CAP Reform, Wheat Price Instability and Producer Welfare

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American Agricultural Economics Association Annual Meeting
Tampa, Florida
July 30 – August 2, 2000

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Abstract

We use a simple nonlinear commodity market model to illustrate the impact of recent reforms of the CAP on the variability of EU and world wheat prices. Second, within an expected utility framework we estimate the transfer and risk effects on producer welfare due to market liberalizing reforms. We found that wheat producers were over-compensated for the losses due to lower prices following the 1992 reforms. The transfer effect clearly dominated while the risk component was small. Further, we did not find producer incomes to be more unstable following to the 1992 CAP reforms.

Keywords: price transmission, CAP reform, price instability, producer welfare, wheat market.

1. Introduction

Commodity price instability remains an important concern in many agricultural markets. The movement toward less government intervention in commodity markets impacts the stability of prices and producer welfare. In a post-Uruguay Round world, domestic price volatility will likely increase in those markets previously insulated from world markets. On the other hand, as more and more countries open their markets and participate in the international price adjustment process, less price volatility in world markets will occur. As a result, prices in domestic markets will become less stable while world market prices will become more stable. We test this hypothesis using domestic and border prices of wheat in the European Union (EU) and information on the nature of the reforms to the Common Agricultural Policy (CAP). These data are used to investigate the extent to which the comovement of prices between world and domestic wheat markets impacts price instability. We measure this price-comovement as the price transmission elasticity. Tyers and Anderson (1992) refer to these elasticities as "price policy parameters" while Dutton and Grennes (1988) describe them as a summary measure of all government policies that separate foreign and domestic markets. Although the commodity trade literature emphasizes the importance of these elasticities, little attention has focused on their specific relationship to price volatility and producer welfare (Bredahl *et al.*, 1979; Zwart and Meilke, 1979; Tyers and Anderson, 1992; Mundlak and Larson, 1992).

How policy reforms impact domestic and international price stability is a particularly timely topic. While policy makers seek answers to the impact of their decisions, others search for appropriate responses. For instance, as the EU transitions from a "price stabilization" policy to an "income maintenance" policy, what role have income transfers played in stabilizing producer incomes? By examining the impact of CAP policy change on price stability and producer welfare we hope to contribute to a better understanding of many important and complex issues.

The purpose of this paper is twofold: first, we use a simple nonlinear commodity market model to illustrate the impact of recent reforms of the CAP on the variability of EU and world wheat prices; second, within an expected utility framework we estimate the transfer and risk effects on producers of trade liberalizing reforms.

2. Analytical Framework

Our theoretical framework is composed of two connected components. First, we specify and estimate a structural econometric model of the EU-rest of world (ROW) wheat market. The model is used to quantify important domestic and world market relationships and to show the impact of EU policy change on price variability. Second, we adopt an expected utility approach to evaluate the welfare effects of policy regime change. As EU agricultural policy transitions toward a goal of "income maintenance", it is sensible to use a framework that can articulate the welfare effects of a policy-induced change on income volatility. Our approach explicitly recognizes that the welfare impact of a policy regime change is a function of both the level and stability of producer incomes; thus, enabling the identification of the transfer and risk welfare effects of the policy change.

2.1 Wheat Market Model

Assuming nonlinear relationships, perfect substitutes and constant elasticities, we define the one-commodity, two-region (EU and ROW) model:

(1) $$Q^D = K^{Q^D} \cdot \left(P^d\right)^{\eta^{Q^D}} \cdot u_1$$

(2) $$A = K^A \cdot \left(P^d\right)^{\eta^A} \cdot \left(Q^S_{t-1}\right)^{\gamma^A} \cdot u_2$$

(3) $$Y = K^Y \cdot \left(P^d\right)^{\eta^Y} \cdot T^{\gamma^Y} \cdot u_3$$

(4) $$X^D = K^{X^D} \cdot \left(P^w\right)^{\eta^{X^D}} \cdot u_4$$

(5) $$X^S = K^{X^S} \cdot \left(P^d\right)^{\eta^{X^S}} \cdot \left(Q^S_{t-1}\right)^{\gamma^X} \cdot u_5$$

