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CAP Reforms in the 1990s and Their Price and Welfare Implications: The Case of Wheat

by

Roland HERRMANN*, Stanley R. THOMPSON**
and Wolfgang GOHOUT***

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* Prof. Dr. Roland Herrmann, Institut für Agrarpolitik und Marktforschung der Universität Gießen, Senckenbergstr. 3, D-35390 Gießen.

** Prof. Stanley R. Thompson, Department of Agricultural, Environmental and Development Economics, The Ohio State University, Columbus, OH, USA.

*** Prof. Dr. Wolfgang Gohout, Fachhochschule Pforzheim - Hochschule für Gestaltung, Technik und Wirtschaft, Tiefenbronner Str. 65, D-75175 Pforzheim.

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1 Introduction

Agricultural policy reforms can have important impacts on commodity prices and the economic welfare of producers and consumers. To provide useful input to the policy-making process, economists often assess the potential impact of alternative policy actions. In agricultural markets Buckwell (1997), Froud and Roberts (1993), Rayner *et al.* (1994) and Tyers and Anderson (1992) have undertaken notable efforts of this nature. These and many other analysts have found strong impacts of policy change on price instability and welfare. For instance, Rayner *et al.* investigated the potential welfare effects of the 1992 MacSharry reforms on the Common Agricultural Policy (CAP) under the two counterfactual scenarios of no reform and annual price cuts of three percent. In both cases, net welfare gains were anticipated. While these *ex ante* studies attempt to anticipate the future, by definition, they cannot accurately assess actual outcomes.

In this paper we provide an *ex post* empirical analysis of recent reforms to the CAP on wheat prices and economic welfare in the European Union (EU). Our analysis is based on a structural econometric model of the EU-rest of world wheat market estimated over the period 1976-2000. We use the model to evaluate the actual effect of recent CAP reforms on prices and welfare in the EU compared to the situation without reforms. The policy changes included are the 1992 agricultural reform in the EU, the Uruguay Round Agreement on Agriculture (URAA) and the first effects of the Agenda 2000 decisions. We evaluate both the aggregate welfare effects as well as the distribution of gains and losses among producers, consumers and the EU budget. In addition, we assess the offsetting effects of reduced price supports and direct producer payments on producer welfare.

The remainder of this paper is organized as follows. In Section 2, we present our analytical framework of analysis which includes both our partial equilibrium market model as well as the procedure to evaluate the welfare effects of policy change. In Section 3 we provide our empirical illustrations. This section includes a description of our data, the nature of the reforms to the CAP, model estimation methods, estimates of the degree of price transmission, and the effect of policy change on economic welfare. Lastly, in Section 4 we offer some concluding remarks.

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 market impact of EU policy change. Second, we adopt a welfare economic approach to evaluate the distributional effects of policy regime change. As EU agricultural policy transitions toward direct income support, we estimate the policy–induced change in producer welfare both with and without compensatory payments.

2.1 Wheat Market Model

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

$$
\begin{array}{lrcl}
(1) & Q^D & = & K^{Q^D} \cdot (P^d)^{\eta^{Q^D}} \cdot u_1 \\
(2) & Q^S & = & K^{Q^S} \cdot (P^d)^{\eta^{Q^S}} \cdot (Q^S_{t-1})^{\gamma^{Q^S}} \cdot T^{\delta^{Q^S}} \cdot u_2 \\
(3) & X^D & = & K^{X^D} \cdot (P^w)^{\eta^{X^D}} \cdot u_3 \\
(4) & X^S & = & K^{X^S} \cdot (P^d)^{\eta^{X^S}} \cdot (Q^S_{t-1})^{\gamma^{X^S}} \cdot u_4 \\
(5) & P^d & = & K^P \cdot (P^w)^{\eta^P} \cdot T^{\gamma^P} \cdot \exp(DV)^{\delta^P} \cdot u_5 \\
(6) & X^D & = & X^S
\end{array}
$$

where Q^D is quantity demanded (EU); Q^S is quantity supplied (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; not contemporaneously) lognormally distributed disturbance variables, i.e.

