REASSESSING PRODUCER BEHAVIOUR IN A POLICY-MODIFIED PRODUCTION ENVIRONMENT*

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ABSTRACT

This paper presents a new approach to assessing the impact of price support policies on producer behaviour. This approach takes explicit account of the impact of such policies on a producer's uncertain production environment and includes a numerical procedure for calculating ex ante price variability from ex post producer price data. The methodology is applied to European agricultural industries in which intervention purchasing schemes operate. Results show that price support policies can so severely distort the signal producers receive from world markets that their supply response is the opposite of that which would occur in the absence of the policy.

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INTRODUCTION

This paper presents a new approach to assessing the impact of price support policies on producer behaviour. Welfare assessments of such policies have typically focused on their transfer effects using the concepts of producer and consumer surplus (e.g. Hazell and Scandizzo, 1975), while assessments of supply response have typically used econometric methods to estimate supply functions with some variable or variables introduced to account for the impact of the relevant policy (e.g. Sarris and Freebairn, 1983).

The research reported here builds on the fundamental recognition that it is not just the expected income (i.e. transfer) effects of such policies which is of concern to producers, but also the impact of the policies on the variability of income (see Newberry and Stiglitz, 1981). Accepting this fundamental point makes it necessary for any policy to be characterised in such a way as to capture both impacts. This is not a straightforward exercise because the available data on producer prices are by definition either ex ante or ex post the introduction of the policy and so some counterfactual situation needs to be constructed. Previous analyses have typically assumed historical data can be substituted for contemporaneous ex ante data. However in Section One of this paper formulae are presented which allow the estimation of the ex ante price distribution using ex post data. These estimates are combined in Section Two with a model of producer welfare which explicitly allows for the impact of the price support policy on both expected income and the variability of income to determine the overall welfare effect of the policy. In addition in this Section supply responses to the policy are estimated by simulating the impact of its introduction on a producer's optimally derived decision rule. Sections One and Two make use of data obtained on EEC producer prices for common wheat, adult cattle (excluding calves) and milk. These industries were chosen because of their significance to European agriculture (together they represent approximately 40% of the total value of agricultural production) and because they all feature intervention buying schemes as a means of supporting producer prices. Data are confined to the period 1981-84 as in all cases suitable indices of producer prices are not available prior to 1981, while in 1984 quotas were introduced on milk production, thereby removing the scope for examining supply responses. In addition, for adult cattle key data for estimating intervention prices were no longer published after 1984, while for common wheat a problem of estimating price support levels arises because of the period of extreme instability which the world wheat market experienced after 1984. Prompted by these difficulties with the data, further analysis is undertaken in Sections One and Two which shows that the estimated impact of the policies is very sensitive to the assumed price level at which intervention purchasing occurs.

Although the sensitivity analysis of Sections One and Two suggests the absolute magnitude of the policy impacts are questionable, the comparative static analysis of Section Three shows there is little doubt about the extremely distorting impact such policies have on the signals producers receive from the world market. In particular, the results of this Section show that in a policy-modified production environment the qualitative impact of parameter changes can be the reverse of those impacts which occur in the absence of the policy.

The paper concludes with a brief summary.

1. ESTIMATING THE EX ANTE PRICE DISTRIBUTION

The essential characteristic of an intervention purchasing scheme is that it puts a floor under which producer prices cannot fall, regardless of the level of price that would otherwise prevail. Effectively, the producer's _ex ante_ price distribution is "winsorised" with a mass of probability weight piled up at the floor level (see Figure 1). In Fraser (1988) the following formulae are derived for determining the impact of introducing such a floor on the expected level and variability of producer prices where these prices are _ex ante_ normally distributed:

$$E(p_u) = F(\hat{p})\ \hat{p} + [1 - F(\hat{p})][\bar{p} + \sigma_p Z(\hat{p})/[1 - F(\hat{p})]] \tag{1}$$

$$Var(p_u) = [1 - F(\hat{p})]\ \sigma_2^2 + F(\hat{p})[\hat{p} - E(p_u)]^2 + [1 - F(\hat{p})][\varepsilon_2 - E(p_u)]^2 \tag{2}$$

where:

$\bar{p}$ = mean of p

σ_p^2 = variance of p

$\hat{p}$ = underwritten price

$Z(\hat{p})$ = $(1/\sqrt{2\pi})\ \exp[-\ 0.5[(\hat{p} - \bar{p})/\sigma_p]^2]$

$F(\hat{p})$ = cumulative probability of $p \leq \hat{p}$

$E(p_u)$ = expected price with underwriting

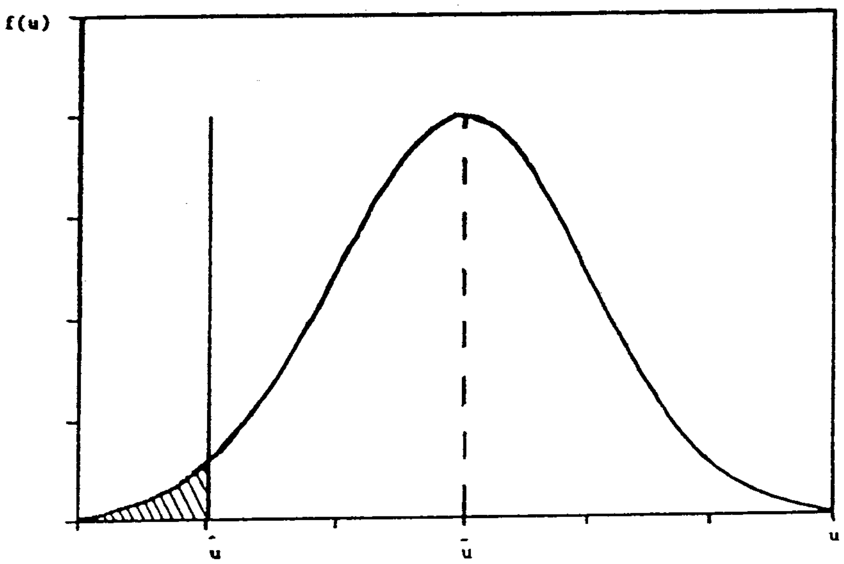
$Var(p_u)$ = variance of price with underwriting

$$\varepsilon_2 = \bar{p} + \sigma_p Z(\hat{p})/[1 - F(\hat{p})]$$

$$\sigma_2^2 = \sigma_p^2[1 - [Z(\hat{p})/(1 - F(\hat{p}))]^2 + [(\hat{p} - \bar{p})/\sigma_p][Z(\hat{p})/(1 - F(\hat{p}))]] .$$

FIGURE 1

Winsorising a Normal Distribution



Producer price data published by Eurostat include a monthly observation of a price index for each major commodity classification across countries as well as for EUR-9 and EUR-10 (appropriately weighted). According to the analytical framework adopted here, such data can be viewed as ex post producer price observations - i.e. observations on p_u - on which basis estimates of $E(p_u)$ and $Var(p_u)$ can be calculated (after the data have been detrended to produce a stationary series). Once estimates of $E(p_u)$ and $Var(p_u)$ have been produced, equations (1) and (2) represent a system of two equations in three unknowns - $\hat{p}$, $\bar{p}$ and σ_p . At this point a problem arises in how best to fix one of these unknowns. In particular, published data on $\hat{p}$

are market not producer prices, while for $\bar{p}$ and σ_p there are well-recognised difficulties associated with using world market prices which could be related, such as by coefficient of variation (CV), to *ex ante* producer prices.

The approach taken here has been first to calculate an average market-based estimate for the ratio $\hat{p}/\bar{p}$ (which assumes that CIF prices are a suitable proxy for *ex ante* market prices) and then to assume that this ratio of intervention price to *ex ante* mean price is indicative of that which is effectively operating at the level of producer prices. However, to allow for the unlikelihood of world prices being independent of the CAP policy, and for any disturbance of marketing margins to the intervention price - *ex ante* mean price ratio, a sensitivity analysis of welfare impacts allowing for about 10% correction is undertaken in Section Two.

With the ratio of $\hat{p}/\bar{p}$ determined, equations (1) and (2) can be solved to determine $\bar{p}$, σ_p and $\hat{p}$. Estimates are shown in Table 1.