(6) $$P^d = K^P \cdot \left(P^w\right)^{\eta^P} \cdot T^{\gamma^P} \cdot \exp(DV)^{\delta^P} \cdot u_6$$

(7) $$X^D = X^S$$

where Q^D is quantity demanded (EU); A is area harvested (EU); Y is yield per unit of area (EU); X^D is import quantity demanded (ROW); X^S is export quantity supplied (EU); P^d is domestic price (EU); P^w is world price (EU border price); Q^S_{t-1} is quantity supplied in previous year (EU); T is linear trend; DV is a dummy variable representing a major policy change, the exponent parameters are the constant elasticities, the K's are constant terms, and the u_i are independent (each over time) lognormally distributed disturbance variables, i.e.

$$u_i \sim LN(0, \sigma_i^2), \quad i = 1, \ldots, 6.$$

Current time period subscripts are omitted to aid readability (with the exception of lagged variables).

In this simultaneous system there are six current endogeneous variables (Q^D, A, Y, P^d, P^w and $X^D = X^S$) and three predetermined variables (Q^S_{t-1}, T and DV). Each equation in this system is identified, thus, enabling statistical estimation of the structure using standard econometric estimation procedures. The quantity supplied in the previous year is specified as a regressor in the area harvested equation since farmers, in making acreage allocation decisions, consider the previous year's acreage harvested as well as yield. For instance, the yield of wheat relative to substitutes in production, say barley, can impact area allocated to wheat. Also, since the export supply equation indirectly includes domestic supply, Q^S_{t-1} is also specified as an argument in equation (5); however, linear trend was not included due to its collinearity with Q^S_{t-1}. Our behavioral approximation of the export supply identity ensures an overall loglinear structure. Wheat yields are strongly trending due to the development of higher-yielding varieties and other technological advances; hence the inclusion of time trend in equation (3). Finally, the price transmission equation also includes deterministic trend plus a dummy binary variable to account for the implementation of the "new CAP" in July 1993.

It is important to note that we have not attempted to model EU stockholding behavior. Public intervention stocks are not determined as an outcome of an optimization process; rather they are determined as a byproduct of the price policy. With domestic prices declining over much of the sample period, there is no incentive for private (individual or firm) stockholding. That is, the intertemporal arbitrage condition dictates that the expected price next period will most certainly be less than the cost of storage. The stocks that do exist are simply pipeline or working stocks. EU and rest of world supplies, however, are adjusted for carry-in and carry-out stock levels.

Considering the market equilibrium condition (equation 7) we no longer need to distinguish X^D and X^S and can write the model in a linear form of the logarithms:

(8) $$\ln Q^D = \ln K^{Q^D} + \eta^{Q^D} \cdot \ln P^d + \ln u_1$$

(9) $$\ln A = \ln K^A + \eta^A \cdot \ln P^d + \gamma^A \cdot \ln Q_{t-1}^S + \ln u_2$$

(10) $$\ln Y = \ln K^Y + \eta^Y \cdot \ln P^d + \gamma^Y \cdot \ln T + \ln u_3$$

(11) $$\ln X = \ln K^{X^D} + \eta^{X^D} \cdot \ln P^w + \ln u_4$$

(12) $$\ln X = \ln K^{X^S} + \eta^{X^S} \cdot \ln P^d + \gamma^X \cdot \ln Q_{t-1}^S + \ln u_5$$

(13) $$\ln P^d = \ln K^P + \eta^P \cdot \ln P^w + \gamma^P \cdot \ln T + \delta^P \cdot DV + \ln u_6$$

with independent (each over time) normally distributed disturbance variables, i.e.

$$\ln u_i \sim N(0, \sigma_i^2), \quad i = 1, \dots, 6.$$

First, from (11) and (13) we get

(14) $$\ln X = \ln K^{X^D} + \frac{\eta^{X^D}}{\eta^P}\left(\ln P^d - \ln K^P - \gamma^P \cdot \ln T - \delta^P \cdot DV - \ln u_6\right) + \ln u_4.$$

The equations (12) and (14) yield the instantaneous relation

(15) $$\ln P^d = \frac{\left(\ln K^{X^D} - \ln K^{X^S} + \ln u_4 - \ln u_5 - \gamma^X \ln Q_{t-1}^S\right) \cdot \eta^P - \eta^{X^D} \cdot \left(\ln K^P + \gamma^P \ln T + \delta^P DV + \ln u_6\right)}{\eta^{X^S}\eta^P - \eta^{X^D}}.$$