$$u_i \sim LN(0, \sigma_i^2), \quad i = 1, \ldots, 5.$$

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, Q^S, P^d, P^w, X^D and X^S) and three predetermined variables (Q^S_{t-1}, T and DV), additional to the constant. Each equation in this system is identified, thus, enabling statistical estimation of the structure using standard econometric procedures. The quantity supplied in the previous year is specified as a regressor in the supply 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. As we expect domestic supply in an earlier period will affect export supply in the current period, Q^S_{t-1} is also specified as an argument in equation (4). Finally, the price transmission equation also includes a 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 change in 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 6) we no longer need to distinguish X^D and X^S and can write the model in a linear form of the logarithms:

$$\ln Q^D = \ln K^{Q^D} + \eta^{Q^D} \cdot \ln P^d + \ln u_1, \tag{7}$$

$$\ln Q^S = \ln K^{Q^S} + \eta^{Q^S} \cdot \ln P^d + \gamma^{Q^S} \cdot \ln Q^S_{t-1} + \delta^{Q^S} \cdot \ln T + \ln u_2, \tag{8}$$

$$\ln X = \ln K^{X^D} + \eta^{X^D} \cdot \ln P^w + \ln u_3, \tag{9}$$

$$\ln X = \ln K^{X^S} + \eta^{X^S} \cdot \ln P^d + \gamma^{X^S} \cdot \ln Q^S_{t-1} + \ln u_4, \tag{10}$$

$$\ln P^d = \ln K^P + \eta^P \cdot \ln P^w + \gamma^P \cdot \ln T + \delta^P \cdot DV + \ln u_5, \tag{11}$$

with independent (each over time; not instantaneously) normally distributed disturbance variables, i.e.

$$\ln u_i \sim N(0, \sigma_i^2), \quad i = 1, \ldots, 5.$$

The world wheat market model (7) to (11) captures European policy in an aggregate form that can be estimated within a structural econometric model for the years 1976 - 2000. No attempt is made to model explicitly all individual instruments of agricultural policy which were in force at any point of time in this period, e.g. set–aside policies, intervention prices, various forms of direct payments like hectare or set–aside premia, co–responsibility levies, variable import levies, import tariffs or variable export subsidies. There are a number of studies available which analyze individual policy measures and their impacts on the price level and stability and welfare [McCalla and Josling (1985); Schmitz (1984); Tyers and Anderson (1992)], on supply, farmers' income and farm income distribution [Lansink and Peerlings (1996); Guyomard, Baudry and Carpentier (1996)], on international prices and trade [Blake, Rayner and Reed (1999); Meyers, Helmar and Hart (1998)], and on compatibility with WTO rules [Swinbank (1999)].

The model distinguishes, in particular, between the old and the new CAP, with the EU's agricultural reform of 1992 being the major force introducing the new CAP. DV accounts for this major change by allowing for a major influence on the EU's domestic price level. Of course, the size of the coefficients will be driven by the structure of agricultural policy instruments. If a given level of protection is achieved with intervention prices and a variable import levy or export subsidy, this would be consistent with a high magnitude of $\ln K^P$ and $\eta^P = 0$. The same level of protection, realized with a percentage import tariff or export subsidy, would be consistent with $\ln K^P = 0$ and $\eta^P > 0$.

The coefficient δ^P captures the relative change in domestic prices due to the policy change. It may differ from the relative change in market order prices as a consequence of imperfect transmission of policy prices [Colman (1985)]. The model also allows for a non–zero linkage between world and domestic prices. A rationale could be budget pressure which might affect price decisions within the CAP, as indicated by earlier studies of the cereals market [Thompson, Herrmann and Gohout (2000)] or of the political economy of agricultural price decisions in the EU [Olper (1998)]. On the other hand, the model does not account for the possibility of a significant policy–induced change in price transmission. Thompson, Herrmann and Gohout (2000) show that the recent policy reforms did not change the pattern of price transmission between world and domestic prices.

