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DO DEVELOPED EXPORTING COUNTRIES CONTRIBUTE TO FOOD SECURITY?

THE CASE OF THE EC

Peter Michael SCHMITZ



Department of Agricultural and Applied Economics

University of Minnesota
Institute of Agriculture, Forestry and Home Economics
St. Paul, Minnesota 55108

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by

Peter Michael Schmitz
Visiting Professor
Center for International Food and Agricultural Policy
Department of Agricultural and Applied Economics
University of Minnesota
1994 Buford Avenue
St. Paul, Minnesota 55108, U.S.A.

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Do Developed Exporting Countries Contribute to Food Security?

The Case of the EC

1. INTRODUCTION

The representatives and advocates of the Common Agricultural Policy (CAP) of the European Community (EC), a major exporter of food and agricultural commodities, claim that (a) food security has already been achieved domestically for a long time as an unambiguous result of a well-defined and successful agricultural policy design, and that (b) their countries even provide abundant food for needy regions in the developing world, thus alleviating food insecurity abroad. Looking at the tremendous production, export, and stock volumes in these countries this statement seems to be supported at a first glance. In this paper it is argued that EC's agricultural policy has, in fact:

- contributed little if at all to domestic food security and is obviously not able to avoid newly arising poverty and hunger for some minorities;
- aggravated the efforts of providing people with enough food at reasonable prices in the developing world.

Before starting the discussion on these hypotheses in Sections 3 and 4, it is worthwhile to give a precise definition of what is meant by food security, to develop an indicator with which one can measure food security, and finally to derive a conceptual framework for evaluating different degrees of food security (Section 2). All three aspects will be discussed and analyzed as general as possible in order to make the food security approach applicable for rural and urban poor in both developing (LDCs) and developed countries (DCs). The paper does neither provide any quantitative estimations of food

security levels, nor does it discuss policy options for coping with the food security issue. Rather, it attempts to improve the theoretical foundation, to develop some alternative indicators, and to apply both to the mentioned hypotheses. More specifically, some more recent developments in the field of applied welfare economics are introduced which, in the author's view, have been under-utilized in food security research. This kind of analysis might especially be useful for comparisons of food security levels between households, regions, and countries as well as for giving a basis on which national and supranational funds can be allocated to the poor.

2. DEFINITION, MEASUREMENT, AND EVALUATION

"Food security is access by all people at all times to enough food for an active and healthy life" (World Bank, 1986). This definition which seems to reach the highest rate of acceptance among concerned researchers implies that (see Phillips and Taylor, 1990, p. 1304):

- food is available, accessible, affordable -- when and where needed -- in sufficient quantity and quality;
- an assurance is given this state of affairs to be reasonably expected to continue.

Moreover, this widely accepted definition reflects the shifts from

- a production orientation to a consumption and health focus;
- country-level to household- or individual-level analysis;
- a solely quantity point of view to both quantity and quality issues;
- static or cross-section analysis to dynamic analysis over time;

-- merely transitory to transitory and chronic malnutrition.

It has been noted that national food security does not imply household or individual food security (Staatz, D'Agostino and Sundberg, 1990, pp. 1312-1316) and that food security today does not imply food security tomorrow. The most important result from previous research, however, has been the observation that not an inadequate level of food supply causes hunger but a lack of individual purchasing power or real income (see also Chisholm and Tyers, 1982, p. 5). Hence, individual poverty is the driving force behind hunger and malnutrition. This makes clear, why food insecurity is not restricted to poor countries. Even in rich countries a small but growing group of the population do not have access to sufficient food (Allen and Thompson, 1990, pp. 1162-1163; Phillips and Taylor, 1990, p. 1304) because their real income falls below the poverty threshold.

With this causal relationship in mind, the question arises under which preconditions individual real income or real household income could be an adequate basis for the measurement of food security. Obviously, a minimum of that income is required to meet individual's needs. A minimum level of real income can also be interpreted as a minimum right to resources in the sense of Atkinson (1991, p. 8) which enables individuals to participate in a particular society, as a guarantee of "positive freedom." As a rule of thumb the poverty or the food security line in developed countries is estimated to be that disposable household income which is less than 40 to 50 percent of the national average, thus implying a relative measure. In Developing Countries it would make more sense, however, to define a fixed amount of real purchasing power which enables individuals to have access to enough and healthy food.

