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The real rate of protection: the income and insurance effects of agricultural policy

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Agricultural price policies in developed countries aim at protecting farmers against both low and volatile world market prices. However, traditional indicators of protection only refer to the income (level) effect of policy. Following other research, it is argued that public policy can also yield an insurance (stabilizing) effect. In this paper a way to measure these dual effects is proposed. The method is illustrated with wheat market data for the USA and the European Union. Strong evidence is found that the insurance effect is an important component of protection, albeit a small one relative to the income effect. Policy support provided higher income and lower insurance effects in the EU than in the USA. For both markets, policy reforms in the 1990s led to significantly reduced income effects and smaller insurance effects. Without accounting for the influence of policy on income variability, traditional measures of protection will understate the real rate of protection.

I. INTRODUCTION

Countries protect their agricultural sectors for many different reasons and in many different ways. Protectionist policies are often entrenched in long histories of political and economic compromise. As a result they are often multifaceted and complex. However, two basic types of policy support to agriculture are generally used: market price supports and budgetary payments. Market price supports often take the form of price interventions (including export subsidies and import tariffs) and payments based on market prices and output (deficiency payments). On the other hand, budgetary payments take the form of direct payments to producers based on area planted, historical entitlements and the like. Because budgetary payments are generally not directly tied to production decisions, they are often considered to be decoupled. While all these measures are generally thought of as supporting producer incomes, in a world of uncertainty additional risk (insurance) benefits may result.

Hennessy (1998) examined the wealth (income) and insurance (risk) effects of policy on optimal production decisions. He argued that studies of trade policy reform in stochastic environments should consider both insurance and income effects. In this paper, these two components are examined, however, within a different context: the measurement of the degree of policy-induced protection. A method to evaluate both the income and insurance components of protection is proposed. The impact of major policy reform on the income and insurance effects is assessed. Among other things, insight is offered into the influence of coupled and decoupled policies on the two components of protection.

Traditional indicators of protection rates only refer to the income (level) effect of policy. For instance, the nominal protection rate simply indicates the percentage by which the domestic price exceeds the border price, the effective protection rate incorporates a value-added dimension while the producer support estimate (PSE) is yet a more

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comprehensive measure in that it attempts to account for all domestic policy transfers to producers. It is argued that these measures by themselves are incomplete since they ignore the income stabilizing or insurance effect.[1]

In fact, agricultural price policies in developed countries aim at protecting farmers against both low and volatile world market prices. It is argued that this kind of 'double protection' can only be computed on the basis of an expected utility approach, measuring the percentage increase in the expected utility of either income or of the certainty equivalent of income, respectively (Schmitz, 1997). Following Newbery and Stiglitz (1981), a mean-coefficient of variation approximation with log-normally distributed incomes is used to derive an expression that is termed the real rate of protection (*RRP*). The proposed measure is illustrated with wheat market data from the USA and European Union. While it is not the intention to provide explicit measures of the effects of actual policy instruments, it is illustrated how the incorporation of insurance effects might affect standard measures. Thus, the analysis is based upon a number of assumptions regarding the nature of preferences, the relevant market prices and risk measures, and other parameters inherent in the analysis.

II. METHODOLOGY

An expected utility approach that incorporates the first and second moments of the probability distribution of income is applied. Assuming a log-normal distribution of real income and constant relative risk aversion utility, the mean-coefficient of variation formula of the expected utility of income is[2]

1 $$E[U(y)] = E[y]\left[1 + cv_y^2\right]^{-0.5R} \tag{1}$$

where, U = utility, y = income, cv_y = coefficient of variation of income and, R = coefficient of relative risk aversion.

Defining the real rate of protection as the percentage change in the expected utility of income with protection ($\hat{y}_i$) *vis-a-vis* without protection ($\hat{y}_0$), the real rate of protection (RRP) can be derived:[3]

$$RRP_i = (1 + ERP_i)\left[\frac{(1 + cv_{y_0}^2)^{0.5R}}{(1 + cv_{y_i}^2)^{0.5R}}\right] - 1 \tag{2}$$

where ERP_i = effective rate of protection (per cent change in income) and cv_{yi} = coefficient of variation of income: $i = 0$ without protection, $i = 1$ with only price and output protection, and $i = 2$ with all protection.