Rearranging (9) to (11) we get the instantaneous relation

$$(12)\quad \ln P^d = \frac{\eta^P(\ln K^{X^D} - \ln K^{X^S} + \ln u_3 - \ln u_4 - \gamma^{X^S}\ln Q^S_{t-1}) - \eta^{X^D}(\ln K^P + \gamma^P \ln T + \delta^P DV + \ln u_5)}{\eta^{X^S}\eta^P - \eta^{X^D}}.$$

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

$$(13)\qquad \ln P^w = \frac{1}{\eta^P}\cdot(\ln P^d - \ln K^P - \gamma^P \ln T - \delta^P DV - \ln u_5).$$

For these expressions, variances can be determined utilizing variances and covariances of the disturbance variables,

$$(14)\qquad \sigma^2_{\ln P^d} = \frac{(\eta^P)^2\cdot(\sigma_3^2+\sigma_4^2-2\sigma_{3,4}) + (\eta^{X^D})^2\cdot\sigma_5^2 - 2\eta^P\eta^{X^D}\cdot(\sigma_{3,5}-\sigma_{4,5})}{(\eta^{X^S}\eta^P-\eta^{X^D})^2}$$

$$(15)\qquad \sigma^2_{\ln P^w} = \frac{\sigma_3^2+\sigma_4^2-2\sigma_{3,4}}{(\eta^{X^S}\eta^P-\eta^{X^D})^2} + (\eta^{X^S})^2\cdot\sigma_5^2 - \frac{2\eta^{X^S}}{\eta^{X^S}\eta^P-\eta^{X^D}}(\sigma_{3,5}-\sigma_{4,5}).$$

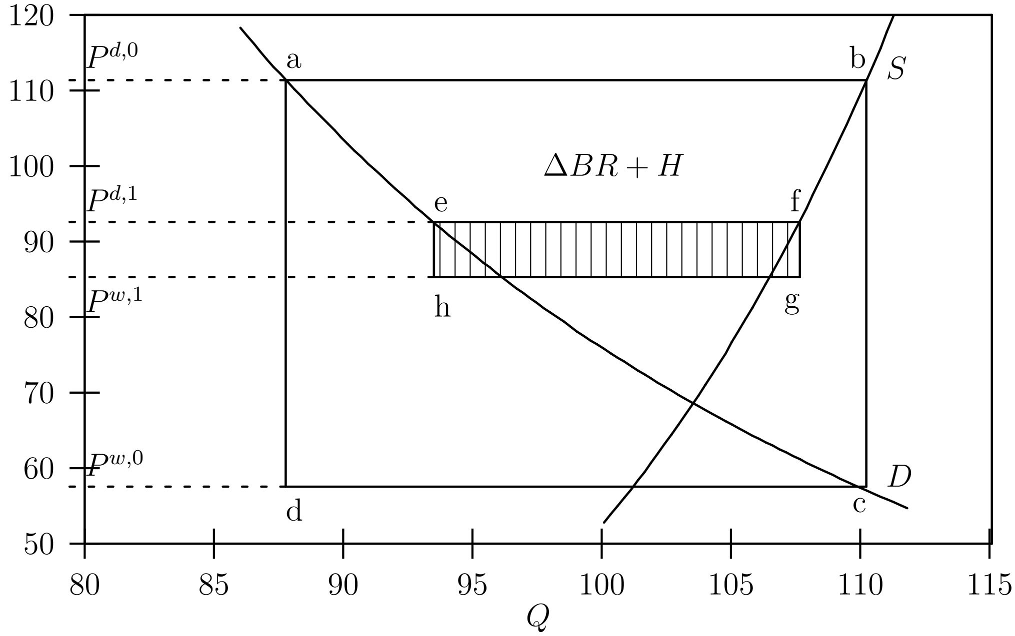
Expressions (14) and (15) show explicitly the dependence of the variance of domestic and world prices on the model parameters. Note that the dependence of the price transmission elasticity, η^P, is non–linear. It is instructive also to consider the expected relations $\partial\sigma^2_{\ln P^d}/\partial\eta^P > 0$ and $\partial\sigma^2_{\ln P^w}/\partial\eta^P < 0$. These inequalities 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. In the empirical application of Section 3, equations (14) and (15) can be calculated from the 3SLS estimation of the simultaneous model. Before we discuss our model estimates and empirical illustrations, we provide a framework for evaluating the economic 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 occurs producers will experience welfare losses due to the lower support prices. With reduced prices and presumably reduced surpluses, budgetary costs will be less. The EU will not only provide reduced producer price support, the surpluses that must be sold (restitution) on world markets will be at a higher world price due to a smaller quantity from domestic markets that will be placed on the world market. Figure 1 illustrates these distributional welfare effects and the change in budgetary revenue on the domestic market.