When calculating this real purchasing power it has to be kept in mind that income in-kind has to be added (i.e., home produced goods and services) and a discount for non-available or rationed food should be subtracted. But even when these problems are solved three additional aspects warrant further attention: the relevant time period considered, the choice of equivalence scale in case of different household sizes, and how food intake corresponds to income. Whereas the measurement of poverty is generally based on cross-section analysis per year (Atkinson, 1991, pp. 5-17), the proposal here is to use time series analysis of real household income in order to capture seasonal variability and life cycle variations including complete breakdowns of income (see also Ravallion and Huppi, 1991, pp. 57-82). The choice of the time unit (daily, weekly, monthly, annually) should depend on whether different options of dissaving, borrowing or participating in income streams of related people are available. If there aren't any risk sharing private or official institutions, then a daily-based income report would be the best. Depending on the size of the household, the age structure of its members, the distribution between male and female, the degree of handicaps of people, and their nutritional and health status, the required minimum household income (food security line) differs widely. Buhmann and others (1988, pp. 115-142) therefore propose an adjusted income indicator (y_{adj}) to make food security or poverty levels of households comparable and to take into account the above mentioned aspects:

$$y_{adj} = \text{total real household income} / n^s$$

where n denotes the number of members of the household and s is the elasticity of family need with respect to family size. The equivalence scales are based on subjective

evaluation and in the poverty literature this ranges from 0.25 to 0.72 (Atkinson, 1991, p. 15). Finally, what can be said about the correlation of real income with food intake and the nutritional and healthy status of individuals? Fortunately, recent contributions in the literature show a strong positive relationship between income and nutrition implying that nutrition and health are improving with income growth (Schiff and Valdés, 1990, p. 1320; Von Braun, 1990, p. 1323). Faced with a lack of data concerning the determinants of the nutrition and health production functions, the real household income might therefore provide an acceptable basis for the measurement of food security (an example of how to calculate this real income indicator for Sub-Saharan Africa is given in Sahn and Sarris, 1991, p. 262).

So far only the level aspect of food security has been addressed. The level of real household income should not fall below a certain target or minimum level. However, food insecurity reflects the adverse effects of an uncertain world as well. Hence, we should also look at the fluctuations of real household income around its mean trend. Formally, this is the probability distribution of real income over time that matters and it should be the objective of any food security policy to keep the probability of real income falling below the target level as low as possible at reasonable opportunity costs. Then one can measure food insecurity as the probability (α) of real income falling below the critical level y^* (see Figure 1 for illustration). The food security level (FS) is then:

$$(1) \text{ FS} = 1 - \text{Prob} \left[F(y) \leq \frac{y^* - E[y]}{(\text{var } [y])^{0.5}} \right] \quad \text{or } 1 - \alpha \text{ in Figure 1}$$

where

Prob probability

E expectation operator

var variance

$y = y_{adj}$ adjusted real income

y^* minimum income

$F(y)$ standard normalized cumulative distribution function

For practical purposes the first (mean) and second (variance) moments of the probability distribution can be used to calculate the degree of food insecurity which ranges from zero to one. In that case the implicit assumption is made that real income fluctuations are normally distributed.