For $\eta^P \neq 0$ we get

(16) $$\ln P^w = \frac{1}{\eta^P} \cdot \left(\ln P^d - \ln K^P - \gamma^P \ln T - \delta^P DV - \ln u_6\right)$$

(17) $$= \frac{\ln K^{X^D} - \ln K^{X^S} + \ln u_4 - \ln u_5 - \gamma^X \ln Q_{t-1}^S - \eta^{X^S} \cdot \left(\ln K^P + \gamma^P \ln T + \delta^P DV + \ln u_6\right)}{\eta^{X^S}\eta^P - \eta^{X^D}}$$

For these expressions, variances can be calculated from the 3SLS estimation of the simultaneous model,

(18) $$\sigma_{\ln P^d}^2 = \left[\eta^{P^2}\left\{\sigma_4^2 + \sigma_5^2 - 2\sigma_{4,5} + \gamma^{X^2}\sigma_{Q_{t-1}^S}^2 - 2\gamma^X\left(\sigma_{4,Q_{t-1}^S} - \sigma_{5,Q_{t-1}^S}\right)\right\}\right.$$
$$+ \eta^{X^{D^2}}\left(\gamma^{P^2}\sigma_T^2 + \delta^{P^2}\sigma_{DV}^2 + \sigma_6^2 + 2\gamma^P\delta^P\sigma_{T,DV} + 2\gamma^P\sigma_{T,6} + 2\delta^P\sigma_{DV.6}\right)$$
$$- 2\eta^{X^D}\eta^P\left\{\gamma^P\sigma_{4,T} + \delta^P\sigma_{4,DV} + \sigma_{4,6} - \gamma^P\sigma_{5,T} - \delta^P\sigma_{5,DV} - \sigma_{5,6}\right.$$

$$-\gamma^{X}\left(\gamma^{P}\sigma_{Q_{t-1}^{S},T}+\delta^{P}\sigma_{Q_{t-1}^{S},DV}+\sigma_{Q_{t-1}^{S},6}\right)\Big\}\Big]\Big/\left(\eta^{X^S}\eta^{P}-\eta^{X^D}\right)^2$$

(19) $$\sigma^2_{\ln P^w}=\frac{\sigma_4^2+\sigma_5^2-2\sigma_{4,5}+\gamma^{X^2}\sigma^2_{Q_{t-1}^{S}}-2\gamma^{X}\left(\sigma_{4,Q_{t-1}^{S}}-\sigma_{5,Q_{t-1}^{S}}\right)}{\left(\eta^{X^S}\eta^{P}-\eta^{X^D}\right)^2}$$

$$+\eta^{X^{S^2}}\left(\gamma^{P^2}\sigma_T^2+\delta^{P^2}\sigma_{DV}^2+\sigma_6^2+2\gamma^P\delta^P\sigma_{T,DV}+2\gamma^P\sigma_{T,6}+2\delta^P\sigma_{DV.6}\right)$$

$$-\frac{2\eta^{X^S}}{\eta^{X^S}\eta^{P}-\eta^{X^D}}\Big\{\gamma^P\sigma_{4,T}+\delta^P\sigma_{4,DV}+\sigma_{4,6}-\gamma^P\sigma_{5,T}-\delta^P\sigma_{5,DV}-\sigma_{5,6}$$

$$-\gamma^{X}\left(\gamma^{P}\sigma_{Q_{t-1}^{S},T}+\delta^{P}\sigma_{Q_{t-1}^{S},DV}+\sigma_{Q_{t-1}^{S},6}\right)\Big\}$$

where, for instance, $\sigma_{4,T}$ denotes the covariance of $\ln u_4$ and $\ln T$, and $\sigma_{Q_{t-1}^{S},DV}$ represents the covariance of $\ln Q_{t-1}^{S}$ and *DV*. Expressions (18) and (19) show explicitly the dependence of the variance of domestic and world prices on the model parameters and on the variances and covariances of the variables; all of which can be estimated. Note that the dependence of the price transmission elasticity, η^P, is non-linear.