A reduction in the support price from $P^{d,0}$ to $P^{d,1}$ results in a gain to consumers, an economic loss to producers and a gain to the EU budget. The aggregate net welfare gain is positive. However, compensatory transfers to producers is also a budgetary cost and hence, must be deducted from the economic gains accruing to the EU budget. The specific result of the EU policy change is an empirical question, which we explore below.

Figure 1. Welfare Effects of CAP Reform for 2000



3 Empirical Illustrations

3.1 The Data

Twenty–five years of annual wheat data (1976—2000) 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 exclude intra–EU trade. Export supply is defined as the difference between quantity supplied (available) and quantity demanded (total domestic use) in the EU. The quantity available covers all sources of supply including production, imports and change in stocks. Further, all data were computed for the EU(15) 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 from monthly data and are deflated by the consumer price indices of their respective countries. Lastly, compensatory payment information was obtained from the Agricultural Situation in the Community (1999). 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 policy regime periods of the CAP: 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 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 premia), 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 1993 Uruguay Round Agreement on Agriculture (URAA). Major decisions under the URAA included (i) tariffication, (ii) the reduction of tariff protection, and (iii) limitations on export subsidization. The old system of threshold prices and variable levies was abolished under the process of tariffication; non–tariff barriers were converted to conventional tariffs. This seems to be a major reform with regard to price transmission at first sight: Unlike variable levies, with fixed *ad–valorem* tariffs the landed price will rise and fall reflecting movements in the world price. However, no pure tariffication was implemented. As the new bound import tariffs were still relatively high, given the reference periods of very low world market prices (1986-88), an alternative minimum import price was introduced at the level of 155% of the intervention price. The 155% rule applies as long as it leads to a lower import price than the bound import tariffs. Additionally, tariffication was not implemented for the export situation. Export subsidies are still variable and not fixed as specific or *ad–valorem* subsidies. Thus, the effects of the implemented rules of tariffication on instability are low [Thompson, Herrmann and Gohout (2000)] and the degree of price transmission between the world and domestic markets is still considerably less than 1.0. However, the URAA decisions on the reduction of bound tariffs should result in a broader range over which domestic prices will reflect world market conditions. The tariff equivalent was to be reduced 36 per cent over a six–year period. Constraints on the total level of support provided by the CAP were also imposed. Additionally, limitations on the volume of subsidized exports and expenditure levels on export subsidies (21 per cent reduction on subsidized exports and budget expenditure by 36 per cent) became effective on July 1, 1995.

Cereal policy under the "new CAP" was continued with the propositions of the Commission of the EU (1997) on the Agenda 2000 and the Agenda decisions by the Council of the EU (1999). According to Swinbank (1999), the decisions of the Agenda 2000 were mainly driven by the need to remain within the existing export commitments as laid down in the URAA. The Agenda 2000 decisions follow the lines which were introduced in the 1992 reform: A further cut in the intervention price for cereals, by 15 per cent in two steps in 2000 and 2001, was set. The price cut will be compensated partly by additional hectare payments. Again, the major changes of the Agenda 2000 do affect the price level rather than price stability.

