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The Real Rate of Protection: The Stabilizing Effect of Price Policies and Direct Payments

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Abstract:

Traditional indicators of protection refer to the level effect of price policies on income and ignore the stabilizing effect. We derive a measure of the real rate of protection which incorporates these dual dimensions. The income stabilizing effects of price policy protection lead to a greater level of real protection than would be measured conventionally. Without compensatory payments real protection rates for the European Union wheat market over the pre- and post-MacSharry reform periods would have been some 10 percent greater than traditional indicators. However, the direct payments to farmers following the 1992 reforms had a major risk reducing impact.

Keywords: Protection rates, income stabilization, EU wheat market

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I. Introduction

Despite the efforts of the WTO to reduce trade barriers, the successful elimination of all barriers remains elusive. There are many different reasons why countries protect their agricultural sectors from international competition. Protectionist policies of individual developed countries are often entrenched in long histories of political and economic compromise. The objectives are often multi-faceted and complex. In general two basic types of policy support to agriculture are used: market-price supports and government subsidies. Price policy supports often take the form of price interventions supported by trade barriers such as tariffs and quantitative restrictions (Valdez). On the other hand, subsidies take the form of government financed surplus storage or removal, indirect input subsides or direct transfer payments to producers. These policies are largely intended to support the level of producer incomes, however, unintended risk benefits may result. In this paper we propose a method to evaluate both the level and risk components of protection.

Traditional indicators of protection rates only refer to the level effect of price policies on income. 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, and PSEs attempt to account for all domestic policy transfers to produces. These measures by themselves, however, ignore the price stabilizing effect. In fact, agricultural price policies in developed countries aim at protecting farmers against *both* low world market prices and volatile world market prices. This kind of "double protection" can only be calculated on the basis of an expected utility approach, measuring the percentage increase of the expected utility of either income or of the certainty equivalent of income, respectively. Following Newbery and Stiglitz (1981), we use the mean-coefficient of variation approximation with log-normally distributed incomes to derive an expression for the real rate of protection (RRP). Algebraically, the RRP is determined by the effective protection rate, the coefficient of variation of income and, the coefficient of relative risk aversion.

II. Methodology

We apply an expected utility approach that incorporates the first (mean) and second (variance) moments of the probability distribution of real income (Schmitz). Assuming a log-normal distribution of real income, the mean-coefficient of variation formula of expected utility of income is[1];

$$(1) \qquad E[U(y)] = E[y]\,[1+cv_y^2]^{-\frac{1}{2}R},$$

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

If we define this double protection rate, or the real rate of protection, as the percentage change in the expected utility of income without protection $(\hat{y}_0)$ *vis à vis* with protection $(\hat{y}_1)$, we can derive (see Appendix A):

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[1] Perhaps more familiar, if one alternatively assumes that real income is normally distributed, the simple *mean-variance* formula of expected utility of income is: E[U (y)] = E(y) – ½ A var(y) where y = income and , A = coefficient of absolute risk aversion.

2) $$RRP = (1 + EPR)\left[\frac{(1+cv^2{}_{y_0})^{0.5R}}{(1+cv^2{}_{y_1})^{0.5R}}\right] - 1 ,$$

where, EPR = effective protection rate (percent change in income), cv_{y_1} = coefficient of variation of income: i= 0 without protection and i = 1 with protection and, R = coefficient of relative risk aversion.

In order to compute the coefficient of variation of incomes *with* (y_1) and *without* (y_0) double protection two further steps are necessary. First, world market price fluctuations (cv_{pw}) have to be transferred to domestic *price* fluctuations (cv_{pd}). This can be accomplished by using estimated price transmission elasticities, η (see Appendix B)

(3) $$cv_{p_d} = \eta \cdot cv_{p_w} .$$

Next, the price fluctuations have to be transferred into *income* fluctuations by considering the inverse profit ratio as a multiplier (see Appendix C),

(4) $$cv_y = \left[\frac{\text{production value}}{\text{income}}\right] \cdot cv_{p_d} .$$