It is instructive also to consider the following relations:

(20) $$\frac{\partial\sigma^2_{\ln P^d}}{\partial\eta^P}>0 \qquad \text{and}$$

(21) $$\frac{\partial\sigma^2_{\ln P^w}}{\partial\eta^P}<0\,.$$

Inequalities (20) and (21) summarize the conventional wisdom of market liberalizing policies, namely, as protectionist policies are removed and price transmission increases, domestic price variability increases while world price variability decreases. Before we discuss our model estimates and empirical illustrations, we provide a framework to evaluate the producer welfare impacts of a policy change.

2.2 Welfare-Economic Approach

Reforms to the CAP have resulted in significant price support reductions with the objective of bringing EU support prices closer to world market levels and better mirror world supply and demand conditions. As this evolves, a departure is made from a pricing structure that is relatively stable to one which can be expected to exhibit greater volatility. With price levels decreasing and volatility presumably increasing, producers can anticipate negative welfare impacts. Newbery and Stiglitz (1981) provide a methodology for the joint economic evaluation of income levels and stability. They characterize a risk-averse producer as having a von Neumann-Morgenstern utility function with income as an argument. Total welfare change is defined as the sum of the transfer and risk effects; the former approximates the classical Marshallian welfare measurement while the latter captures the change in the risk premium the agent faces in light of the policy. This framework is used to compute the impact of a policy which affects the riskiness of income as the change in the utility of income with and without the regime change.

To show the welfare benefits of a policy change for a risk-averse farmer, consider the coefficient of relative risk aversion (attitude of the farmer toward risk):

(22) $$R(Y)=-Y\cdot U''(Y)/U'(Y),$$

where Y denotes the farmer's income and U represents the farmer's concave utility function. To derive an expression for the *absolute welfare benefit*, B, we equate the expected utility of the (hypothetical) income without the CAP reform, Y^*, to the expected utility of the actual income, Y, diminished by the value of B,

$$E(U(Y^*)) = E(U(Y-B)). \tag{23}$$

Expanding both sides in Taylor series, centered at the mean hypothetical income, $\bar{Y}^*$,and cutting off terms of higher than quadratic order yields

$$\tfrac{1}{2}U''(\bar{Y}^*)\cdot V(Y^*) \approx U'(\bar{Y}^*)\cdot(\bar{Y}-B-\bar{Y}^*)+\tfrac{1}{2}U''(\bar{Y}^*)\cdot\left[V(Y)+(\bar{Y}-B-\bar{Y}^*)^2\right]. \tag{24}$$

Solving for B and dividing by $\bar{Y}^*$ results in the *relative welfare benefit*

$$\frac{B}{\bar{Y}^*} \approx \frac{\bar{Y}-\bar{Y}^*}{\bar{Y}^*}-\frac{1}{R(\bar{Y}^*)}+\sqrt{\left(\frac{1}{R(\bar{Y}^*)}\right)^2+\frac{V(Y^*)-V(Y)}{\bar{Y}^{*2}}}. \tag{25}$$

The first ratio of the right hand side represents a transfer portion of the relative welfare benefit and the rest of the right hand side a risk effect. In our empirical illustrations these dimensionless relative welfare benefits will be computed over a range of reasonable relative risk-aversion coefficients.

3. Empirical Illustrations

3.1 The Data

Twenty-three years of annual wheat data (1976-98) were used to obtain estimates of the parameters of the economic model and derive our welfare estimates. Quantity data were obtained from the Economic Research Service and the Foreign Agricultural Service of the U.S. Department of Agriculture. We used trade year data which excludes intra-EU trade. Export supply is defined as the difference between quantity supplied (available) and quantity demanded (total domestic use) in the EU. Quantity supplied is annual production adjusted for imports and change in stocks. Import demand for the rest of the world (ROW) is defined as the difference between the quantity demanded and supplied in the world less the respective quantities for the EU. For both the EU and ROW, supply (quantity available) is stock adjusted production. Further, all data were adjusted to account for EU country enlargement over the sample period. World wheat prices, CIF Rotterdam ($US), were also obtained from the USDA-ERS. For the European Union, the prices received by German producers serve as a proxy for EU prices. They were obtained from the CRONOS data bank of EUROSTAT. Currency exchange rates from the IMF were used to place world prices on a local (German Marks) currency basis. Both price series are annualized as geometric means of monthly data and are deflated by the consumer price indices of their respective countries. Before we discuss estimation and results, we first review the nature and evolution of the agricultural policy environment in the European Union.