In the international trade literature, the effective protection coefficient (*EPC*) is conventionally defined as the ratio of actual value added by domestic resources to the value added in a market free of distortions. The effective protection rate follows simply as $100(EPC - 1)$. A similar value added measure of income (*ERP*) is used, defined as $(Y_i - Y_0)/Y_0$, $i = 1, 2$, where income is defined as revenue less variable cost and the subscript i refers to different degrees of policy protection.

In the assessment of how policy impacts the coefficient of variation of income, two scenarios are considered, each differing by the assumptions made about the probability distribution of price and quantity. First, it is assumed that the coefficient of variation of income is determined by the single random variable price and its variance is constant over the sample period. Given adaptive expectations and market rigidities this scenario posits quantity produced to be predetermined.

In the second scenario, the assumption of constant price variance is relaxed and time varying variances computed using implied volatilities. Annual implied volatilities, calculated from wheat futures prices on the Chicago Board of Trade (CBOT), are used to assess the variability of wheat prices. These volatilities allow relaxation of the assumption that price variance is constant over time. Indeed, an examination of the implied volatilities demonstrates the fact that market price volatilities vary considerably from year to year, depending on market conditions. The implied volatilities are the implied volatilities taken from the Bridge database. In particular, these prices were calculated using September prices for the following July Chicago Board of Trade futures contracts. Using the log-normality assumption, a simulated series of log-normal prices were derived for each market. It is assumed that annual border prices represent the mean price and that the volatility faced at the border in each market is the same as that implied by the CBOT options market. Thus, a series of log-normally distributed simulated prices are generated (1000 replications are used) that display the variances implied by the CBOT price volatility.

It is further assumed that domestic policies truncate this distribution, such that expected prices and price variability are altered according to the truncated distribution. In particular, the truncation point is given by the domestic support price, which serves to establish a minimum expected price. This truncated distribution is used to calculate the coefficient of variation of incomes under the domestic policies. This computed coefficient of variation reflects the fact

[1]Any measure of policy effects is likely to suffer shortcomings and the validity of any given measure depends upon exactly what aspect of support the instrument intends to represent. Measures of market distortions may imply a quite different picture of support when compared to measures of producer income effects, such as the one considered here.

[2]If it is alternatively assumed that real income is normally distributed and constant absolute risk aversion utility, the simple mean-variance formula of expected utility of income is: $E[U(y)] = E(y) - 1/2\ A\ \mathrm{var}(y)$ where y = income and, A = coefficient of absolute risk aversion.

[3]Equation 2 is derived in the Appendix.

that stochastic prices are stabilized by policies undertaken to protect domestic markets from international effects.

The second scenario also accounts for stochastic quantities. Specifically, crop yields are assumed to be log-normally distributed with simple price-yield correlations simulated over reasonable negative values.[4] The method of Johnson and Tenebein (1981) is then used to draw correlated random yields and prices from which is generated a series of log-normally distributed yields. The assumptions of this scenario allow for the explicit examination of policy regime change. This is accomplished through subperiod analysis.

III. EMPIRICAL ILLUSTRATIONS – THE CASE OF US AND EUROPEAN WHEAT

The data

Annual data for 1986–2000 were used to implement the theoretical model. Wheat market data for the USA and EU provide the empirical illustrations. Producer prices, border prices, quantities produced and budgetary payments were obtained from the Organization for Economic Cooperation and Development (OECD various issues). Annual data on variable production costs per hectare for wheat over this same period were obtained from the US Department of Agriculture and Eurostat (2001). All data were available for the EU-15, treated as a single entity, however input costs are available only for individual countries. Since wheat production costs can vary widely across the EU, it was chosen to proxy the EU with variable cost data for France. By volume, France is the largest wheat producer in the EU. Incomes are defined in per hectare terms. All data are available from the authors upon request.