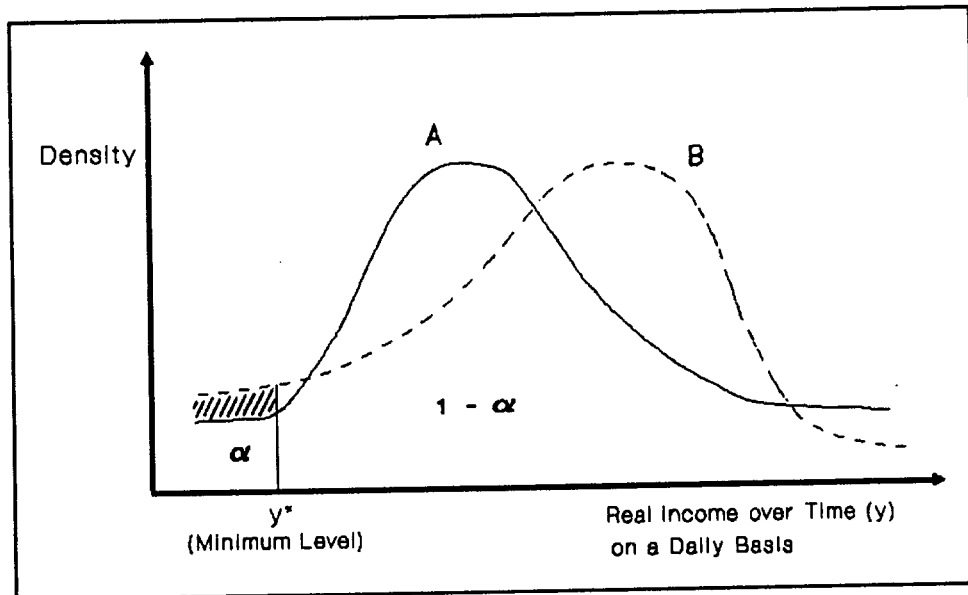


Figure 1. Measurement of Food Insecurity

So far we have only addressed the positive questions of measurement. Nothing has been said on the evaluation of different probability distributions in welfare terms or how food security does correspond to individual welfare measures. Normatively speaking, i.e., does the individual prefer the probability distribution B over A (Figure 1) although food insecurity increases (α plus shaded area)? The answer to this question depends on the weights the individual gives to mean, variance, skewness, and other moments in his/her preference function. Hence, an economic agent would prefer B over A if and only if the level increasing benefit outweighs the risk loss neglecting higher moments. The most common practice of economic analysis in such cases has become to apply the expected utility approach or the stochastic dominance approach (see Dillon and Anderson, 1990, pp. 120-157). In the following we'll use the former assuming a normal distribution of real income which leads to a simple mean-variance formula of expected utility of income (Newbery and Stiglitz, 1981, p. 85):

$$(2) \quad E [U (y)] = E [y] - \frac{1}{2} \cdot A \cdot \text{var} [y]$$

A coefficient of absolute risk aversion

U utility

This equation is especially useful as a complementary tool for evaluation of food security because it

- contains both mean and variance of income as arguments, thus considering the stochastic nature of the problem;

- can be applied to producers, consumers, and other agents such as taxpayers and politicians;
- contains the risk attitudes of market agents;
- allows comparisons over time and among agents of situations with a different extent of food insecurity;
- provides a reasonable money measure of food security costs and benefits.

We are now in a position to define, to measure, and to assess food security or food insecurity, respectively. Hence, the question can be answered: What is the contribution of the CAP to domestic food security?

3. COMMON AGRICULTURAL POLICY AND DOMESTIC FOOD SECURITY

Agricultural Price Policy in the EC implies an average increase of producer prices over their free market levels, a considerable stabilization of prices compared to the world market (see Table 1), and finally a distortion of the price pattern in favor of grains, milk, beef, and sugar beets. These market interventions will be evaluated from a producer's and consumer's point of view.

3.1 Producer's Welfare and Food Security

The impact of this price policy on producer's welfare can be measured by the expected utility of an indirect profit function (see Just, Hueth and Schmitz, 1982, p. 349):

$$(3) E [U (\pi)] = E [U (\pi \{p, v, K\})]$$

Table 1. Variability^a of German Food Import Prices -- 1970-1985

Products	Price Variability (%)	
	Imports from EC-Member Countries	Imports from Third Countries
<u>Aggregates</u>		
Grains and Cereal Products	5.6	17.9
Milk and Dairy Products	3.4	6.5
Swine and Pork	9.5	7.7
Cattle and Beef	7.3	16.4
Poultry and Poultry Meat	6.0	4.9
Eggs and their Derivatives	11.5	17.2
<u>Single Products</u>		
Wheat	5.8	24.5
Barley	6.4	21.3
Corn	6.1	17.9
Soymeal	18.3	21.4
Rice	9.3	21.6
Raw Sugar	4.3	62.2
Cattle	6.2	13.5
Swine	8.1	14.4
Butter	4.3	32.3

Source: Own Calculation on Basis of German Agricultural Statistics (see Schmitz, 1987, p. 366)

^aMeasured as Trend-Corrected Coefficient of Variation Following the Approach of Cuddy and Della Valle, 1978, pp. 79-85.

which is homogenous of degree 1 in prices and has the following properties (Hoteling's Lemma):

$$\frac{\partial \pi}{\partial p} = q_s > 0; \quad \frac{\partial^2 \pi}{\partial p^2} < 0; \quad - \frac{\partial \pi}{\partial v} = x_D > 0; \quad \frac{\partial^2 \pi}{\partial v^2} < 0$$

where

- π indirect profit
- p producer prices
- v factor prices
- K quantity vector of fixed inputs
- q_s output supply
- x_D input demand