3.2 EU Policy Environment

We identify two fundamentally different EU policy regime periods, the "old CAP" and the "new CAP".

The CAP policy regime during the period 1976 to 1992 is characterized as the "old CAP". The policy objective during this period was to support farm incomes at a high and stable level. The general result was that EU prices were in excess of and more stable than world prices. In order to keep internal market prices from falling below the administratively set intervention price (set well above world market levels), intervention agencies would buy wheat at the intervention price, store it and then sell it on the world market at a loss or, more commonly, provide private exporters a subsidy (restitution) equal to the difference between the intervention price and the world price. At the same time variable levies ensured domestic market protection from low-priced imports.

Responding to calls for reform, some new policies affecting cereals were implemented in 1988. At this time, co-responsibility levies (deductions from farmers to pay for the cost of surplus production), stabilizers (increase in co-responsibility and reduction in the intervention price if production exceeded a maximum guaranteed quantity) and, voluntary set-asides were introduced. The adoption of this "stabilizer package" was a somewhat successful effort to link price levels to output; however the "old CAP" structure of variable levies and intervention buying remained intact.

The first major structural adjustment in European agricultural policy took place with the CAP (MacSharry) reform of 1992 (Mahe and Roe, 1996). The changes were considered so significant to warrant the name the "new CAP" (Swinbank, 1997). Although truly significant changes occurred, they were implemented within the existing CAP structure of variable levies, export restitutions and the like. This structure continued to isolate European agriculture from the world economy. Implemented in July 1993, the MacSharry reforms called for compensatory payments to farmers and a continued lowering of price supports to levels closer to expected world prices. The three major components of this reform were: (1) a substantial cut in intervention prices (30 percent), phased in over a three-year period, (2) compensation to farmers for the price cuts through subsidies per hectare (area premiums), and (3) land "set-aside" requirements; preference was given to small farmers who were eligible to receive payments without the set-aside requirement. Even though the compensatory payments were not truly decoupled from cropped area, this was a major step toward a market-oriented grain economy. It was a regime change financially as well; a move from largely consumer financed (through higher prices) to where taxpayers pay a larger share (compensatory transfers). Notwithstanding the significance of these changes, the old variable levy and export subsidy structure continued to insulate the EU from world markets.

This "new CAP" period also includes the 1995 Uruguay Round Agreement on Agriculture (URAA). The old system of threshold prices and variable levies was abolished under the process of tariffication; these and other non-tariff barriers were converted to conventional tariffs and reduced over time. The first of the tariff cuts took place in July, 1995, and the new arrangements limited the import tax so that the landed price could not exceed 155 percent of the intervention price or the tariff equivalent, which ever was less. The tariff equivalent was to be reduced 36 percent over a six-year period. Constraints on the total level of support provided by the CAP were also imposed. It is most important to note that, unlike variable levies, with fixed import levies the landed price will rise and fall reflecting movements in the world price. This is indeed structural reform pointing toward more efficient markets. However, with the "intervention price plus 55 percent" rule, a variable levy type system *de facto* remains at "high" reference (world price at Rotterdam) prices. Only at "low" reference prices do the fixed tariff equivalent rates apply, and yield a landed price that varies directly with the world price. Continued lowering of the intervention price will result in a broader range over which domestic prices will reflect world market conditions. Until that time, however, the degree of international price transmission will remain considerably less than 1.0. The change to tariff equivalents and limits on the volume of subsidized exports and expenditure levels on export subsidies (21 percent reduction on subsidized exports and budget expenditure by 36 percent) became effective on July 1, 1995.

3.3 Model Estimation

Equations (8 - 13) were estimated as a system using three-stage least squares (3SLS) to obtain consistent parameter estimates in the presence of right-hand-side endogenous variables as well as contemporaneous correlation among the disturbances. Hence, there is both an economic and statistical dependency among the equations in our model. The parameter estimates are provided in Table 1.