TABLE 1

Estimates of Ex Ante Producer Price Distributions

	$\hat{p}/\bar{p}$	$E(p_u)$	$Var(p_u)$	$\bar{p}$	σ_p^2	CV_o	CV_1
Wheat[a]	1.1	178.81	80.95	159.06	605.94	15.48	5.03
Adult Cattle[b]	1.5	165.27	38.28	109.31	1459.70	34.95	3.74
Milk[c]	1.5	149.88	18.79	99.39	1006.91	31.93	2.89

Notes: [a]Based on detrended monthly observations January 1981 - December 1984 of Eurostat's, EUR-10 common wheat nominal producer price index. Data for market $\hat{p}$, $\bar{p}$ as published in Agricultural Markets, where observations on $\bar{p}$ are CIF prices and $\hat{p}$ are intervention prices for feed wheat.

[b]Detrended monthly observations January 1981 - December 1984 of Eurostat's EUR-10 adult cattle excluding calves nominal producer price index. Data for market $\hat{p}$ taken as 70% of published guide prices and for market $\bar{p}$ as guide price less the levy on imports from other countries.

[c]Detrended monthly observations January 1981 - March 1984 of Eurostat's EUR-10 milk nominal producer price index. Data for butter and skimmed milk powder basing $\bar{p}$ on threshold prices less import levies gave estimates of 1.79 and 1.59 for $\hat{p}/\bar{p}$ respectively. Reduced here to 1.5 for all milk to allow for the limited coverage of intervention purchasing.

2. ESTIMATING THE WELFARE IMPACTS OF AND SUPPLY RESPONSES TO PRICE SUPPORT

The model outlined in Fraser (1988) is used to characterise the impact of the policy on the welfare of producers via changes in the expected level and variability of income. In this model, producer welfare is given by:

$$U(\overline{p}\overline{x}) + 0.5U''(\overline{p}\overline{x})\ \overline{x}^2(\sigma_p^2 + \sigma_\theta^2\ \overline{p}^2) - \sigma_{p\theta}\overline{x}U'(\overline{p}\overline{x})(R - 1) - w\ell \qquad (3)$$

where: $U(px)$ = utility of random income $(U' > 0,\ U'' \leq 0)$

x = $\theta f(\ell)$ = uncertain actual output

$\overline{x}$ = $f(\ell)$ = planned output $(f'(\ell) > 0,\ f''(\ell) < 0)$

σ_θ^2 = variance of θ

$\sigma_{p\theta}$ = covariance of p, θ

R = $-U''(\overline{p}\overline{x}) \cdot \overline{p}\overline{x}/U'(\overline{p}\overline{x})$ = the producer's coefficient of of relative risk aversion (evaluated at $\overline{p}$, $\overline{x}$).

w = (constant) marginal disutility of labour.

ℓ = labour input.

The utility function is assumed to be represented by the constant relative risk aversion function:

$$U(px) = (px)^{1-R}/(1 - R)$$

Estimates of the variability of output and its covariance with price are calculated using data from Eurostat's Animal Production and Crop Production while the correlation coefficient of price with output (ρ)

is provided by the definition:

$$\rho = Cov(p,x)/\sigma_p\sigma_x$$

It is assumed that the correlation coefficient of price with output is unchanged by the policy. Summary data are presented in Table 2.

TABLE 2

Summary Data of Variability of Output and Covariability with Price

	CV_x	ρ
Wheat[a]	6.54	-0.12
Adult Cattle[b]	9.78	-0.42
Milk[c]	13.69	-0.74

Notes: [a]Planned output level is normalised to unity. Yield variation is based on annual estimates for common wheat contained in Eurostat's Crop Production.

[b]Planned output level is normalised to unity. Output variation is based on monthly estimates of adult cattle slaughterings contained in Eurostat's Animal Production.

[c]Planned output level is normalised to unity. Output variation is based on monthly estimates of milk collected contained in Eurostat's Animal Production.

