THE INTERRELATIONSHIP OF A PESTICIDE REGULATION TO TARGET PRICES: A MULTIPLE POLICY APPROACH TO PEST MANAGEMENT ANALYSIS

by

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Background

In the U.S., we are about to reach a turning point in our methods and attitudes for dealing with pests whereby integrated pest management is gaining recognition as a useful approach to utilizing our agricultural resources. This systems approach emphasizes the use of non-chemical control measures such as the augmentation of natural predators and agronomic practices (changes in tillage practices, water management, crop varieties, fertilization practices, and so on) in combination with a rational application of chemical agents (whenever necessity for pesticides is determined through scouting).

Most integrated pest management studies to date have tended to focus on the pest-host-predator interactions. At the national level, economic analyses of pesticide issues have evaluated the economic impacts of pesticide restrictions and regulations proposed by EPA; these aggregate analyses are usually conducted under the assumption that other agricultural policies will remain unchanged in the event of a new pesticide regulation.

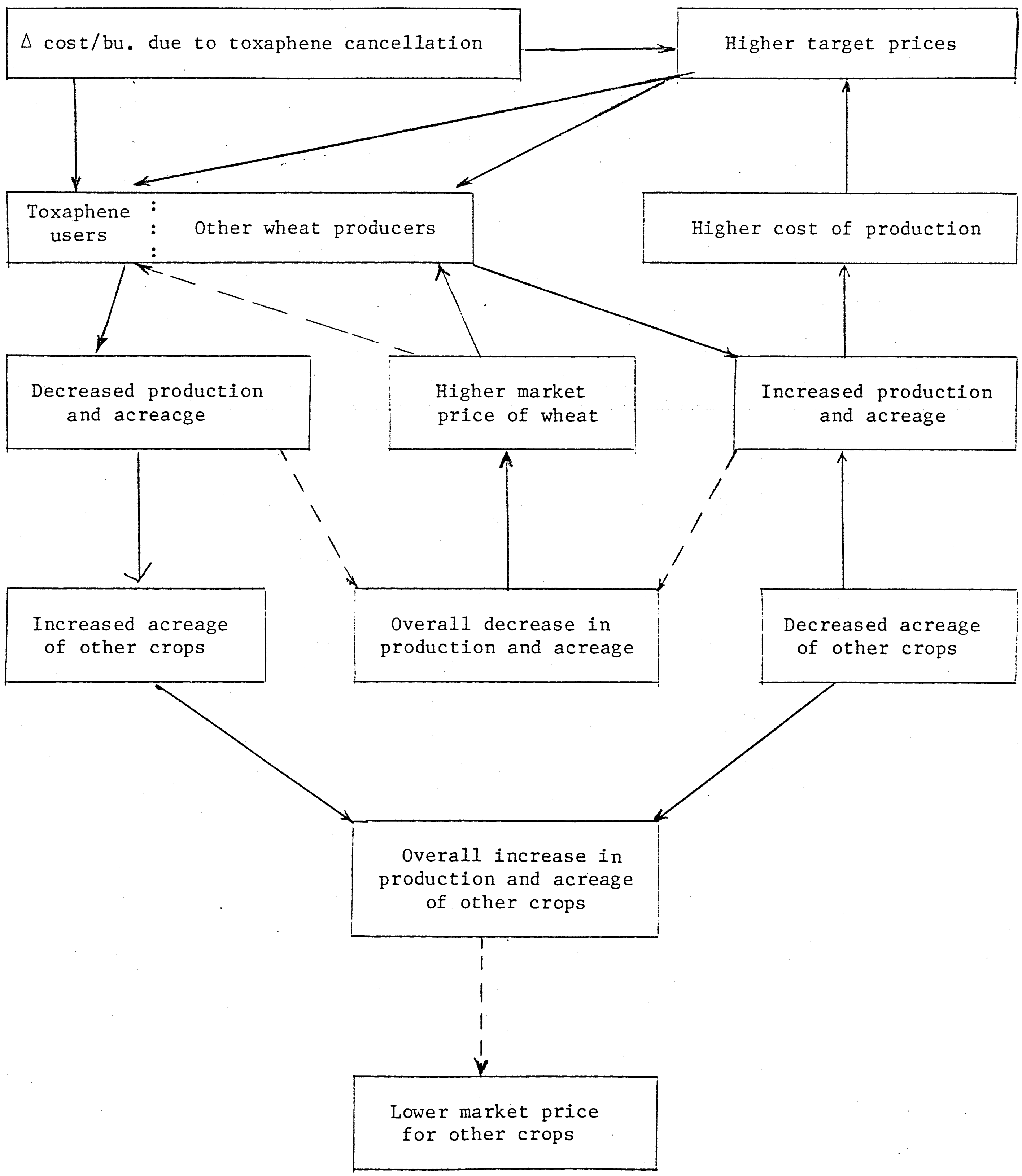
However, in the agricultural policy world, ceteris may not be paribus. Federal pesticide policies contradict and complement other agricultural policies in ways that need to be explicitly recognized if a comprehensive economic evaluation of a pesticide policy is to be conducted. For example, the direct effects of a pesticide cancellation may be to reduce yield per acre and increase the variable cost per bushel of the affected commodity. However, at the national level this action may result in a policy "reaction" that exerts additional, indirect effects.

