $q^*$ does not exceed $b_i$); otherwise, $q_i^* = b_i$. Let $\phi_i(q_i) = \pi_i^c(a_i - q_i) > 0$ represent the marginal alternative value (opportunity cost) of COP land. Then, since
$\pi^*_i$ is strictly concave, $\varphi'_i(q_i) = -\pi^{i''}_{i}(a_i - q_i) > 0$ and $\varphi_i$ is increasing in $q_i$. When $\varphi(b_i) \geq py^* - C(y^*) + s_0$, it does not pay to plant COP more than $b_i$ acres and the profit maximizing COP acreage satisfies

$$(4) \quad \varphi(q^*_i) = p - C(y^*_i) + s_0;$$

otherwise (when $\varphi(b_i) < py^* - C(y^*) + s$), $q^*_i = b_i$. Our discussion below assumes that the subsidy $s_0$ satisfies $\varphi(b_i) = py^*_i - C(y^*_i) + s_0$ for all farmers, so that equation (4) holds for all $i$.

Consider now the effect of prorating, under which the subsidy $s_1 = s_0 \cdot 0.8B/Q$, where $Q = \sum_{i=1}^{N} q_i$ is the actual (aggregate) COP acreage. The purpose of prorating is to decrease aggregate COP planting to 80% of the base $B$. But will the individual farmers comply? Suppose that farmer $i$ believes that all other farmers plant at 80% of their base, i.e., $q_j = 0.8b_j$ for all $j \neq i$. Then, $Q = 0.8(B - b_i) + q_i$ and

$$(5) \quad s_1 = s_0 \cdot \frac{0.8B}{Q} = s_0 - \frac{s_0(0.8b_i - q_i)}{0.8(B - b_i) + q_i} = s_0 - \frac{s_0(0.8b_i - q_i)}{N \bar{q}}$$

where $\bar{q}$ is average COP planting. Then, it is clearly NOT in the interest of farmer $i$ to set his COP planting ($q_i$) at $0.8b_i$, since if he does so then $s_1 = s_0$, but under $s_0$ he should plant $b_i$. Indeed, it is easy to verify that farmer $i$’s optimal COP planting under $s_1$ falls between $0.8b_i$ and $b_i$ and approaches $b_i$ as $N$ increases indefinitely. Since all farmers are as smart as farmer $i$, they will produce above 80% of their base and the prorated subsidy $s_1$ will not achieve its goal.

However, if all farmers overproduce, the per acre payment decreases and eventually total COP acreage settle at some equilibrium level between 0.8B and B, at which the total acres planted will be the same as if the total lump sum subsidy was distributed as a per acre subsidy. Thus, the EU compensatory payments are fully coupled. Figure 2 illustrates the equilibrium level of output to be $X^*$ (again, assuming a fixed variable costs of production per acre planted and a fixed yield per acre). $X^*$ represents the same output level as if the compensatory payments were distributed in a fully coupled manner. Area $A + B (= R)$ is identical to that of area $B + C$. The marginal cost of acres planted (opportunity cost of land plus
variable costs of production) equals the subsidy payment per hectare plus the pro-rated subsidy $s_1$. This result holds under the assumption of a large number of farmers, i.e., under a competitive economic environment, even though payments are limited to the fixed base acreage. The payment per acre planted does not change, but the proportion of eligible acres receiving the payment is prorated down by the extent to which total regional plantings exceed the regional base.

3. The Economics of Payments for Acres Planted with Voluntary Acre Set-Aside

The European Union currently mandates a minimum acreage set-aside of 10 percent of the base, and a possibility to voluntarily set-aside up to 30 percent of base acreage. The set-aside premiums were less than the compensatory payment per acre planted prior to the Berlin Accords in 2000 but is now equal.
Denote \( t \) as the fixed payment per acre set aside with the source of funds independent of the amount \( R \) reserved for acres planted. Denote the level of acres set-aside (or diverted) for each farmer to be \( d_i \). The opportunity cost of land (rental value) is denoted by \( \phi(T) \) where \( T = q_i + d_i \), and \( \phi'(T) > 0 \). Assume the opportunity cost of land and the variable cost of production are separable.

The objective function for the \( i^{th} \) farmer becomes:

\[
(5) \quad \max_{q_i} \prod_i = p \cdot q_i \cdot y_i - q_i \cdot C(y_i) - f(T_i) + q_i \left( \frac{B}{q_i + Q_i} \right) s_o + t \cdot d_i
\]

where \( q_i \) and \( d_i \) take on non-negative values and all other variables are defined as before.

The constrained optimization problem can be represented in the following Lagrangian:

\[
L = p \cdot q_i \cdot y_i - q_i \cdot C(y_i) + f(T_i) + q_i \left( \frac{B}{q_i + Q_i} \right) s_o + t \cdot d_i + \lambda_1 q_i + \lambda_2 d_i,
\]

where \( \lambda_1 \) and \( \lambda_2 \) are shadow prices for acres planted and diverted, respectively.

The Kuhn-Tucker first order conditions are:

\[
(7) \quad \frac{\partial L}{\partial q_i} = p y_i - C(y_i) - \phi'(T_i) + s_o \left( \frac{B}{Q} \right) [1 - \frac{q_i}{Q}] + \lambda_1 = 0
\]

\[
(8) \quad \frac{\partial L}{\partial d_i} = -\phi'(T_i) + t + \lambda_2 = 0
\]

\[
(9) \quad \frac{\partial L}{\partial y_i} = p q_i - q_i \cdot C'(y_i) = 0
\]

\[
(10) \quad \lambda_1 q_i = 0 \quad \text{and} \quad q_i \geq 0 \quad \text{and} \quad \lambda_2 d_i = 0 \quad \text{and} \quad d_i \geq 0
\]

where \( q_i / Q \rightarrow 0 \) as \( n \rightarrow \infty \).