3.3 Model Estimation

Equations (6) – (10) 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. Model Parameter Estimates, 1976 — 2000

eq. (7)	$\ln Q^D$	$=$	6.22 (51.58)	$-0.34 \cdot \ln P^d$ (-16.82)		
eq. (8)	$\ln Q^S$	$=$	-7.34 (-2.69)	$+0.13 \cdot \ln P^d$ (1.71)	$+0.35 \cdot \ln Q^S_{t-1}$ (3.34)	$+2.11 \cdot \ln T$ (3.55)
eq. (9)	$\ln X$	$=$	6.95 (5.40)	$-0.77 \cdot \ln P^w$ (-3.39)		
eq. (10)	$\ln X$	$=$	-14.20 (-3.62)	$+0.49 \cdot \ln P^d$ (1.90)	$+3.17 \cdot \ln Q^S_{t-1}$ (5.45)	
eq. (11)	$\ln P^d$	$=$	21.30 (7.44)	$+0.18 \cdot \ln P^w$ (2.11)	$-3.64 \cdot \ln T$ (-6.73)	$-0.23 \cdot DV$ (-7.25)

Note: t–values are in parentheses.

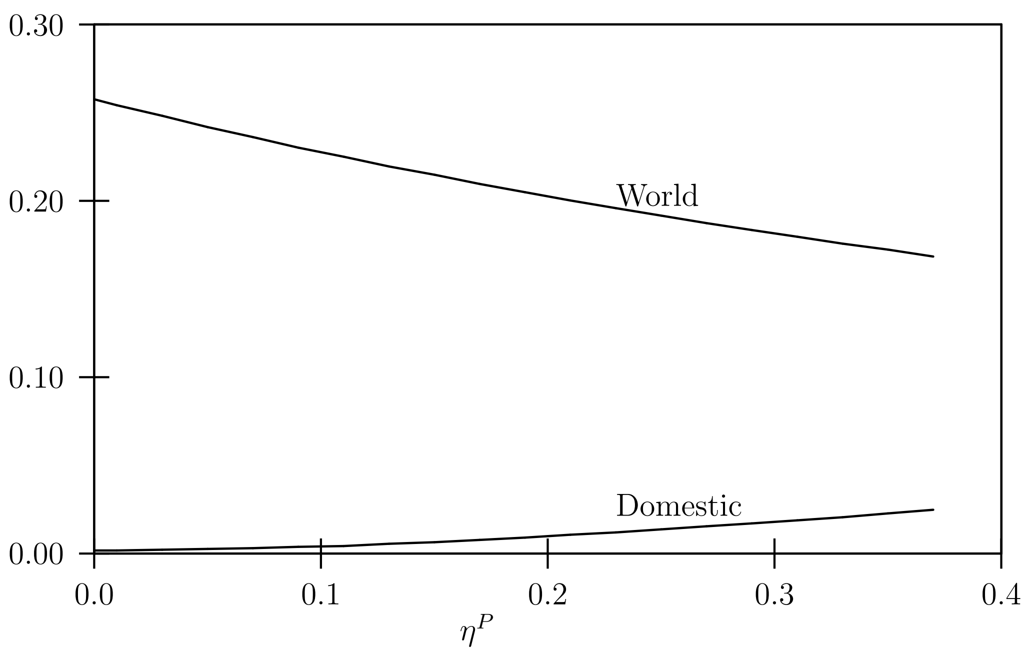
Source: Authors' computations.