III. Empirical Illustrations—the Case of European Wheat

The data

Twenty-four years of annual wheat data in the European Union were available to implement our theoretical model. World wheat prices, CIF Rotterdam ($US), were obtained from the Economic Research Service of the U.S. Department of Agriculture. Since price data for the entire EU were not available, prices received by German producers were used as a proxy and obtained from the CRONOS data bank of

EUROSTAT[2]. Currency exchange rates from the IMF were used to place world prices on a local (German Mark) currency basis. Both price series were deflated by the consumer price indices of their respective countries. Wheat production data were obtained from the Economic Research Service and the Foreign Agricultural Service of the USDA. Cost of production data was available from Stanton (1986), Bureau *et al.* (1992) and personal correspondence with Jean-Pierre Butault. Real producer incomes were on a per farm basis. The data list is provided in Appendix D.

The Policy Environment

We identify two fundamentally different policy regime periods of the European Union's Common Agricultural Policy (CAP): the "old CAP" and the "new CAP". These two periods define the "protection" and the "without protection" periods, respectively. 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 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.

The first major structural adjustment in European agricultural policy took place with the CAP (MacSharry) reform of 1992. The changes were considered so significant to warrant the name the "new CAP". Although truly significant changes occurred, they were implemented within the existing CAP structure of variable levies, export restitutions

[2] Germany is second only to France in volume of EU wheat production.

and the like. This structure continued to isolate European agriculture from the world economy. Implemented in July 1993, the MacSharry reforms called for compensatory payments to farmers and a continued lowering of price supports to levels closer to expected world prices. The three major components of this reform were: (1) a substantial cut in intervention prices (30 percent), phased in over a three-year period, (2) compensation to farmers for the price cuts through subsidies per hectare (area premiums), and (3) land "set-aside" requirements; preference was given to small farmers who were eligible to receive payments without the set-aside requirement. Even though the compensatory payments were not truly decoupled from cropped area, this was a major step toward a market-oriented grain economy.

This "new CAP" period also includes the 1995 Uruguay Round Agreement on Agriculture (URAA). The old system of threshold prices and variable levies was abolished under the process of tariffication; these and other non-tariff barriers were converted to conventional tariffs and reduced over time. The first of the tariff cuts took place in July, 1995, and the new arrangements limited the import tax so that the landed price could not exceed 155 percent of the intervention price or the tariff equivalent, which ever was less. The tariff equivalent was to be reduced 36 percent over a six-year period. Constraints on the total level of support provided by the CAP were also imposed.

Model Implementation

In order to implement our measure of the Real Rate of Protection (RRP) we need to compute the individual components of equation (2). First, we compute the traditional ERP measure as the percentage change in real producer incomes over the two periods: period 1 (1988-92) and period 2 (1993-99). Income is defined as a gross margin per farm, price minus variable cost. The mean income for periods 1 and 2 is 35,000 and 5700 DMs, respectively. The ERP simply represents the percent that profits during the highly protected pre-MacSharry period exceeded those of the post-MacSharry period. Without compensatory payments, our ERP is estimated to be 5.065. This implies that the pre-MacSharry average real farm income was more than five-fold the post-reform period. Stated differently, the post-MacSharry period real farm incomes were only 16 percent of the pre-reform average. However, when compensatory payments are added (variable C_t in Appendix D), the estimated ERP is 0.119, meaning that post-MacSharry incomes were 88 percent of the pre-reform average. Since compensatory payments have been made, the latter analysis is a more accurate representation of reality; the former results are representative of "what might have happened" had direct payments not been made.

Second, we compute the coefficients of variation of world *prices* for the two periods. Equation (3) is used to transform these to *domestic* price coefficients of variation. As shown earlier, the coefficient of variation of *domestic* price is simply the product of the price transmission elasticity and the coefficient of variation of *world* price. Instead of computing the coefficient of variation of domestic prices directly, we estimate them under alternative assumptions of the price elasticity of transmission. Tyers and Anderson (1992) refer to these elasticities as "price policy parameters" while Dutton and Grennes describe them as a summary measure of all government policies that separate foreign and domestic markets. Thus, as a general measure of domestic market insulation from world markets, the transmission elasticity increases as markets are liberalized. Drawing upon the empirical work of Thompson *et al.* (2000), we illustrate the sensitivity of RRP to transmission elasticities of 0.15, 0.25, 0.30. Even with the MacSharry and subsequent Uruguay Round reforms, EU wheat price transmission elasticities greater than 0.30 for the EU have not been empirically found. A transmission elasticity of 1.0 implies perfect transmission of world market price signals back to domestic markets.