The first order conditions give us the result that all acres are either planted where:
The intuition for this result is presented in Figure 3. If there are no set aside payments, then acres planted are given by \( Q^* \). The equilibrium opportunity cost of land would be \( \varphi^* \). What is the effect of introducing a voluntary acreage set-aside program? Each acre set-aside receives a payment \( t \). Assuming identical producers, the analysis above showed that it is a 0,1 outcome: all acres are diverted or all acres are planted. To show this in Figure 3, consider arbitrarily the case where the farmer, initially at \( Q^* \), would set-aside \( D_1 \) acres (plantings would now be \( Q^* - D_1 \)).

If we assume \( s_1 \) remains unchanged, the loss from not producing equals area \( a \) and the gain from diverting \( D_1 \) acres and the additional acres \( D_2 \) is area \( c + b \). Note that the gain from setting acres aside is always greater than loss from not planting for all \( t > \varphi^* \). Consequently, for all \( t \geq \varphi^* \), no production will take place and all the land \( Q' \) is set aside. This result also holds when the assumption of constant \( s_1 \) is relaxed. As acreage planted decreases, \( s_1 \) increases. This reduces the loss of not planting.

For \( t < \varphi^* \), no land is set aside and all the acres \( Q^* = T \) are planted. This is because diverting acres planted results in a larger loss than the benefit from the set-aside payments. The acreage planted remains at the fully coupled level of \( Q^* \) and \( t \) is not a factor.

Relaxing the assumption of yield independent of acres planted, consider the case where per acre production cost is now a function of the level of acres planted with decreasing returns to planting. Thus, \( C(y_1, q_1) \) and \( C_{q_1}(y_1, q_1) > 0 \).

A fixed per acre payment on acres set aside (in addition to the pro-rated subsidy on acres planted) has an ambiguous effect on the level of production compared to no policy at all. The effect depends on the level of the per acre payment relative to the market price, the payment per acre planted, and other market parameters.
Figure 3. Economic Effects of Payments for Acres Planted and Set-Aside (constant output/hectare)

(A) \( C(y_i, q_i) \) and \( C_{q_i} (y_i, q_i) > 0 \): the cost of production per acre is a function of acres planted and the cost increases with acres planted.

(B) \( C(y_i(q_i)) \) and \( C_{y_i} (y_i, q_i) > 0 \) and \( \frac{\sigma y_i}{\sigma q_i} < 0 \): the yield depends on acres planted with decreasing returns to acres planted.

The objective function for the \( i^{th} \) farmer becomes:

\[
\max_{q_i} \Pi_i = p \cdot q_i \cdot y_i - q_i \cdot C(y_i, q_i) - f(T_i) + q_i \left( \frac{B}{q_i + Q_i} \right) s_0 + t \cdot d_i
\]

where \( T_i = q_i + d_i \) and the same non-negativity constraints on acres planted and diverted.

The relevant Lagrangian is now:
\[ L = p \cdot q_i \cdot y_i - q_i \cdot C(y_i, q_i) - f(T_i) + q_i \left( \frac{B}{q_i + Q_i} \right) s_0 + t \cdot d_i + ?_1 q_i + ?_2 d_i, \]

The Kuhn-Tucker first order conditions are:

\[ \frac{\partial L}{\partial q_i} = p y_i - C(y_i, q_i) - q_i \cdot C'(y_i, q_i) - \phi'(T_i) + s_0 \left( \frac{B}{Q} \right) \left( 1 - \frac{q_i}{Q} \right) + ?_1 = 0 \]

\[ \frac{\partial L}{\partial d_i} = -\phi'(T_i) + t + ?_2 = 0 \]

\[ \frac{\partial L}{\partial y_i} = p q_i - q_i \cdot C'(y_i, q_i) = 0 \]

\[ \lambda_i \cdot q_i = 0 \text{ and } q_i \geq 0 \text{ and } \lambda_i \cdot d_i = 0 \text{ and } d_i \geq 0 \]

where \( q_i / Q \to 0 \) as \( N \to \infty \).

Remember that the payment \( t \) is constant and independent of the number of acres planted or set aside. In an interior solution, the total number of acres (planted and set aside) will be such that the marginal opportunity cost of an additional hectare equals \( t \). The payments on the set aside decrease production if \( \phi^* < t < t^{**} \) (see Figure 4). For example, for \( t' \), \( Q' \) are the hectares planted and \( T' - Q' \) are the acres set aside. At \( Q' \), the marginal cost of production equals the difference between the subsidized price \( p + s_i \) and \( t' \). As \( t \) increases, the difference \([p + s_i - t']\) decreases, and for an increasing marginal cost of production, less acres are planted. For all levels of \( t > t^{**} \), it does not pay to plant, and the amount of set-aside is \( T^{**} \) (which is greater than \( Q^* \), which is interesting).
For all \( t \leq \phi^* \), no land is set aside and acres planted remain at the level \( Q^* \). The set aside payment \( t \) is non-binding and acres planted payments remain fully coupled. These theoretical results need to be further refined to include minimum mandatory acreage set-aside requirements and maximum voluntary acreage set-aside.

These theoretical results will be extended to include:

1. minimum mandatory acreage set-aside requirements (farmers get paid the same as that for the minimum acres set-aside)

2. “extra-ordinary” set-aside that has no financial compensation and is in proportion to the excess acres (what proportion, I do not know yet).
References