The elasticity estimates are reasonable: domestic supply, short-run is 0.13 and long-run is 0.20; domestic demand is −0.34; export supply[1] is 0.49; import demand is −0.77, and the price transmission elasticity is 0.18. Our long-run wheat supply elasticity is a bit lower than the 0.35 estimate of Sarris and Freebairn (1983) and the 0.30 estimate of Makki, Tweeten and Miranda (1996). Our price elasticity of domestic demand compares to Sarris and Freebairn (−0.20) and Tyers and Anderson (−0.30). Our price transmission elasticity is small, yet it is significantly different from zero.[2] This estimate is the same as that obtained by Thompson, Sul and Bohl (2001).[3] 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.[4] The addition of an interaction term ($P^w \cdot DV$) to the price transmission equation was not found to be statistically significant (Thompson, Herrmann and Gohout, 2000).

3.4 Price Transmission and Variability

Equations (14) and (15) are utilized in Figure 2 to get an impression of the dependency of price variability on the price transmission elasticity.

Figure 2. Variances of domestic and world wheat prices and the elasticity of price transmission, η^P



In Figure 2 it is apparent that, as η^P increases the variability of domestic price increases and that of world price decreases. While these two variances converge as η^P increases, caution should be taken in extrapolating values of η^P that are well beyond our estimated transmission elasticity.

3.5 Policy Change and Economic Welfare

In this section we explore the welfare implications of the MacSharry and URAA reforms. Using our estimated model, we present the procedure used to calculate the changes in consumer surplus (ΔCS), producer surplus (ΔPS), budgetary revenue (ΔBR), and of the aggregate net welfare change (ΔNW) due to the policy regime change. Producer surplus will be calculated without and with (ΔPS^p) direct income transfers (H), i.e. hectare premia. From (12) and (8), succeedingly and iteratively:

$$\ln P_t^d = \frac{\eta^P(\ln K^{X^D} - \ln K^{X^S} + v_{3,t} - v_{4,t} - \gamma^{X^S}\ln Q_{t-1}^S) - \eta^{X^D}(\ln K^P + \gamma^P \ln T_t + \delta^P DV_t + v_{5,t})}{\eta^{X^S}\eta^P - \eta^{X^D}}, \tag{16}$$

and

$$\ln Q_t^S = \underbrace{\ln K^{Q^S} + \gamma^{Q^S}\cdot \ln Q_{t-1}^S + \delta^{Q^S}\cdot \ln T_t + v_{2,t}}_{=:\quad c_t} + \eta^{Q^S}\cdot \ln P_t^d, \tag{17}$$

are calculated for $t = 1, \ldots, 25$. Normally distributed random numbers $v_{i,t}$ with contemporaneous covariance matrix Σ are generated for that reason. Σ is an estimate of the covariance matrix of the disturbance variables $\ln u_{i,t}$, which is assumed invariant over time. Σ is derived from our econometric model. Solving (17) for P_t^d, we get the annual supply functions,

$$P_t^d = e^{-c_t/\eta^{Q^S}} \cdot (Q_t^S)^{1/\eta^{Q^S}}. \tag{18}$$

Domestic prices are simulated with ($P_t^{d,1}$) and without ($P_t^{d,0}$) the influence of the CAP reform, utilizing the dummy variable DV respectively. For each year, the area above the supply curve over the range from $P_t^{d,0}$ to $P_t^{d,1}$ represents the (negative) change of the producer surplus; thus $\Delta PS_t < 0$,

$$\Delta PS_t = \int_{P_t^{d,0}}^{P_t^{d,1}} e^{c_t}\cdot p^{\eta^{Q^S}}\,dp \quad = \quad e^{c_t}\cdot \frac{(P_t^{d,1})^{1+\eta^{Q^S}} - (P_t^{d,0})^{1+\eta^{Q^S}}}{1+\eta^{Q^S}}. \tag{19}$$

In a similar fashion, the (positive) change in consumer surplus is calculated. Utilizing the already endogenously calculated domestic prices in equation (7) and solving for P_t^d, yields the annual demand functions,

$$P_t^d = e^{-(\ln K^{Q^D} + v_{1,t})/\eta^{Q^D}} \cdot (Q_t^D)^{1/\eta^{Q^D}}. \tag{20}$$