Among the many policies which interact with pesticide policies, the commodity program provisions for target prices and loan rates may produce the greatest distortion in impacts of pesticide policies. The Secretary of Agriculture has some discretion in setting target prices and loan rates. Minima and maxima are incorporated into the same legislation. A further provision mandates an automatic adjustment of the targetprice to keep pace with increments in costs per unit of production. The adjustment is equivalent to the average change in cost per unit of production for the previous two years. Therefore pesticide policies which cause yields and/or costs to change have a direct impact on the level at which target prices are set in future years.

It is evident that, in order to establish a rational set of pest management policies at the national level, a comprehensive view of how all relevant agricultural policies interact with each other and affect pest management economics must be considered. This integrated policy approach at the national level is analogous to the integrated pest management approach at the micro level.

Introduction

This paper presents an attempt at considering several interactions between a pesticide policy and a related income stabilization policy. The illustration used is the evaluation of the economic impacts of a ban on the use of toxaphene for the production of wheat. The interrelationship between this policy and target prices is illustrated. In the past, the income supplements produced by target prices were viewed as a means of moderating the effects of short-run price fluctuations. This paper illustrates how target prices also may moderate the effects of changes in the cost of production due to pesticide regulations.



Interdependence of Pesticide and Target Price Policy Impacts

Adjustment of Target Price and Effective Support Price

By Law

Target Price (t + 1) = target price (t) + (cost (t) - cost (t-2))/2

In the Model

TP (1978) = TPE(1978)
TP (1979) = TPE(1979) + 1/2 cost/bushel
TP (1980) = TPE(1980) + cost/bushel

Where: TP = target price
TPE = original exogenous target price
cost/bushel = exogenous regulatory cost of cancelling toxaphene
cost (t) = average of variable, machinery, and overhead costs per bushel

Effective Support Price

Effective support price = loan rate + allocation factor * defiency payment rate
= Allocation factor * target price + (1 - allocation factor) * loan rate

A team of entomologists and economists conducted a preliminary state-by-state partial budget and yield study on the effect of a ban on toxaphene (USDA,1978). Results indicated that a ban on toxaphene to control grasshopper, armyworm, and cutworm infestations in wheat would affect winter wheat states.

These partial budget cost and yield impacts can be introduced into the "pesticide" version of the Wheat Model through the acreage and yield equations (see Figures 1 and 2). The "pesticide" version of the Wheat Model is a modification of a 1978 wheat model created in the Commodity Economics Division (CED) of the Economics, Statistics and Coorperatives Service (ESCS) in USDA.

The Wheat Model

In the CED model, winter wheat planted acreage is a function of diversion payments for wheat; exogenous effective support rates for winter wheat, cotton, and sorghum; season average prices of winter wheat, cotton, and sorghum; and time. In the pesticide version, the effective support rate of wheat is endogenized. This makes the planted acreage variable positively related to target prices, since the effective support rate is a weighted average of the target price and the loan rate. Because the Food and Agriculture Act of 1977 states that target price adjustments should be directly proportional to changes in the unit costs of production, the effective support rate variable should exert an upward force on the planted acreage variable in response to a toxaphene ban.

A cost of production variable (W25) has been introduced into the "pesticide" version. A decrease in yield and/or an increase in variable cost per acre (i.e., the increase in variable cost per bushel) will exert a downward force on the planted acreage variable.

The final outcome of this contest between counteracting forces can be evaluated by examining the output of the model. Before doing so, let's take a look at the yield equation.