Third, we transfer the coefficients of variation of domestic *prices* into coefficients of variation of *income*. For each period, this computation is made according to equation (4). The coefficients of variation of real incomes are measured as trend-corrected coefficients of variation following the approach of Cuddy and Della Valle (1978). Finally we need to assess the coefficient of relative risk aversion, R. Drawing upon the work of Saha, Shumway and Talpaz (1994), we posit three possible levels of increasing risk aversion, 1.0, 2.0, and 3.0, respectively.

The term in the square bracket of equation (2) adjusts the traditional effective rate of protection (ERP) by the relative volatility of income for a risk-averse producer. Three cases are identified. First, this term is larger than 1.0 if the trend-adjusted coefficient of income *with* protection is lower than *without* protection. On the other hand, this term is smaller than 1.0 if the trend-adjusted coefficient of income *with* protection is greater than that *without* protection. And, this term is 1.0 if the trend-adjusted coefficient of income is unaffected by the level of protection.

In the first case above, the value of RRP is larger than the traditional ERP. This means the real rate of protection (RRP) is evaluated as higher than the traditional evaluation because of the dampening effect on income volatility resulting from protection. In the second case, the value of RRP is smaller than ERP and in the third case we have the same evaluation. Again in the first case, the more risk averse the producer the greater the term in the square bracket. This is because the more risk averse the producer, the greater the benefit from decreased income volatility. The opposite is true in the second case. In general, the greater the level of relative risk aversion, the greater the real rate of protection.

This adjustment for risk aversion is reasonable for a risk averse producer because his utility is higher as the volatility of income decreases. Although the traditional way of evaluating price support protection programs takes the expected value of income into consideration, it does not considered the volatility of income; a reasonable approach only if producers are risk neutral.

In Table 1 estimates of the real rate of protection (RRP) for the EU wheat market are shown *without* compensatory payments. We examine the effects on RRP of increased price transmission elasticities and levels of relative risk aversion. Recall our estimate of ERP was 5.065. Thompson, *et al* (2000) found the price transmission elasticity during the pre-MacSharry period to be about 0.15. These authors further found that the MacSharry and subsequent Uruguay Round reforms increased the transmission of world price signals to domestic EU wheat markets such that the post-reform elasticity was near 0.30. In other words, the price transmission increased as policy reforms evolve.

The relationships shown in Table 1 are consistent with expectations. In particular, the real rate of protection is positively related to both the price transmission elasticity and the degree of relative risk aversion. For all reported vales in Table 1, the real rate of protection exceeds the traditional measure. More concretely, because income volatility was found to be greater during the post-MacSharry period than before, a greater degree of wheat industry protection has actually occurred than traditional measures would have revealed. Thus, without accounting for the effect of price policy protection on producer *income volatility,* traditional measures of protection are misleading. In the case of the EU wheat market, the traditional ERP is about 7 percent smaller than the real rate of protection (for R =2.0 and η = 0.30). Also as the degree of risk aversion increases from 1.0 to 3.0 (η = 0.30) the RRP increases by some 10 percent.

Some interesting results are obtained when the compensatory payments are added to real incomes (Table 2). The addition of these payments had the effect of virtually eliminating the importance of risk in the RRP calculation. As we increased R from 1.0 to 3.0 the RRP did not noticeably depart from the ERP. In this case, the direct payments substantially reduced the role of risk in the measurement of protection.

IV. Conclusions

Traditional indicators of protection refer to the level effect of price policies on income and ignore the stabilizing effect. We derive a measure of the real rate of protection that incorporates these dual dimensions. The income stabilizing effects of price policy protection reveal a greater level of real protection than would be measured conventionally. Computed real protection rates for the European Union wheat market over the pre- and post-MacSharry reform periods were found to be some 10 percent greater than would have been traditionally conceived had compensatory payments not been made. The addition of direct (compensatory) payments to farmers virtually closed the gap between the traditional and our risk-adjusted protection measure. Direct payments had a major risk reducing impact.