Policy environment

Over the last two decades in the European Union, the 1992 MacSharry reform and the Agenda 2000 have been the major policy reforms to the EU's Common Agricultural Policy. The Agenda 2000 continues and deepens the MacSharry reforms. The two basic policy instruments used for cereals are: market price support (MPS) which includes the use of administered prices, export subsidies, and import tariffs and; area payments which are direct payments based on current acreage of the 'grand cultures' (cereal, oilseeds, protein plants) conditional subject to land set-aside requirements. MPSs are considered to be 'coupled' in the sense that they are directly production and trade distorting, while direct payments are widely accepted as less distorting and more targeted to the income objects. The transition from MPS to direct payments under MacSharry was announced as an effort to decouple payments to producers, although this is not quite true since the payments are still coupled to the factors of production. Since 1992 direct (compensatory) payments have been made to partially compensate for the market distorting MPSs. Indeed, a reduction in MPSs has continued following Agenda 2000 but area payments have increased. Important differences in the price and producer welfare effects of policy have been found between the pre- and post-MacSharry regimes (Thompson *et al.*, 2000; Thompson *et al.*, 2002a; Thompson *et al.*, 2002b). The *ex post* analysis does not include the period of Agenda 2000.

The USA has also moved to decouple supports with direct income transfers instead of interventions that place prices above market clearing levels. The 1996 FAIR Act phased out the deficiency payments and acreage set-asides of the 1990 farm bill in favour of fixed decoupled payments, termed production flexibility contracts payments (PFCs). PFC payments are historically based and widely considered to be decoupled. Since 1996, however, additional producer support programmes have been added. For example, in 1999 PFC payments were supplemented with a sizeable 'market loss assistance' programme and in 2001, with a costly crop insurance premium subsidy. While 1996 reforms were a major step toward a more market oriented agriculture, *ad hoc* additions have hampered liberalization progress. Provisions of the 2002 Farm Bill became effective after the sample period used for the empirical illustrations. Like the EU, two major policy regime periods for the USA are identified as pre- and post-FAIR.

IV. MODEL IMPLEMENTATION

To empirically illustrate the analytical framework, farmer income estimates are derived both *with* and *without* policy, the latter measure being the situation that would have occurred if there were no policy distortions. The former estimate considers two policy scenarios: *producer incentive supports* (actual market price and output payments) and *total support* (support including the addition of direct payments). Thus, three measures of producer incomes are computed:

without support:

$$Y_0 = \left[P_b \cdot Q(P_p)\right] - VC \tag{3}$$

[4]The exact value used for the Spearman correlation coefficient is –0.4. This value was used for corn prices by Hennessy *et al.* (1997). They based their calculation on test plot data for Iowa corn markets. Of course, this value may vary from year to year and certainly may be different across alternative crops, including wheat. This coefficient was found to be a reasonable estimate as our simulations were relatively insensitive to alternative values.

with producer incentive support:

$$Y_1 = \left[P_p \cdot Q(P_p) + P_0\right] - VC \quad (4)$$

with total support:

$$Y_2 = \left[P_p \cdot Q(P_p) + B_P\right] - VC$$

where, P_b is the border price, P_p is the producer price, Q is the quantity produced, P_0 is output (deficiency) payments, B_P is total budgetary payments (including P_0) and, VC is variable cost of production. All quantities and payments are on a per hectare basis. Using these definitions, Y_0 is the income that would have occured in a well-functioning market free of policy distortions; Y_1 is the income resulting from incentive (actual market price and output) supports and, Y_2 is the income with incentive supports plus all other budgetary payments to producers. Producer incentive supports are considered to be coupled to production (thus influencing production and trade) while the additional budgetary payments (area payments and payments based on historical entitlements) are considered effectively decoupled.

Descriptive statistics for price and incomes are shown in Table 1. For the USA, producer *incentive supports* (market price and output payments) increased the mean price by 15% and lowered its variablity by nearly 30%, relative to what would have occurred without support. Incentive supports shifted the price distribution to the right and narrowed it significantly in dispersion. As measured by the coefficient of variation (CV), the reduction in price volatility was more than one-third. For the EU, producers' *incentive supports* increased the mean price by more than 40% while the CV fell to less than half of the without support scenario.

More pronounced relationships hold for producer income. For the USA, producer *incentive supports* reduced the CV of income by more than 50% with little further reduction achieved when all support is included. For the EU, producer incentives reduced the CV of income by 38% *percent*. However, the addition of other budgetary support reduced the CV by another 52% *percent*. When all support is included, the CV of income fell by 55% and 70% for the USA and EU, respectively. Clearly, policy interventions in both markets increased the mean and lowered the variablility of producer incomes. The reduction in price and income variability (risk) due to policy is an insurance effect. Policy had a greater insurance effect on producer income than it did on prices.