Also outlined in Fraser (1988) is a model for determining the optimal output decision associated with welfare given by (3):

$$U'(\bar{p}\bar{x})[\bar{p} + 0.5(\sigma_p^2/\bar{p} + \sigma_\theta^2\bar{p})[R(R-1) - \bar{p}\bar{x}R'] + \sigma_{p\theta}[(R-1)^2 - \bar{p}\bar{x}R']]\ f'(\ell) = w \ . \qquad (4)$$

By assuming $f(\ell)$ is given by:

$$\bar{x} = \ell^{0.5}$$

optimal output decisions based on <u>ex ante</u> and <u>ex post</u> price distributions can be determined.[1/]

Combining the estimates in Tables 1 and 2 and the models of welfare and output in equations (3) and (4) allows calculation of the welfare impacts of and supply responses to the price support policy. These results are presented in Table 3 for a range of attitudes to risk.

TABLE 3

Estimates of Welfare Impacts of and Supply Responses to Price Support

		R			
		0	0.3	0.6	0.9
Wheat:	%w.t.p.[a]	11.12	11.38	11.63	11.88
	% Δ output[b]	12.51	6.72	3.14	0.67
Adult Cattle:	% w.t.p.	34.72	35.65	36.56	37.44
	% Δ output	53.17	26.79	12.05	2.50
Milk:	% w.t.p.	35.66	36.08	36.50	36.90
	% Δ output	55.41	27.23	12.00	2.45

<u>Notes</u>: [a]Percentage willingness-to-pay (% w.t.p.) is calculated as the amount of expected income which would compensate a producer for the removal of the price support.

[b]Percentage change in output (% Δ output) is calculated as the change in output which would follow the removal of the price support.

It is interesting to note that in each case the % w.t.p. increases with risk aversion reflecting the fact that price support not only increases the level of expected income (in each case by the amount given by $R = 0$) but also reduces the variability of income, so that risk averse producers are willing to pay more for the policy. However, note that with risk aversion also comes an increasing unwillingness to change output levels in response to the policy. As Table 3 shows, with each increase in risk aversion there is a dramatic decrease in the magnitude of the supply response. The aggregate supply response will in turn depend on the distribution of attitudes to risk among producers. Finally, there is a noticeable distinction between adult cattle and milk in terms of the risk benefits. For adult cattle, Table 1 shows that price is ex ante more variable than for milk, so that even though risk neutral producers are willing to pay more for milk price support, risk averse producers $(R > 0.6)$ are willing to pay more for meat price support at the same ratio of $\hat{p}/\bar{p}$ of 1.5.

The magnitude of these results is, however, particularly sensitive to the ratio of $\hat{p}/\bar{p}$ used in the calculations, as shown in Table 4. A comparison of the results in Tables 3 and 4 shows that a 10% change in the ratio of $\hat{p}/\bar{p}$ can bring about a 50% change in the estimated welfare effects and supply responses, suggesting that the magnitudes are probably unreliable for policy purposes.

TABLE 4

Sensitivity of Results to $\hat{p}/\bar{p}$ Value

	$\hat{p}/\bar{p}$		R: 0	0.3	0.6	0.9
Wheat:	1.2	% w.t.p.	18.20	18.70	19.20	19.69
		% Δ output	22.25	11.81	5.48	1.16
	1.0	% w.t.p.	3.47	3.54	3.60	3.67
		% Δ output	3.59	1.96	0.92	0.20
Adult Cattle:	1.3	% w.t.p.	24.46	34.19	25.38	25.82
		% Δ output	32.38	16.69	7.59	1.59
	1.7	% w.t.p.	42.60	44.07	45.50	46.83
		% Δ output	74.21	36.75	16.39	3.38
Milk:	1.3	% w.t.p.	25.06	25.17	25.27	25.37
		% Δ output	33.44	16.88	7.54	1.55
	1.7	% w.t.p.	43.77	44.60	45.40	46.15
		% Δ output	77.86	37.41	16.31	3.30

3. PRODUCER IMPACTS OF CHANGES IN POLICY AND WORLD MARKET CONDITIONS

In this Section three changes in a producer's production environment are considered:

(a) A change in the level of intervention price;

(b) A change in the expected level of world prices;

(c) A change in the variability of world prices.