References

Bureau, J.C., J.P. Butault and A. Hoque. "International Comparisons of Cost of Wheat Production in the EC and United States". U.S. Dept. of Agriculture, Economic Research Service. Staff Report No. 9222, August 1992.

Butault, Jean-Pierre. INRA, Paris, France. Jean-Pierre.Butault@nancy-engref.inra.fr

Cuddy, J.D.A., Della Valle, P.A. "Measuring the Instability of Time Series Data." *Oxford Bull. of Econ. and Statist.* 40(1978):79-85.

Dutton, J. and Grennes, T. "The Role of Exchange Rates in Trade Models." Ch. 4 in *Elasticities in International Agricultural Trade*, eds., Carter, C.H. and Gardiner, W.H., Westview Press, 1988.

Newbery, D.M.G. and J.E. Stiglitz. *The Theory of Commodity Price Stabilization: A Study in the Economics of Risk.* Oxford:Oxford University Press, 1981.

Saha, A., R. Shumway and H. Talpaz. "Joint Estimation of Risk Preference Structure Using Expo-Power Utility". *Am. J. Agr. Econ.* (May 1994):173-184.

Schmitz, M. "CAP and Food Security" in *Issues in Agricultural Competitiveness: Markets and Policies*. Eds. R. Rose, C. Tanner, and M. Bellamy. IAAE Occasional

Paper No. 7. International Association of Agricultural Economists. Ashgate Publishing: Brookfield, Vermont, 1997.

Stanton, B. F. "Production Costs for Cereals in the European Community: Comparisons with the United States, 1977-1984". Dept. Agr. Econ., Cornell University. A.E. Res. 86-2, 1986.

Thompson, S.R., R. Herrmann and W. Gohout. "Agricultural Market Liberalization and Instability of Domestic Agricultural Markets: The Case of the CAP". *Am. J. Agr. Econ.* 82(August 2000):718-726.

Tyers, R. and Anderson, K. *Disarray in World Food Markets: A Quantitative Assessment.* Cambridge University Press, 1992.

USDA, Economic Research Service. "World Wheat and Course Grains: Supply and Demand." Available at http://jan.mannlib.cornell.edu/data-sets/international/93002/.

USDA, Foreign Agricultural Service. "European Union: Grain Supply and Demand, Wheat and Course Grains," Available at http://www.fas.usda.gov/circular/1999-02/graintoc.htm.

Valdez, A. "Measures of Agricultural Support Policies in Transition Economies: 1994-1997". *Am. Econ. Rev.* 89(May 1999):265-270.

Table 1. Estimated Real Rates of Protection Without Compensatory Payments 1988-99

Post-MacSharry[a] Price Transmission Elasticity (η):	Coefficient of Relative Risk Aversion (R)		
	1.0	2.0	3.0
0.15	5.104	5.144	5.183
0.25	5.177	5.290	5.406
0.30	5.226	5.391	5.561

[a] The pre-MacSharry price transmission elasticity was 0.15.

Table 2. Estimated Real Rates of Protection With Compensatory Payments 1988-99

Post-MacSharry[a] Price Transmission Elasticity (η):	Coefficient of Relative Risk Aversion (R)		
	1.0	2.0	3.0
0.15	0.119	0.119	0.119
0.25	0.120	0.120	0.121
0.30	0.120	0.121	0.122

[a] The pre-MacSharry price transmission elasticity was 0.15.