Empirical income and insurance effects

The *income* effect of policy is described by the effective rate of protection (ERP). ERP_1 and ERP_2 are respectively, the percentage change in mean incomes Y_1 and Y_2, relative to Y_0. For the USA and EU these are shown in Tables 2 and 3.

Table 1. *Wheat price and producer income variation, USA and EU, 1986–2000*

	USA ($)			EU (€)		
	Mean	Std.dev.	CV^a	Mean	Std.dev.	CV
Price						
Without support (P_B)	106.4	28.3	0.27	108.2	21.0	0.19
With incentive support ($P_p + P_0$)	122.9	20.6	0.17	154.2	13.9	0.09
Income						
Without support (Y_0)	85.0	40.0	0.47	371.7	139.0	0.37
With incentive support (Y_1)	116.7	25.6	0.22	657.9	151.1	0.23
With all support (Y_2)	212.0	45.1	0.21	974.8	104.0	0.11

Note: [a]*cv* is the coefficient of variation.

Table 2. *Estimated rates of protection, effective (ERP) and real (RRP), and insurance effects (IE) with constant price variance, USA, 1986–2000*

Effective rate of protection (ERP)			
ERP_1	0.37		
ERP_2	1.50		
Real rate of protection (RRP)	Coefficient of relative risk aversion (R)		
	1.0	2.0	3.0
RRP_1	0.48	0.60	0.73
IE_1 (%)	8	17	26
RRP_2	1.70	1.92	2.15
IE_2 (%)	8	17	26

Table 3. *Estimated rates of protection, effective (ERP) and real (RRP), and insurance effects (IE) with constant price variance, European Union (15), 1986–2000*

Effective rate of protection (*ERP*)			
ERP_1	0.77		
ERP_2	1.62		
Real rate of protection (*RRP*)			
	Coefficient of relative risk aversion (*R*)		
	1.0	2.0	3.0
RRP_1	0.84	0.92	0.99
IE_1 (%)	4	8	12
RRP_2	1.78	1.96	2.14
IE_2 (%)	6	13	20

Recall, the *ERP*s show the percentage change in producer income per hectare due to policy intervention.

For the USA, the value 0.37 (ERP_1) implies that, on average, incomes were 37% greater with producer incentive supports than without protection. Similarly, the value 1.50 (ERP_2) implies that incomes were 150% greater with all supports than with no policy interventions. Clearly, over this 15-year period, US wheat farmer incomes benefitted greatly from farm policy interventions.

For the EU, incomes were 77% and 162% greater due to producer incentive supports and to all support, respectively, than would have obtained without the CAP or other policy support structures. While the *ERP*s for both countries are of the same magnitude for the all support situation, the more market distorting producer incentive component (ERP_1) plays a much larger role for the EU than it does for the USA. These results would suggest that, over the 1986–2000 period, EU policy instruments were relatively more market distorting than those used by the USA.

The *insurance* effect enables the real rate of protection (*RRP*) to be defined. It is a measure of the benefit accruing to risk averse producers due to stabilized incomes. The insurance effect is accounted for by the term in brackets in Equation 2, which is composed of two determinants.

The first determinant is the relative variablility of income as measured by the *CV*s. Referring back to Table 1, it was seen that the $CV(Y_0) > CV(Y_1) > CV(Y_2)$. Thus, for a given degree of farmer risk aversion, *R*, the term contained in brackets in Equation 2 is greater than 1.0. This means that the variation of income without protection is greater than with protection. If this is the situation, both incentive supports and all budgetary payments lead to dampened income volatility. In the special case, where policy had no impact on income stability, the value of the insurance component would be 1.0. A similar result would occur for the risk neutral producer ($R = 0$).