In the first case the focus of the analysis will be on the extent to which a change in the intervention price brings about both a change in expected producer prices and, consequently, a supply response. In the latter two cases the focus of the analysis will be on the extent to which world price signals to producers are modified by the presence of the price support policy.

3.1 A Change in Intervention Price

Table 5 shows the impact of an increase and a decrease of 10% in the level of intervention prices on producer prices for each product.

TABLE 5

Impact on Producer Prices of a 10% Change in Intervention Prices

Intervention Price		$E(p_u)$ (%)	$Var(p_u)$ (%)	$\lvert Cov(p_u,x) \rvert$ (%)
Wheat:	+ 10%	+8.19	-76.71	-51.74
	- 10%	-5.99	+174.71	+65.75
Adult Cattle:	+ 10%	+9.42	-68.21	-43.61
	- 10%	-8.79	+160.48	+61.39
Milk:	+ 10%	+9.58	-71.74	-46.86
	- 10%	-9.02	+200.37	+73.67

The first point to note about these results is that a change in the intervention price affects both the expected level and the variability of producer prices. The second point to note is that the magnitude of the impact depends on whether an increase or a decrease in intervention prices is being considered. The explanation for this asymmetry in relation to expected producer prices is that the mass of probability weight associated with an increase in intervention prices is larger than that associated with a decrease - in the latter case some probability weight remains in the region previously supported. While in relation to the variability of producer prices, the explanation is based on the shape of the probability distribution in the region of the support price. The third point to note is that, in the case of expected producer prices the impact is stronger the higher is the initial level of support (e.g. wheat and adult cattle) and the lower is the initial variability of producer prices (e.g. adult cattle and milk), while in the case of the variability of producer prices and the covariability with output no such relationship can be observed.[2/]

Turning to the impact of these changes on producer welfare and the consequent supply response, consider the results presented in Table 6. In the case of risk neutral producers, it can be seen that the willingness-to-pay is in each case slightly larger than the change in expected producer prices. This is because expected income is also affected by the change in the variability of producer prices through the negative covariance between price and output. Consequently, when intervention prices are increased, the associated reduction in the variability of prices also reduces the magnitude of the covariance and therefore increases expected income further. For risk averse producers, it can be seen that willingness-to-pay is larger again in the case of wheat and adult cattle, reflecting the added direct welfare effect of the change in the variability of prices. However, in the case of milk, intervention is so distorting to the distribution of producer prices that the variability of prices is less important than the covariation of prices with output in determining the variability of income. (Note the relatively large variability of output in the case of milk in Table 2.)

TABLE 6

Welfare Impacts and Supply Response to Changes in Intervention Prices

			R = 0	R = 0.3	R = 0.6	R = 0.9
Wheat:	+ 10%	% w.t.p.	+8.21	+8.24	+8.26	+8.29
		% s.r.	+9.24	+4.65	+2.07	+0.42
	− 10%	% w.t.p.	−6.02	−6.08	−6.15	−6.22
		% s.r.	−6.77	−3.55	−1.62	−0.34
Adult Cattle:	+ 10%	% w.t.p.	+9.50	+9.50	+9.50	+9.51
		% s.r.	+14.55	+6.34	+2.57	+0.49
	− 10%	% w.t.p.	−8.90	−8.93	−8.95	−8.98
		% s.r.	−13.63	−6.21	−2.59	−0.50
Milk:	+ 10%	% w.r.p.	+9.74	+9.71	+9.68	+9.65
		% s.r.	+15.14	+6.51	+2.61	+0.50
	− 10%	% w.t.p.	−9.26	−9.22	−9.18	−9.14
		% s.r.	−14.39	−6.46	−2.66	−0.52

Consequently an increase in intervention prices which in turn decreases the variability of prices itself decreases the magnitude of the negative covariance of price with output. Since this covariance is providing a stabilising effect on income, overall variability of income increases and risk averse producers are worse off.