In the CED Model, the total U.S. production of wheat was a function of the price of wheat, a fertilizer price index, total acreage planted, a weather index, and time. The pesticide version of the model converted the production equation into a yield equation by dividing each term in the former by total acreage harvested (W29).

The change from a target pesticide to less effective substitutes translates into a downward shift in the production function. This effect is introduced into the pesticide yield equation via a constant adjustment factor (W30). The variable cost of production (W43) is also affected by the introduction of less effective pesticides. This cost change results in a shift along the production function which also is accounted for in the pesticide version.

An Experiment With the Wheat Model

The impact of including producer response to dynamic target prices prices in acreage and production projections was analyzed by obtaining four distinct solutions to the Wheat Model:

A. Exogenous target price ($3.40), toxaphene available

B. Exogenous target price ($3.40), toxaphene registration cancelled

C. Endogenous target price, toxaphene available

D. Endogenous target price, toxaphene registration cancelled

The partial-budget estimates of impacts from cancelling toxaphene use on wheat were used as inputs to the model for solutions B and D. Without adjustments, the average cost of producing winter wheat would increase by 2.1 cents per acre. Yields decline .068 bushels per harvested acre. The cancellation would result in no substantial change in the cost or yield for spring wheat acreage.

The Wheat Model was accessed with USDA's GASSP package, a model projections system based on the Gauss-Seidel algorithm for solving simultaneous equations.

Along with other data relevant to the wheat sector, the model tabulates projections for planted acreage, production, yield, and price. Differences in these projections when calculated as:

Solution B - Solution A,

or Solution D - Solution C

are the impacts due to a cancellation of toxaphene use on wheat (Table 1). Observations were made by comparing the impacts estimated under an exogenous target price specification with the impacts estimated under an endogenous target price specification.

First, there was no difference among the four solutions in projections of average farm price received. The scenario used in this experiment is a pessimistic one in which lack of government activism results in reduced export opportunities and reduced diversion incentives. The market price of wheat is projected to rest on the loan-rate floor.

Second, endogenizing the target price substantially reduces the impact on plantings of winter wheat after the first year of impact. This reflects the market response to higher target prices (a lagged function of production costs).

Planted acreage (in thousands)

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                                   =E(K1)-1718.08
                                   -9147.71*Z(1,J)
                                   +   16393.0*W24
                                   -   21897.6*Z(3,J)
                                   -   3548.7 *Z(4,J)
+3459.4438*(Y(16,J-1)  / Z(5,J-1))*W25
+2594.5828*(Y(16,J-2)  / Z(5,J-2))*W25
+1729.7219*(Y(16,J-3)  / Z(5,J-3))*W25
+846.86095*(Y(16,J-4)  / Z(5,J-4))*W25
-1056.1347*(Z(6,J-1)  /  Z(5,J-1))
-792.10103*(Z(6,J-2)  /  Z(5,J-2))
-528.06735*(Z(6,J-3)  /  Z(5,J-3))
-264.03368*(Z(6,J-4)  /  Z(5,J-4))
-1320.17  * Z(7,J)
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where,

Z1 = effective diversion payment rate for winter wheat

W24 = effective support rate for winter wheat*

Z3 = effective support rate for cotton

Z4 = effective support rate for sorghum

Y16 = average price of wheat received by farmers

Z5 = season average price of cotton received by farmers

W25 = the winter wheat/cotton variable cost ratio (before a pesticide ban) multiplied by the cotton/winter wheat variable cost ratio that is in effect after a pesticide ban

Z6 = the average price of sorghum received by farmers

Z7 = dummy variable for 1962-72

J = a subscript, denoting time

* The effective support is a weighted average of the target price and the loan rate; the weights are determined by the proportion of farmers who are participating in commodity programs. See Houck, et. al. (1976) for additional information.