[Table 1 here]

The elasticity estimates are reasonable: domestic supply is 0.29; domestic demand is -0.32; import supply is 0.39; export demand is -0.96, and the price transmission elasticity is 0.13. The wheat supply elasticitiy is comparable to those of Sarris and Freebairn (0.35) and Makki, Tweeten and Miranda (0.30). Our price elasticity of domestic demand compares to Sarris and Freebairn (-0.20), Tyers and Anderson (-0.30). Our price transmission elasticity is small, yet it is significantly greater than zero.[1] This estimate compares to those obtained by Thompson and Bohl (1999) which range from 0.18 to 0.25.[2] The sign and significance of the binary dummy variable parameter reflects a significant downward shift in domestic price beginning in July 1993 when the MacSharry reforms were implemented.[3]

3.4 Price Transmission and Variability

Before we empirically examine equations (18) and (19) relative to η^P, the underlying time series of $\ln P^d$ and $\ln P^w$ should be detrended to avoid interpreting spurious variation due to sheer trend. We perform this detrending in a similar manner to Cuddy and Della Valle (1978), who propose the usage of the *corrected coefficient of variation*. Since the coefficient of variation for $\ln P^w$ does not vary due to η^P, we consider the variances instead of coefficients of variation. First, from the linear regression

(26) $\ln P_t = a + b \cdot t$

for each price we get the coefficient of determination

(27) $R^2 = 1 - \sum_{t=1}^{n} \left(\ln P_t - \ln \hat{P}_t\right)^2 \Big/ \sum_{t=1}^{n} \left(\ln P_t - \ln \overline{P}_t\right)^2 .$

This can be transformed to

(28) $\sum_{t=1}^{n} \left(\ln P_t - \ln \hat{P}_t\right)^2 = \frac{n-2}{n-1} \cdot \sum_{t=1}^{n} \left(\ln P_t - \ln \overline{P}_t\right)^2 \cdot (1 - R^2) \cdot \frac{n-1}{n-2},$

which results in a formula for the squared standard error of the regression,

(29) $SSE^2 = \frac{1}{n-2} \cdot \sum_{t=1}^{n} \left(\ln P_t - \ln \hat{P}_t\right)^2 = V(\ln P_t) \cdot (1 - \overline{R}^2)$

with the adjusted coefficient of determination $\overline{R}^2 = 1 - (1 - R^2) \cdot \frac{n-1}{n-2}$. Thus, to release the variance of a time series from a linear trend, it should be multiplied by one minus the adjusted coefficient of determination from a regression on time. We get an adjusted coefficient of determination of 0.972 for domestic prices and 0.841 for world prices. These detrended variances for domestic prices and for world prices are plotted in Figure 1 dependent on η^P. These are the empirical illustrations of equations (18) and (19) and confirm the expected directional impacts of the inequalities (20) and (21). They are the detrended variances derived from equation (29). In Figure 1 it is apparent that, as η^P increases the variability of domestic price increases and world price drcreases. These are trend-adjusted variances. While these two variances converge as η^P increases, it is important to recognize that little confidence can be maintained in extrapolating values of η^P that are well beyond two standard errors of our estimated transmission elasticity.

[Figure 1 here]

3.5 Policy Change and Producer Welfare

In this section we explore the welfare implications of the MacSharry and URAA reforms. We estimate the transfer and risk effects of the "new CAP" as shown in equation (25). Measurement of the transfer effects is straightforward. Producer income accruing from the new policy regime is compared to that which would have been expected if the new policy had not been implemented. First, domestic prices, P^d, are calculated from equation (15) using the estimated parameters from Table 1 and neglecting the disturbance terms. Hypothetical prices, P^{d^*}, which would have been observed over the six year post-reform period (1993 - 98), are derived similarly, but setting the dummy variable DV to zero. This dummy variable was introduced to our structural model to indicate the policy change. If we now let it be zero, we should get the prices that had occurred without the CAP reform in the last six years. Next, the supply quantities, Q^S, are calculated endogeneously as the product of area harvested and yield per hectare, again using the estimates from Table 1. This results in the recursive expression,

$$(30) \qquad Q_t^S = \exp(-13.1) \cdot \left(P_t^d\right)^{0.29} \cdot \left(Q_{t-1}^S\right)^{0.24} \cdot T_t^{3.29}, \quad t = 1, \ldots, 23 \quad (1976-93).$$