In relation to supply responses, it is interesting to note that even though the willingness-to-pay increases with risk aversion for wheat and adult cattle, the supply response decreases at a rapid rate, while in the case of milk the rate of decrease in supply response far exceeds that of willingness-to-pay. In addition, the results for adult cattle the milk suggest an asymmetry in supply response, with supply more responsive in a downwards direction. This suggestion is confirmed by Table 7 which contains the approximate elasticities of supply (with respect to $E(p_u)$ implied by the results in Tables 5 and 6. Note that this asymmetrical elasticity in the case of risk neutral producers can be explained by the asymmetry of the covariance effect, while in the

TABLE 7

Estimated Elasticities of Supply

		R			
		0	0.3	0.6	0.9
Wheat:	+ $E(p_u)$	1.13	0.57	0.25	0.05
	- $E(p_u)$	1.13	0.59	0.27	0.06
Adult Cattle:	+ $E(p_u)$	1.54	0.67	0.27	0.05
	- $E(p_u)$	1.55	0.71	0.29	0.06
Milk:	+ $E(p_u)$	1.58	0.68	0.27	0.05
	- $E(p_u)$	1.60	0.70	0.29	0.06

case of risk averse producers can be explained both by the asymmetry of the variance and covariance effects and by diminishing marginal utility.

These results suggest that all producers are willing to pay at least 6% of expected income for an increase of 10% in intervention prices (or to avoid a decrease of 10%), with the willingness-to-pay tending towards 10% of expected income where prices are already supported at a higher level. However, supply response to such a change may exceed or be less than 10% depending on the distribution of attitudes to risk among producers. For example, supply response may be up to 15% if all producers are risk neutral and prices highly supported, but as little as 0.5% if producers are very risk averse. Finally, supply is typically less responsive to an increase in intervention prices than to a decrease.

3.2 A Change in the Expected Level of World Prices

Table 8 shows the impact of an increase and a decrease of 10% in expected world prices on producer prices for each product.

TABLE 8

Impact on Producer Prices of a 10% Change in Expected World Prices

Expected World Price		$E(p_u)$ (%)	$Var(p_u)$ (%)	$\lvert Cov(p_u,x) \rvert$ (%)
Wheat:	+ 10%	+3.34	+155.16	+59.72
	- 10%	-1.52	-72.93	-47.98
Adult Cattle:	+ 10%	+0.66	+92.25	+38.65
	- 10%	-0.38	-52.30	-30.93
Milk:	+ 10%	+0.53	+111.72	+45.50
	- 10%	-0.29	-55.80	-33.52

A comparison of Tables 5 and 8 shows that the basic difference between a change in intervention prices and a change in expected world prices is that the former reduces the variation of prices and their covariance with output while the latter increases them (in both cases the expected producer price moves in the same direction as the parameter change and with asymmetrical magnitude). This suggests that risk averse producers will have a stronger preference for an increase in intervention prices than risk neutral producers in situations where the variance effect dominates the covariance effect (and vice versa).

However even for risk neutral producers there is a clear distinction between the developments in terms of the magnitude of their impact on expected producer prices. In particular a much smaller proportion of the world price signal is transmitted to producers than is the case for the intervention price signal. Moreover, the distortion to the world price signal is greater the higher the initial level of price support (e.g. wheat and adult cattle) and the smaller the initial level of producer price variability (e.g. adult cattle and milk).

Nevertheless, the results of Table 9 show that even these heavily distorted expected price effects are sufficient to dominate the various and covariance effects, with all producers better off following a world price increase and worse off for a decrease. Table 9 shows also the conflict between the variance and covariance effects for risk averse producers, with the variance effect dominating in the case of wheat, the two effects more or less in balance for adult cattle and the covariance

TABLE 9

Willingness-to-Pay for a Change in Expected World Price

		R			
Expected World Price		0	0.3	0.6	0.9
		(%)	(%)	(%)	(%)
Wheat:	+ 10%	+3.32	+3.27	+3.21	+3.16
	- 10%	-1.50	-1.48	-1.45	-1.43
Adult Cattle:	+ 10%	+0.60	+0.60	+0.60	+0.60
	- 10%	-0.34	-0.34	-0.34	-0.35
Milk:	+ 10%	+0.40	+0.43	+0.45	+0.48
	- 10%	-0.19	-0.21	-0.23	-0.26

effect dominating for milk, so that risk averse producers are willing-to-pay more than a risk neutral producer for an increase in expected world prices. In addition, a comparison of Tables 6 and 9 confirms that risk averse producers will have a stronger preference for an increase in intervention price over an increase in expected world prices than a risk neutral producer in the case of wheat, but weaker preference in the case of milk. For example, in the case of wheat, a risk averse producer with $R = 0.9$ would be willing-to-pay 0.24% of expected income more than a risk neutral producer for an increase in intervention prices over an increase in expected world prices, whereas in the case of milk a producer of the same risk aversion would be willing-to-pay 0.17% of expected income less than a risk neutral producer.