Using the simple mean-variance approach of equation (2) and the approximation procedure for both moments following Mood, Graybill and Boes [1974, p. 181, see equations (19) and (20)], one can easily derive a money measure (\equiv certainty equivalent indirect profit) for the expected utility of profits leaving the variance of input prices unaffected by policy:

$$(4) \quad E [U (\pi)] \approx \pi(\bar{p}, \bar{v}, K) + \frac{1}{2} \cdot cv_p^2 \cdot \epsilon \cdot Rev - \frac{1}{2} \cdot R \cdot cv_p^2 \cdot \frac{Rev^2}{\pi(\bar{p}, \bar{v}, K)}$$

where

- \bar{p}, \bar{v} mean prices

cv coefficient of variation

ϵ supply elasticity

Rev Revenue

R coefficient of relative risk aversion

The first term on the RHS of equation (4) is that level of profit where prices are at their mean. A mean preserving spread of producer prices, however, creates two additional terms in equation (4). The second term on the RHS is equivalent to an increase of the expected profit under fluctuating prices from which the producer obviously benefits, whereas the third term addresses the producer's risk attitude. A risk averse producer, i.e., would face a loss of welfare under fluctuating prices. The producer gains from pure price stabilization under the Common Agricultural Policy if, and only if

$$(5) \quad R > \epsilon \cdot \frac{\pi}{\text{Rev}}$$

which is likely the case assuming plausible parameter values.

Since the mean profit change is also positive, the producers welfare position has been clearly improved by the CAP.

Referring to the food insecurity status of producers under the CAP, it has to be stated that the probability (Prob) of real profit (π) to fall below the critical level (π^*) has unequivocally been decreased since the mean is up and the variance is down:

$$(6) \quad \text{Prob} \left[F(\pi) < \frac{\pi^* - E[\pi]}{\sqrt{\text{var}[\pi]}} \right]$$

Hence, price support as well as price stabilization under the CAP have improved both the welfare position and food security of farmers although the benefits seem to be very unevenly distributed among different farms and regions (see von Witzke, 1979; Tarditi and Croci Angelini, 1982).

3.2 Consumer's Welfare and Food Security

Analogous to the producer case, the impact on consumers should be measured as the expected utility of equivalent income or money metric (MM):

$$(7) E [U (MM)]$$

Money metric itself can be defined as that level of income needed at some vector of reference prices (p_0) in order for the consumer to attain the same utility level he/she enjoys from income y_0 when faced with price vector (p_1). In other words money metric is the sum of the initial income (y_0) and the equivalent variation (EV). Since the equivalent variation from a pure price change can be derived from an expenditure function ($e[\cdot]$) as (see Boadway and Bruce, 1989, p. 205):

$$(8) EV = e (p_0, u_1) - e (p_1, u_1).$$

for the money metric it follows:

$$(9) MM = Y_0 + \Delta e (p, \bar{u})$$

where the expenditure function is increasing with prices and utility, is homogeneous of degree 1 in prices, is concave in p , and has the following property (Shepard's Lemma):

$$\frac{\partial e (p, \bar{u})}{\partial p} = q_D^C \quad (\text{compensated demand function})$$

Using again the simple mean-variance approach of equation (2), the Mood, et. al. approximation procedure for the mean and the variance of the money metric, and rearranging some terms, yields:

$$(10) \quad E [U (MM)] \approx Y_0 + \frac{1}{2} \sigma_p^2 |\eta^c| EX - \frac{1}{2} R \sigma_p^2 \frac{EX^2}{Y_0}$$

where

η^c compensated demand elasticity ($= \eta + s \lambda$)

s budget share of products with fluctuating prices

λ income elasticity

η (uncompensated) demand elasticity

EX mean expenditures for products with fluctuating prices

The interpretation of equation (10) is analogous to that of equation (4) for the producer. In accordance with the considerations of Helms (1985, pp. 93-100), the expression in (10) could be called the ex-ante equivalent income. The consumer finally gains from pure price stabilization if and only if:

$$(11) \quad R > |\eta^c| / s$$

which is again likely to be the case as Turnovsky, et. al. (1980) state, although the relative gains seem to be negligible (Wright and Williams, 1988, pp. 616-627) due to the low food share in consumer's budget. Thus, even with equal coefficients of risk aversion, producers might be more heavily affected by fluctuating prices than consumers.

However, the central question of how the CAP affects mean and variance of consumer prices has been left unanswered so far. The answer very much depends on the

transmission of price impulses from the wholesale to the retail level. Empirical studies show the EC consumers to shoulder the full burden of the price support at the wholesale level because the potential for replacing price increasing intermediate food or for substituting final food consumption is very limited (i.e., Schmitz, 1987, pp. 368-370) and the CAP covers nearly the whole range of food items. In addition, the CAP contributes little to consumer's price stability. The statistically observed stability already exists due to high proportions of stable non-food inputs in food value added, to partly anticyclical margin behavior over time, and to risk transferring mechanism for which consumers are obviously willing to pay. Surprisingly, the level of stability of final food prices hardly differs among products, irrespective of the fact that some wholesale prices or producer prices are subject of the CAP and others not (see Table 2). Hence, the CAP has not only weakened the welfare position of consumers but has also increased the level of food insecurity. This is in contrast to policymakers' claims. It holds especially for those consumers who spend a large portion of their budget on food, namely the older generation, families with many children, and unemployed people. The low real income of those minorities is eroded further by the CAP.