Initializing was done by the observed value of 1975 from the above-mentioned data sources $\left(Q_0^S = 55.4\right)$. The hypothetical supply quantities, $Q_t^{S^*}$, which would have occurred without the CAP reform, are calculated by analogy, but utilizing the hypothetical prices and the recursively following hypothetical lagged supply quantities. Finally, we use these values to derive annual supply functions from our model,

$$(31) \qquad Q_t^S = \underbrace{K^A \cdot K^Y \cdot \left(Q_{t-1}^S\right)^{\gamma^A} \cdot T_t^{\gamma^Y}}_{=:\, c_t} \cdot \left(P_t^d\right)^{0.29} \qquad \text{or} \qquad P_t^d = c_t^{-1/0.29} \cdot \left(Q_t^S\right)^{1/0.29}.$$

These supply functions induce annual incomes,

$$(32) \qquad Y_{0,t} = P_t^d \cdot Q_t^S - \int_0^{Q_t^S} c_t^{-1/0.29} \cdot q^{1/0.29} dq = P_t^d \cdot Q_t^S - c_t^{-1/0.29} \cdot \frac{\left(Q_t^S\right)^{1+1/0.29}}{1+1/0.29},$$

and annual (hypothetical) producer losses from the CAP reform,

$$(33) \qquad Z_t = \int_{P_t^{d^*}}^{P_t^d} c_t \cdot p^{0.29} dp = c_t \cdot \frac{\left(P_t^d\right)^{1.29} - \left(P_t^{d^*}\right)^{1.29}}{1.29}.$$

Turning back to our welfare-economic approach in section 2.2, we are comparing the expected utilities of a hypothetical income, $Y_t^* = Y_{0,t} - Z_t$, with that of the actual income, $Y_t = Y_{0,t} + K_t$, where K_t denotes the average annual (real) transfer payments that have been given to the farmers as a compensation for the experienced producer losses.

Using the above procedure we simulate the transfer and risk effects of the post-1992 CAP reforms. For all computations we use our estimated price transmission elasticity of 0.13. Thompson and Bohl (1999) found little evidence to support a significant increase in the transmission between world and domestic prices following the reforms of the 1990s. Similarly, Thompson, Herrmann and Gohout (1999) found no evidence of price transmission change after the URAA decision on tafiffication. Notwithstanding these results, the greater the transmission of prices, the greater the expected welfare benefits.

Since hectare premia payments were used to compensate farmers for reduced prices, we compute producer welfare effects both with and without these payments; the top and bottom portions of Table 2, respectively. With payments, both the transfer and risk effects are positive. The transfer effect is invariant to the degree of producer risk aversion while the risk effect is positively related. Without payments (lower portion of Table 2), the transfer effect is –0.229. That is, producers would have been willing to pay 23 percent of their income to avoid the implementation of the reforms. However, with compensation (upper portion of Table 2), there is a positive welfare gain; that is, producer annual income is 4.6 percent greater than without the post-1992 reforms. Clearly, producer losses are avoided only with direct payments.

[Table 2 here]

While the actual direct payments more than offset the estimated negative transfer effects without payments, they had little impact on the riskyness of producer incomes. Strategic targeting of payments, however, can be used as a tool to provide greater income stability.

Our conclusion is that farmers were over-compensated for the losses due to lower prices. This result is valid for all years except 1993 where we found under-compensation. These findings are consistent with previous studies also finding farmers as a group to be over-compensated in the mid-1990s (Buckwell). Moreover, the transfer effect clearly dominated while the risk component was effectively zero. Thus, the 1992 reforms did not contribute to significant income risk, as many market participants expected.

4. Concluding Remarks

This study examines the theoretical and empirical relationships among policy reform, domestic and international price stability and producer welfare. Using an expected utility approach we compute the transfer and risk effects on wheat producers in the European Union due to a major policy change. We illustrate the policy-induced effects by using estimates obtained from a partial equilibrium model of the world wheat market. Twenty-three years of data were used for model estimation and several important findings were obtained.