Finally, Table 10 shows the extent to which the price support policy has modified the supply response of producers to a change in expected world prices by converting the supply elasticities contained in Table 7 to supply elasticities with respect to world prices.

TABLE 10

Supply Elasticities with Respect to Expected World Prices

		R = 0	0.3	0.6	0.9
Wheat:	$+\bar{p}$	0.38	0.19	0.08	0.02
	$-\bar{p}$	0.17	0.09	0.04	0.01
Adult Cattle:	$+\bar{p}$	0.10	0.04	0.02	0.00
	$-\bar{p}$	0.06	0.03	0.01	0.00
Milk:	$+\bar{p}$	0.08	0.04	0.01	0.00
	$-\bar{p}$	0.05	0.02	0.01	0.00

In this table all producers exhibit inelastic supply responses to changes in expected world prices, with this elasticity barely above zero for risk averse producers in the more highly supported industries. Such elasticities clearly paint a bleak picture of the responsiveness of European agriculture to price signals from the world market.

3.3 A Change in the Variability of World Prices

It is a well-known result in the theory of the firm under uncertainty that, if price is the only uncertain parameter, an increase in the level of its uncertainty will have no effect on the behaviour of a risk neutral producer, but will leave a risk averse producer worse off. The situation is somewhat more complicated if more than one parameter is uncertain. In particular, if output is also uncertain and correlated with price then even a risk neutral producer will be affected by an increase in price uncertainty. This is because expected income in this situation depends not just on the expected levels of price and output, but also on the magnitude of their covariance:

$$E(px) = \bar{p}.\bar{x} + Cov(p,x)$$

If, as is the case in the products considered here, there is a negative correlation between price and output, then an increase in the uncertainty of price will also increase the magnitude of the negative covariance and so reduce expected income. For risk averse producers the situation is also more complicated because the negative covariance acts as a stabiliser to the variability of income in that higher prices tend to coincide with lower outputs and vice versa. Consequently an increase in its magnitude, ceteris paribus, could have a favourable impact on a risk averse producer (see equation (3)). If, however, this increase is an indirect effect of an increase in price uncertainty, then the unfavourable variance effect can be expected to dominate the favourable covariance effect so that, overall, risk averse producers would still be worse off following an increase in price uncertainty, even though this price has a negative covariance with output.

All these results need, however, to be reassessed in the presence of a price support scheme. In particular, it is shown in Fraser (1988) that where there is a price support policy an increase in underlying (i.e. world) price uncertainty leads not only to an increase in the variance of supported price and in the magnitude of its negative covariance with output, but also an increase in the expected level of the supported price by virtue of the policy-induced asymmetrical impact the increase in uncertainty has on this parameter. Consequently, if this latter effect dominates, an increase in world price uncertainty can have a favourable impact on both risk neutral and risk averse producers - a result which is completely the reverse of that which applies in the absence of the policy.

The results in Table 11 show the impact of a change of 10% in world price uncertainty on producer prices for the three industries considered here.