FIGURE 1. Winter Wheat Acreage Equation

Bushels per harvested acre = W30 +

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(-2748.16
 +11918.2*((Y(16,J-2)-W43)/Z(11,J-1))
 +14.992*YY(K3)+8.2223*Z(12,J)+36.5478*Z(8,J))/W29
```

where,

W30 = constant adjustment factor to reflect the change in yield per harvested acre that is induced by a pesticide ban

Y16 = average price of wheat received by farmers

W43 = change in the cost per bushel of wheat

Z11 = fertilizer price index

YY3 = total acreage planted

Z12 = weather index

Z8 = year

W29 = total acreage harvested

FIGURE 2. Yield Equation for Wheat

Third, an impact on spring wheat acreage planted is projected by the endogenizing target price model only, since market prices rest on the loanrate floor. Without toxaphene, more spring wheat acreage will be planted. The impact on total wheat acres planted is, with an endogenous target price, about one third the reduction estimated with a fixed target price.

Fourth, the lower reductions in crop acreage due to endogenizing target prices result in lower reductions in production ie., in 1982 a reduction of 4.1 million bushels compared to 5.0 million bushels if target prices are not determined within the model. The effect of endogenizing the target price in projecting impacts on production are relatively less important since the effects on acreage and yield estimates tend to mute each other in the production estimates.

Also, there are several differences in distribution of the regulatory action's burden. Who would be worse off and who would be better off with a toxaphene cancellation depends in large part upon whether or not target prices are fixed.

Fixed target price

With a fixed target price, deficiency payments decline along with production if the allocation factor is not fully compensatory. Also, from the reduced level of production there results a lower government cost of disposing of surplus wheat. Wheat producers who did not use toxaphene would be no better nor worse off. Those who did use toxaphene and continue to produce wheat would absorb the increased cost per bushel on their acreage since both market and government support prices of wheat remain unchanged. Those who used toxaphene and would shift to production of other, less profitable, crops absorb part of the regulatory costs. Producers of these other crops would be worse off since acreage would shift from wheat and depress their market prices. Consumers of the other crops would be better off, while domestic consumers of wheat would be no better nor worse off.

Variable target prices

The distrubution of cost burden is substantially altered by the enodgenous target price. The deficiency payments are affected by two changes: (1) the decreased production and (2) the increased target price level. The decrease in production is less than with the fixed target price, tending to decrease deficiency payments but to a lesser extent. The increase in target prices tends to increase payments. Additionally, the government's cost of disposing of surplus wheat is affected. The lesser decrease in production results in a lesser decrease in these costs. Depending on the balance between the increments and decrements of government costs, the taxpayer may or may not be worse off with an endogenous target price and cancellation of toxaphene. He is certainly less well off than with a fixed target price.

Wheat producers who did not use toxaphene would be better off due to higher deficiency payment rates. Toxaphene users would still be worse off, but would not bear as much of the regulatory cost as before. Producers of other crops would not face such large decreases in market prices of their commodities.

Domestic consumers of wheat would, again, be no better nor worse off with the market prices resting on the loan rate. Consumers of other crops would not benefit to the extent that they would with fixed target prices.

In summary, the legislative provision for varying target prices with producer costs results in a substantial shift in the burden of increased costs of production from agricultural producers to taxpayers and consumers. However, we should not forget that within the agricultural community the distribution of burden from environmental regulation remains concentrated most heavily upon those producers who are directly affected by the pesticide cancellation or other regulatory action.

You may not recognize that among sectors of the economy not addressed in this paper, several would be affected by a cancellation of toxaphene use on wheat and the affects might depend on the nature of farm commodity programs. The distribution of environmental benefits from the regulatory action are also ignored.

Table 1. Projected impacts due to a ban on the use of toxaphene in wheat production.

Year	Impact due to a ban on toxaphene on wheat	
	Exogenous target price	Endogenous target price
Winter wheat acres planted, thous.		
1978	-98	-98
1979	-95	-76
1980	-95	-57
1981	-90	-52
1982	-88	-50
Spring wheat planted acres		
1978	0	0
1979	0	+11
1980	-	+22
1981	0	+22
1982	0	+22
Total wheat acres planted, year t+1, July-June, thous.		
1978	-98	-98
1979	-95	-65
1980	-95	-35
1981	-90	-31
1982	-87	-28
Wheat production in year t+1, millions of bushels		
1978	-5.4	-5.4
1979	-5.3	-4.8
1980	-5.3	-4.4
1981	-5.0	-4.1
1982	-5.0	-4.1

Conclusion

The main point that the authors wish to make is that analyses of pest management policy impacts should be made within the context of a more comprehensive agricultural policy perspective. This concept has been given empirical flavor through our evaluation of the impacts of a ban on toxaphene "with and without" an endogenous target price variable in the CED Wheat Model. Endogenizing target prices does make a difference. The results suggest that other agricultural policies may, in some cases, redistribute the adverse impacts of pesticide decisions and that, with a more complete model of producer response to incentives, the nature of regulatory impacts can be better understood. To what extent do producers, taxpayers, and consumers share in the cost? The answer is a dynamic one, shaped by the incentives and sanctions provided in other government policies.

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