Secondly, the size of the insurance effect is related to the extent to which the producer is averse to risk (Saha *et al.*, 1994). The greater *R*, the greater the term in brackets; hence, the greater *RRP*. The more risk averse the producer, the greater the benefit received from decreased income volatility. As farmers place a greater value on income stability, the greater the 'real' benefit they receive from policy interventions. In other words, producer utility increases as income volatility decreases. Although the traditional way of evaluating price and income support policies takes the expected value of income into consideration, it does not consider the income volatility dimension, or what is termed the insurance effect. The traditional approach is only valid if producers are risk neutral or if policy has no effect on the volatility of income.

The empirical *RRP* computations are shown in the bottom portions of Tables 2 and 3. As expected, the *RRP* is greater than the ERP and positively related to the degree of risk aversion. The insurance effect is empirically important. For both the USA and the EU, since income volatility was greater without protection than under either of the two policy interventions, the real level of wheat industry protection would be understated by traditional measures of protection.

For the USA, the RRP_1 ($R = 2.0$) is 0.60 while the ERP_1 is 0.37; the difference between 1.60 and 1.37 is the insurance effect. This is the percentage change in the utility of income due to the stabilizing effect of producer incentive support policies. In this case the stabilizing effect yields real rates of protection that are 17% greater than would occur if policy had not stabilized incomes. In other words, it is the value of the policy's risk reduction effect to risk averse producers. If the policy did not yield this insurance effect, producers would clearly not receive this added benefit. While important, the insurance effect remains small relative to the income effect. Only for very risk averse producers do the stabilizing benefits of producer incentive policies approach the magnitude of the income effect. Empirically, the insurance effect is invariant to the addition of all remaining budgetary payments.

For the EU, the insurance effect of producer incentive policies is about half as large as that for the USA. When all budgetary support is included the EU insurance effect remains relatively smaller. What stands out, is the relatively larger insurance effect associated with US producer incentive policies than those of the EU.

Policy regime analysis with stochastic yields

The impact of both price and yield variability on producer revenue, and, hence income, depends on Cov(P,Q). A large negative correlation would tend to stabilize incomes. The effect of stochastic prices and yields on the *ERP*s is as follows. Holding $E[Y_i]$ constant, if $E[Y_0]$ decreases, ERP_i will increase. On the other hand, holding $E[Y_0]$ constant, if $E[Y_i]$ decreases (increases), $\mathrm{ERP_i}$ will decrease (increase). The magnitude of these changes is an empirical question which we explore below.

Relaxation of the earlier constant price variance assumption enables a more targeted investigation of policy regime change. Regimes 1 and 2 are defined to represent major policy regime periods. For the USA, this is pre- and post-FAIR while for the EU this is pre- and post-MacSharrry. The descriptive statistics for price and incomes are disaggregated by policy regime period and reported in Table 4. For both markets, the incentive support policy changes resulting from period 2 regime reforms led to lower price levels and increased price variability.

The FAIR incentive support reforms resulted in increased incomes and reduced variability. With the addition of all other budgetary support (largely PFC payments) income levels nearly doubled with little change in variability. The MacSharry reforms showed reduced income levels with incentive support reforms. However, with the addition of all other budgetary payments (largely area or compensatory payments) incomes nearly doubled during the post-MacSharry period while income variability changed little. The computed income and insurance effects for each policy regime are discussed next.

Income effect. For the USA, large differences in the *ERP*s (income effects) are observed between the two periods (table 5). In regime 1, $ERP_1 = 0.96$ suggests that on average incomes were 96% greater due to producer incentive supports. Following FAIR reforms (regime 2), ERP_1 fell to 0.36. $ERP_2 = 2.71$ suggests that incomes were 271% greater with all policy support than they would have been without support. Although ERP_2 fell to 1.67 in the post-FAIR period, a still somewhat high degree of overall protection remained.

For the EU, large differences in the *ERP*s are also observed between the two regimes (Table 6). In regime 1, $ERP_1 = 1.88$ suggests that on average incomes were 188% greater with producer incentive supports than without. Following the MacSharry reforms ERP_1 fell to 0.45. $ERP_2 = 2.17$ suggests that incomes were 217% greater with all policy support than they would have been without support. Although, RRP_2 fell to 1.78 in the post-MacSharry period, a relative high degree of overall protection remained.