TABLE 11

Impact of 10% Change in World Price Uncertainty on Producer Prices

World Price Variability		$E(p_u)$	$Var(p_u)$	$\mid Cov(p_u,x) \mid$
		(%)	(%)	(%)
Wheat:	+ 10%	+0.22	+15.84	+7.64
	- 10%	-0.23	-15.26	-7.95
Adult Cattle:	+ 10%	+0.17	+28.16	+13.21
	- 10%	-0.16	-26.13	-14.06
Milk:	+ 10%	+0.13	+31.79	+14.80
	- 10%	-0.12	-27.19	-14.67

Table 11 shows not only all the expected qualitative impacts of the increased world price uncertainty but also some interesting patterns in the magnitude of these impacts. In particular, for the more highly supported industries the magnitude of the impact is smaller on expected producer prices but larger on the variance of producer prices and its covariance with output. As was shown in the case of an increase in expected world prices, expected producer prices are more highly insulated from world price developments the more highly supported is the industry. By contrast, the variance of producer prices (and their covariance with output) appears to be more sensitive to changes in world price uncertainty in the more highly supported industries.

Table 12 shows the overall results of these changes in terms of producers' willingness-to-pay.

TABLE 12

Willingness-to-Pay for a Change in World Price Uncertainty (percentage)

World Price Uncertainty		R: 0	0.3	0.6	0.9
Wheat:	+ 10%	+0.22	+0.21	+0.21	+0.20
	- 10%	-0.22	-0.22	-0.21	-0.21
Adult Cattle:	+ 10%	+0.15	+0.15	+0.15	+0.15
	- 10%	-0.14	-0.14	-0.14	-0.14
Milk: + 10%	+ 10%	+0.09	+0.09	+0.10	+0.11
	- 10%	-0.08	-0.09	-0.10	-0.11

It was shown in Fraser (1988) that only in situations where the level of price support is relatively low will the variance and covariance effects dominate the expected price effect so that producers are made worse off by an increase in world price uncertainty, as is the case in the absence of price support. In each industry considered here the level of price support is relatively high and therefore it is not surprising that the results in Table 12 show all producers being better off for an increase in uncertainty and worse off for a decrease in uncertainty. Nevertheless, these results do, once again, confirm the distorting influence a price support policy can have on the price signals received by producers from the world market. In particular, in the three industries considered here, both risk neutral and risk averse European producers would respond to an increase in world price uncertainty by increasing planned production, whereas in other countries where price support is lower, all producers would respond to this signal by decreasing planned production.

The results in Table 12 also show a contrast between the three industries in terms of the impact of a change in price uncertainty on risk averse producers. In particular, for wheat producers, the effect of increased price uncertainty on the variability of income dominates the covariance effect so that, on balance, risk averse producers are willing-to-pay less than risk neutral producers. Therefore, in this case, at least, the price support policy does not so distort the determinants of income variability that risk averse producers perceive income variability to be reduced by increased price uncertainty. This situation does not apply, however, in the other industries. For example, in the case of milk, residual (i.e. after price support) producer price uncertainty is a less significant determinant of income variability than the negative covariance of producer price with output so that, as a consequence, risk averse producers find the variability of their income reduced overall by an increase in price uncertainty, and are therefore made even better off than risk neutral producers by such an increase. This situation is clearly in marked contrast to that which occurs in the absence of a price support policy, where risk averse producers will typically be made worse off than risk neutral producers by an increase in price uncertainty.

CONCLUSION

In this paper a new approach to assessing the impact of price support policies on producer behaviour has been presented. This approach not only takes explicit account of the impact of such policies or a producer's uncertain production environment but also includes a numerical procedure for calculating <u>ex ante</u> (in the absence of the policy) price variability from <u>ex post</u> (in the presence of the policy) producer price data. In the paper the European agricultural industries of common wheat, adult cattle and milk are used as examples for applying the methodology.

In general, the results of the analysis show that price support policies can severely distort the signals producers receive from world markets. More specifically, in the case of a decrease in expected world prices, the signal that producers actually receive can be so heavily diminished that their supply response is effectively non-existent. In addition, in the case of an increase in the variability of world prices, the signal that producers in countries with highly supported prices receive leads them to increase supply, while producers in other countries respond in the usual manner and decrease supply.

It has therefore been shown that the problem of price support policies is not just the artificial stimulus to production they induce but also the extent to which they distort the impact of market signals on producer behaviour.

FOOTNOTES

1/ Note that this output function has a deterministic supply elasticity of unity.

2/ In a study of wheat Meilke and de Gorter (1988) found using an econometric model that a 1% increase in intervention prices resulted in an increase of between 0.8 and 1% in producer prices.

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