Appendix A

Following Newbery and Siglitz (p.89),

$$(A.1) \qquad E[U(y)] = E[y][1+cv_y^2]^{-\frac{1}{2}R}$$

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

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

or

$$(A.3) \qquad RRP = \frac{\hat{y}_1 - \hat{y}_0}{\hat{y}_0}$$

$$(A.4) \qquad = \frac{\dfrac{E[y_1]}{(1+cv^2 y_1)^{0.5}}}{\dfrac{E[y_0]}{(1+cv^2 y_0)^{0.5R}}} \quad -1$$

$$(A.5) \qquad = \frac{E[y_1]}{E[y_0]} \cdot \underbrace{\frac{(1+cv^2 y_0)^{0.5R}}{(1+cv^2 y_1)^{0.5R}}}_{K} -1$$

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 (A.5) gives,

$$(A.6) \qquad RRP = (1 + EPR) \cdot K - 1$$

Appendix B

The price transmission elasticity (η) is given by

$$(B.1) \qquad p_d = \alpha \; p_w^{\eta}$$

$$(\mathrm{B.2}) \qquad \mathrm{E[p_d]} = \alpha \; E[p_w]^{\eta}$$

$$(B.3) \qquad \mathrm{var}[p_d] = \mathrm{var}[p_w] \cdot [\eta \, \alpha \; p_w^{\eta-1}]^2$$

$$= \mathrm{var}[p_w] \cdot \eta^2 \left(\frac{\alpha \; p_w^{\eta}}{p_w} \right)^2$$

$$= \mathrm{var}[p_w] \cdot \eta^2 \; \frac{p_d^2}{p_w^2}$$

$$(B.4) \qquad \sigma_{p_d} = \sigma_{p_w} \eta \frac{p_d}{p_w}$$

$$(B.5) \qquad cv_{p_d} = \frac{\sigma_{p_d}}{E[p_d]}$$

$$= \frac{\sigma_{p_w} \cdot \eta \dfrac{p_d}{p_w}}{\alpha E[p_w]^2}$$

$$(B.6) \qquad cvp_d = \eta \cdot cv_{p_w}$$

Appendix C

Step three was derived as follows:

$$(C.1) \qquad y = p_d \cdot q - v \cdot x$$

where, y = income (profit)

v = factor prices, and

x = factor inputs.

$$(C.2) \qquad E[y] = E[p_d] \cdot q - v \cdot x$$

$$(C.3) \qquad \text{var}[y] = q^2 \cdot \text{var}(p_d)$$

$$\sigma_y = q \cdot \sigma_{p_d}$$

$$(C.4) \qquad cv_y = \frac{\sigma_y}{E[y]}$$

$$= \frac{q\sigma_p}{E[p_d]} \cdot q - vx$$

$$= \frac{p_d \cdot q\sigma_p}{y \cdot p_d}$$

$$(C.5) \qquad cv_y = \frac{p_d \cdot q}{y} cv_{p_d}$$

Appendix D: The Data List

Year	A_t [ha][a]	Y_t [t/ha]	$A_t * Y_t$	P_t^d [DM/t]	P_t^w [DM/t]	C_t [DM][a]
1976	19.07	3.10	52.98	732.75	656.00	0
1977	15.47	3.25	50.28	704.44	482.27	0
1978	16.44	3.72	61.16	684.67	451.60	0
1979	16.13	3.62	58.39	657.06	468.41	0
1980	17.00	3.96	67.32	633.58	451.55	0
1981	16.93	3.74	63.32	609.50	506.89	0
1982	17.33	4.07	70.53	598.37	462.53	0
1983	17.62	4.03	71.01	584.91	471.06	0
1984	17.75	5.12	90.88	543.75	493.02	0
1985	16.78	4.70	78.87	480.68	460.40	0
1986	17.27	4.63	79.96	470.38	289.30	0
1987	17.41	4.52	78.69	448.56	222.27	0
1988	16.90	4.80	81.12	407.09	260.11	0
1989	17.70	4.80	84.96	382.50	287.61	0
1990	17.30	5.10	88.23	353.74	200.87	0
1991	17.50	5.30	92.75	336.80	185.85	0
1992	17.40	5.00	87.00	320.13	208.00	0
1993	15.70	5.30	83.21	279.51	227.80	3767
1994	15.80	5.40	85.32	238.55	227.88	5176
1995	16.20	5.30	85.86	218.97	206.90	6705
1996	16.70	5.90	98.53	223.37	222.31	6806
1997	17.10	5.50	94.05	201.92	179.44	6840
1998	17.10	6.10	104.31	189.61	141.41	6778
1999	17.20	5.60	96.32	183.53	127.38	6778

[a]millions of hectares