For each year, the area below the demand curve over the vertical range from $P_t^{d,0}$ to $P_t^{d,1}$ is the (positive) change of the consumer surplus; thus $\Delta CS_t > 0$,

$$\Delta CS_t = \int_{P_t^{d,1}}^{P_t^{d,0}} \exp[\ln K^{Q^D} + \eta^{Q^D}\cdot \ln p + v_{1,t}]\,dp \tag{21}$$

$$= \int_{P_t^{d,1}}^{P_t^{d,0}} K^{Q^D}\cdot e^{v_{1,t}}\cdot p^{\eta^{Q^D}}\,dp \tag{22}$$

$$= K^{Q^D}\cdot e^{v_{1,t}}\cdot \frac{(P_t^{d,0})^{1+\eta^{Q^D}} - (P_t^{d,1})^{1+\eta^{Q^D}}}{1+\eta^{Q^D}}. \tag{23}$$

Finally, the change in budgetary revenue (ΔBR_t) is calculated for each year as the rectangular area 'abcd' in Figure 1, diminished by the inner rectangle 'efgh' and by the compensation payments (H_t),

$$(24) \qquad \Delta BR_t = (Q_t^{S,0} - Q_t^{D,0})(P_t^{d,0} - P_t^{w,0}) - (Q_t^{S,1} - Q_t^{D,1})(P_t^{d,1} - P_t^{w,1}) - H_t,$$

where all quantities are calculated with ($Q^{\cdot,1}$) and without ($Q^{\cdot,0}$) the impacts of the CAP, respectively. Actual change in producer surplus (including direct income transfers) and the aggregate net welfare change are calculated as

$$(25) \qquad \Delta PS_t^p = \Delta PS_t + H_t$$

$$(26) \qquad \Delta NW_t = \Delta CS_t + \Delta PS_t^p + \Delta BR_t.$$

Using the values of our parameter estimates, the numerical results of a Monte Carlo study with 1000 replications are reported in Table 2. The tabulated estimates are the mean values and the uncertainty measures in parentheses are the standard deviations from all 1000 simulated series.[5] The following welfare effects of the MacSharry and URAA reforms were estimated: (1) consumers *gain*, (2) producers *lose* without hectare-premia payments, (3) producers *gain* with hectare-premia payments, (4) change in budgetary revenue is *negative*, and (5) net welfare change is *positive*. Our conclusion is that farmers were overcompensated for the losses due to lower post–reform prices. This result is valid for all years except 1993, where we found undercompensation. These findings are consistent with previous studies also finding farmers as a group to be overcompensated in the 1990s (Buckwell, 1997).

Table 2. Changes of consumer surplus (ΔCS), producer surplus without (ΔPS) and with (ΔPS^p) side payments (H), budgetary revenue (ΔBR), and net welfare (ΔNW); (Million Euros)

Year	1993	1994	1995	1996	1997	1998	1999	2000
ΔCS	2227	1973	1872	1787	1731	1668	1628	1571
	(201)	(178)	(173)	(165)	(164)	(148)	(145)	(137)
ΔPS	−2798	−2481	−2375	−2278	−2221	−2152	−2119	−2054
	(315)	(279)	(276)	(265)	(266)	(240)	(236)	(232)
H	1926	2646	3428	3480	3497	3466	3442	3815
ΔPS^p	−872	165	1053	1202	1277	1314	1323	1761
	(315)	(279)	(276)	(265)	(266)	(240)	(236)	(232)
ΔBR	−972	−1521	−2268	−2296	−2321	−2283	−2274	−2636
	(217)	(252)	(254)	(238)	(223)	(223)	(203)	(193)
ΔNW	382	617	658	694	687	698	677	695
	(236)	(245)	(252)	(228)	(213)	(204)	(189)	(173)

Note: Standard deviations are in parentheses.

Source: Authors' computations.