First, as the EU continues on the path of market liberalization, albeit slowly, real domestic price levels can be expected to fall while price instability will increase, *ceteris paribus*. As the EU participates more fully in the world marketplace, we expect world prices will become more stable. Trend-adjusted price variances increase for the EU and decrease for the world.

Second, our estimated price transmission elasticity from world to domestic EU markets is 0.13. Although small, we conclude this elasticity estimate is significantly greater than zero. Together with our estimated market model, we use this transmission elasticity to assess the welfare impacts of the 1992 CAP reforms. We evaluate average producer incomes with and without the policy reforms. Following Newbery and Stiglitz, we decompose the aggregate welfare estimate into its transfer and risk components.

Third, we found average producer welfare increased as a result of the 1992 CAP reforms. With hectare premia payments, farmers were over-compensated 4.6 percent of average annual incomes as a result of the policy change. However, without direct payments farmers would have incurred welfare losses of some 23 percent. Producer losses were avoided only because of the direct payments.

Our conclusion is that farmers were over-compensated for their losses due to lower prices. This finding is consistent with previous research finding farmers as a group to have been over-compensated in the mid-1990s. Additionally, the 1992 reforms did not contribute to increased producer income risk, a pre-reform fear of many.

Notes

1. For $H_0 : \eta^P = 0$ and $H_a : \eta^P > 0$, the *t*-value of 1.68 has *p*-value = 0.0547, 19 d.f.

2. These authors used monthly data for the same prices over the same sample period used in this study to investigate the stochastic generating processes of the wheat price data. As a result of a number of integration, cointegration and price asymmetry tests, they obtained reliable long-run international wheat price transmission elasticities ranging from 0.18 to 0.25, with the larger estimate occurring during the post-MacSharry reform subperiod.

3. A Chow-test (Chow, 1960) for structural change was performed based on two regressions of P^d on P^w and *T*; the first for $t = 1, \ldots, 17\ (1992)$ and, the second, $t = 18\ (1993), \ldots, 23$. The null hypothesis of no change was rejected with *p*-value less than 0.00001.

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Tables

Table 1. Model Parameter Estimates, 1976 - 98

						$\bar{R}^2$
eq. (8)	$\ln Q^D =$	6.07 (44.66)	$-0.32 \cdot \ln P^d$ (–14.00)			0.90
eq. (9)	$\ln A =$	1.19 (2.07)	$+0.10 \cdot \ln P^d$ (2.70)	$+0.24 \cdot \ln Q^S_{t-1}$ (2.83)		0.28
eq. (10)	$\ln Y =$	-14.29 (-3.45)	$+0.19 \cdot \ln P^d$ (1.40)	$+3.29 \cdot \ln T$ (4.38)		0.92
eq. (11)	$\ln X =$	8.10 (5.30)	$-0.96 \cdot \ln P^w$ (-3.62)			0.31
eq. (12)	$\ln X =$	-14.34 (-3.36)	$+0.39 \cdot \ln P^d$ (1.38)	$+3.35 \cdot \ln Q^S_{t-1}$ (5.30)		0.66
eq. (13)	$\ln P^d =$	22.42 (7.83)	$+0.13 \cdot \ln P^w$ (1.68)	$-3.83 \cdot \ln T$ (-7.02)	$-0.24 \cdot DV$ (-6.58)	0.99

Note: *t*-values are in parantheses.

Table 2. Welfare Effects of the 1992 CAP Reform, 1993 – 1998 (%)

$R(\bar{Y}*)$	0.5	1.0	1.5	2.0	2.5	3.0
results with payments:						
transfer	4.676	4.676	4.676	4.676	4.676	4.676
risk	0.019	0.039	0.058	0.077	0.096	0.115
$B/\bar{Y}*$	4.695	4.715	4.734	4.753	4.772	4.791
results without payments:						
transfer	-22.937	-22.937	-22.937	-22.937	-22.937	-22.937
risk	0.041	0.081	0.122	0.162	0.202	0.242
$B/\bar{Y}*$	-22.896	-22.856	-22.815	-22.775	-22.735	-22.695

Figures

Figure 1. Detrended variances of domestic and world wheat prices and the elasticity of price transmission, .