For both markets, producer income effects were substantially higher during regime1 than during the post-reform regime period. While the income effects fell dramatically

Table 4. *Wheat price and income variation by policy regime periods, USA and EU, 1986–2000*

	USA ($)		EU (€)	
	Regime 1 1986–1995	Regime 2 1996–2000	Regime 1 1986–1992	Regime 2 1993–2000
Price:				
Without support (P_B)				
Mean	102.8	113.8	101.3	114.1
Std. dev.	29.3	27.7	20.0	22.2
CV	0.29	0.24	0.20	0.19
With incentive support ($P_p + P_0$)				
Mean	123.6	121.4	180.3	131.4
Std. dev.	21.1	21.9	10.3	16.3
CV	0.17	0.18	0.06	0.12
Income:				
Without support (Y_0)				
Mean	73.4	108.2	318.6	418.2
Std. dev.	43.4	18.6	135.5	132.7
CV	0.59	0.17	0.43	0.32
With incentive support (Y_1)				
Mean	112.1	125.9	797.6	535.6
Std. dev.	30.3	8.7	28.3	91.3
CV	0.27	0.07	0.04	0.17
With all support (Y_2)				
Mean	190.2	255.7	881.3	1056.5
Std. dev.	26.1	44.8	49.0	56.5
CV	0.14	0.18	0.06	0.05

Table 5. *Effective protection rate (ERP), real protection rates (RRP) and insurance effects (IE) with stochastic production, USA, 1986–2000*

Coefficient of relative Risk aversion (R)		Regime 1: 1986–1995	Regime 2: 1996–2000
		$ERP_{11}=0.96$ $ERP_{21}=2.71$	$ERP_{12}=0.36$ $ERP_{22}=1.67$
1.0	RRP_1	1.23	0.42
	IE_1 (%)	14	4
	RRP_2	3.34	1.82
	IE_2 (%)	17	6
2.0	RRP_1	1.62	0.48
	IE_1 (%)	34	9
	RRP_2	4.22	1.98
	IE_2 (%)	41	12
3.0	RRP_1	2.17	0.55
	IE_1 (%)	62	14
	RRP_2	5.50	2.15
	IE_2 (%)	75	18

Table 6. *Effective protection rate (ERP), real protection rates (RRP) and insurance effects (IE) with stochastic production, European union (15), 1986–2000*

Coefficient of relative Risk aversion (R)		Regime 1: 1986–1992	Regime 2: 1993–2000
		$ERP_{11}=1.88$ $ERP_{21}=2.17$	$ERP_{12}=0.45$ $ERP_{22}=1.78$
1.0	RRP_1	2.04	0.50
	IE_1 (%)	5	3
	RRP_2	2.35	1.90
	IE_2 (%)	6	4
2.0	RRP_1	2.23	0.55
	IE_1 (%)	12	7
	RRP_2	2.56	2.02
	IE_2 (%)	13	9
3.0	RRP_1	2.42	0.61
	IE_1 (%)	18	11
	RRP_2	2.78	2.15
	IE_2 (%)	19	13

following the regime changes, the addition of all remaining budgetary transfer payments dampened the decline attributable only to reduced incentive payments. For both regimes, the producer incentive effect (ERP_{1i}) for the EU was about double that of the USA However, when all budgetary supports are included (ERP_{2i}) both markets maintained roughly equivalent income effects.

Insurance effect. The insurance effect is the percentage change in the real rate of protection due to the stabilizing effect of policy. For the USA ($R=2.0$), the stabilizing benefit of the pre-FAIR producer incentive policies contributed an additional (beyond the 'income effect') 34% increase in producer incomes. This is an added benefit to producers. The post-FAIR reforms lead to a substantial reduction of the insurance benefit. With all policy support included, the real rate of protection would be understated by 41% in regime 1 but only 12% in regime 2. Risk averse producers suffered real losses as a result of post-FAIR reforms.

For the EU ($R=2.0$), the stabilizing benefit of the incentive policies contributed an additional 12% increase in expected utility of producer income during regime 1. However, in the post-MacSharry period this insurance effect fell to 7%. Producers place a relatively greater value on the stabilizing characteristics of the pre- more than the post-MacSharry policies. A similar relationship is observed for all policy support.