4 Concluding Remarks

We examined the theoretical and empirical effects of reforms to the CAP in the 1990s on wheat prices and economic welfare. This analysis is based on a structural econometric model of the EU wheat market with linkages to the rest of the world. The model is estimated with annual data over the period 1976 to 2000. With eight years post-MacSharry, a sufficient observation period is available to perform an *ex-post* analysis of the recent CAP reforms.

The empirical evidence suggests that the main impact of the post-1992 CAP reforms was on price levels, not price instability. This result is consistent with that of Thompson, Herrmann and Gohout (2000) who showed that without true tariffication the transmission of world price signals to domestic markets would be zero and domestic price instability would not increase. Over the sample period our price transmission elasticity estimate was 0.18. While not zero, its magnitude is small. This estimate is identical to the 0.18 estimate of Thompson, Sul and Bohl (2001) obtained using monthly data for wheat in France, Germany and the United Kingdom. Moreover, the evidence suggests that a significant increase in this elasticity did not occur with the Uruguay Round Agreement. This is not surprising since true tariffication has not occurred.

Our model was used to explore the aggregate and distributional welfare implications of the MacSharry and subsequent reforms. We found that (1) consumers gain (2) producers would have lost without hectare premia payments (3) producers gain with hectare payments, (4) budgetary costs rise, and (5) the net aggregate welfare is positive (more than 600 million Euros annually). Government expenditures were less than the welfare gains of producers and consumers. Standard errors of these point estimates using Monte Carlo simulation procedures suggest a high level of confidence in our findings. These empirical results are consistent with the *ex-ante* estimates of Rayner *et al.* (1994) under his counterfactual scenario of annual price reductions of three percent. Finally, we found that producers were overcompensated on average with direct premia payments for the policy-induced price reductions.

Notes

1. Using our econometric estimates for the domestic supply, domestic demand and price transmission-elasticities, we use the following theoretical relationship to compute the export (excess) supply elasticity:

$$\eta^{X^S} = \eta^{Q^S} \cdot \eta^P \left(\frac{Q^S}{X^S}\right) - \eta^{Q^D} \cdot \eta^P \left(\frac{Q^D}{X^D}\right),$$

   where

$$\begin{aligned} \eta^{Q^S} &= \text{price elasticity of supply,} \\ \eta^{Q^D} &= \text{price elasticity of demand, and} \\ \eta^P &= \text{price transmission elasticity.} \end{aligned}$$

At mean quantity values we obtain the estimate for η^{X^S} of 0.457. This compares to our econometric estimate for export supply of 0.49.

2. For $H_0: \eta^P = 0$ and $H_a: \eta^P > 0$, the t–value of 2.11 has a p–value $= 0.0235$ and 21 d.f.

3. These authors used monthly data for the same prices over the sample period 1976–98 to investigate the stochastic generating processes of wheat prices in France, Germany and the United Kingdom. Using a seemingly unrelated error-correction model, they obtained an estimate of the long–run international wheat price transmission elasticity of 0.18.

4. 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)$, \ldots, 25$. The null hypothesis of no change was rejected with p–value less than 0.00001.

5. The goodness–of–fit test of Anderson and Darling with an extension of Stephens (1986) has been performed on ΔCS, ΔPS, ΔBR and ΔNW to investigate their 'degree of normality'. This *omnibus test* is based on the empirical distribution function (EDF) and tests the normality assumption against all other (continuous) distributions. From these tests, ΔCS can be well assumed to be normal, and ΔPS and ΔBR are not far from beeing normal. ΔNW doesn't seem to be normal at all, while the plot of its empirical distribution function against its theoretical counterpart doesn't show large deviations. The distribution of ΔNW seems to be leptokurtic, but unimodal and symmetric, quite like a t–distribution. Thus, the calculated standard deviations could be interpreted quite 'normally' for ΔCS, ΔPS and ΔBR, and bit more cautiously for ΔNW.

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