In general, as regime 1 is moved from, which was characterized by support based mostly upon price and output, to regime 2, which was characterized by more decoupled support, the relative insurance effects fall. This accords with expectations in that policies in the latter regimes provided relatively more support through direct, decoupled payments. This does not imply that overall support was less but only that the proportion of that support delivered through policies having substantial insurance effects was smaller. Indeed, support levels could be large and the insurance effects smaller as more of the support is delivered through decoupled types of programmes. As expected, insurance effects rise as risk aversion increases in that risk-reducing programmes provided more benefits to highly risk averse producers.

Also, for both markets, as a move is made from only incentive supports to total budgetary support within regime 2, an increase in the insurance effect is observed. This is because the addition of large direct payments (e.g., market loss assistance payments in the USA) provided an added measure of insurance. Despite policy reforms, an important insurance benefit continues to be provided to farmers.

V. CONCLUSIONS

The degree to which agricultural policy protects and supports agricultural producers is important. Traditional indicators of protection refer only to the income effect. It is argueed that these measures by themselves are incomplete since they do not account for the insurance effect resulting from more stable incomes. The insurance effect is a measure of public sector insurance which is delivered through a variety of government policies.

A way to incorporate both the income and insurance effects in a comprehnsive protection measure is proposed. This indicator is termed the Real Rate of Protection. The method is empirically illustrated with data from the US and EU wheat markets for the period 1986–2000. Strong evidence is found that the insurance effect is an important component of protection, albeit a small one relative to the income effect. This result accords with the conclusions of

Hennessy (1998), who found that decoupled payments had relatively modest insurance effects. Relative to no policy interventions, the average US farmer income was found to increase 37% due to producer incentive support and 150% when all budgetary support is included. For the EU, the corresponding increases were 77% and 162%, respectively. While the income effect of total budgetary support was similar for both the USA and EU, a greater portion of total support was due to producer incentive support in the EU than in the USA.

It was found that the insurance (stabilizing) effect of producer incentive policies to be considerably greater for the USA than the EU. When all market support incentives and budgetary payments are included, both the USA and EU policies provided insurance effects roughly 10–20% greater than their income effects, with the larger insurance benefit accruing to the more risk averse farmers.

Greater insight into the effects of coupled and decoupled policies was obtained through an examination or policy regime subperiods. For the USA, this was pre- and post-FAIR Act regimes and for the EU pre- and post-MacSharry reform periods. The post-FAIR and post-MacSharry policies tended to be more decoupled than their pre-regime change counterparts. It was found that overall real rates of protection remained high following the two reforms (although smaller than during the pre-reform periods), while important insurance benefits continued to be delivered through the post-reform policies. Decoupled support policies, however, tended to deliver relatively smaller additional insurance benefits to producers than coupled price and output policies alone.

Without accounting for the influence of policy on income volatility, traditional measures of protection, which rely on income levels only, may be misleading, at least to the extent that policy benefits include a reduction in the risk faced by farmers. In the case of US and EU wheat, they will considerably underestimate the real rate of policy protection.

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APPENDIX

$$E[U(y)] = E[y][1 + cv_y^2]^{-0.5R} \tag{A1}$$

$$\hat{y} = \frac{E[y]}{(1 + cv_y^2)^{0.5R}} \tag{A2}$$

Define the real rate of protection (RRP) as the percentage change in the expected utility of income with protection ($i=1$) *vis a vis* without protection ($i=0$).

Or

$$RRP = \frac{\hat{y}_1 - \hat{y}_0}{\hat{y}_0} \tag{A3}$$

$$= \frac{E[y_1]/(1 + cv^2 y_1)^{0.5}}{E[y_0]/(1 + cv^2 y_0)^{0.5R}} - 1 \tag{A4}$$

$$= \frac{E[y_1]}{E[y_0]} \cdot \underbrace{\frac{(1 + cv^2 y_0)^{0.5R}}{(1 + cv^2 y_1)^{0.5R}}}_{K} - 1 \tag{A5}$$

Now, let

$$\frac{E[y_1] - E[y_0]}{E[y_0]} = ERP$$

or

$$\frac{E[y_1]}{E[y_0]} = (1 + ERP)$$

substituting into Equation (A5) gives,

$$RRP = (1 + EPR) \bullet K - 1 \tag{A6}$$

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