Nevertheless, some advocates might still argue that for a vast majority of people food security has already been provided. That is true. But this has not been caused by the food and agricultural policy. Rather, it originates from the overall performance and efficiency of the economy. Thus, it is fair to say that food security for most people exists despite the CAP.

Table 2. Variability^b of German Food Prices at Different Stages in the Food Chain 1970-1985

Product	Price Variability (%)	Product	Price Variability (%)
Swine	8.1	Cattle	6.2
Roast Pork	9.4	Roast Beef	4.2
Lard	3.1	Fillet of Beef	4.1
Ham	2.7		
		Poultry	5.3
Calf	6.5	Broiled Chicken	3.6
Veal Cutlet	8.4		
		Raw Milk	4.8
Eggs from Producers	6.4	Fresh Milk	4.4
Eggs Packing Incl.	5.7	Butter	4.3
		Cheese	4.6
Wheat	5.8	Sugar Beets	6.9
Wheat Flour	3.2	White Sugar	4.3
White Bread	3.2		
		White Cabbage	33.1
Rye	6.4	Cabbage with Trade-Mark	14.0
Rye Bread	2.5	Cabbage in Cans	4.9
Potatoes from Producer	42.2	Red Cabbage	42.8
Potatoes Packing Incl.	24.5	Cabbage with Trade-Mark	15.5
Potato Salad	5.0	Cabbage in Cans	4.8
Potato Chips	2.4		
		Must	20.3
Apple from Producers	36.6	Red Wine	2.8
Apple with Trade-Mark	15.2	German Champaign	6.8
Apple Juice	7.2	Brandy	4.2
Apple-Purée	5.6		

Source: Own Calculation on Basis of German Agricultural Statistics (see Schmitz, 1987, pp. 363-364).

^bMeasured as Trend-Corrected Coefficient of Variation Following the Approach of Cuddy and Della Valle, 1978, pp. 79-85.

4. COMMON AGRICULTURAL POLICY AND FOOD SECURITY IN LDCs

A vast literature exists on the impact of the CAP or similar agricultural policies of other industrialized countries on world markets and on developing countries (i.e., Anderson and Tyers, 1990; Hartmann and Schmitz, 1991). The focus has been on price level induced welfare effects in the third world. However, only few studies have addressed the question of how to evaluate the price transmission with respect to variability of certain domestic variables, such as welfare or food security. A model is developed which allows us to analyze different kinds of stochastic disturbances.

Although in an uncertain world dozens of sources of real income fluctuations exist, we will confine ourselves to only two sources which are claimed to be the most important in food security issues: (1) fluctuations in domestic food production and (2) external fluctuations coming from the world market or from developing countries' food production (Valdés, 1981, pp. 4-5). The following simple stochastic partial equilibrium model is used including one commodity (i.e., grains), two countries (developed country, developing country) and four agents (domestic consumers and producers, domestic government, foreign export demand). The model is formulated in general terms and is especially useful to reveal the determinants of mean and variance of world market prices and their interaction with certain price transmission policies.

$$(12) \quad q_s = f(P_s, \theta) \quad \text{domestic supply function of the EC}$$

$$(13) \quad q_D = g(P_D) \quad \text{domestic demand function of the EC}$$

$$(14) \quad q_{ED} = h(P_w, \phi) \quad \text{export demand function of the LDC}$$

$$(15) \quad P_s = k(P_w) \quad \text{world price transmission concerning EC producer prices}$$

(16) $P_D = l(P_w)$ world price transmission concerning EC consumer prices

(17) $q_s - q_D - q_{ED} = 0$ equilibrium condition

where

$q_{s,D}$ = domestic supply, demand;

q_{ED} = export demand;

$P_{s,D,w}$ = producer price, consumer price, world market price;

θ, ϕ = stochastic disturbance terms related to domestic supply and export demand;

f, g, h, k, l = functional parameters

Substituting equations (12), (13), (14), (15) and (16) into equation (17) yields:

$$(18) \quad f[k(P_w), \theta] - g[l(P_w)] - h[P_w, \phi] = 0$$

Following Mood, Graybill, Boes (1983, p. 181) one can derive approximations for the mean $E[\cdot]$ and the variance $\text{var}[\cdot]$ of world market prices from such an implicit stochastic equation. Thus we have:

$$(19) \quad E[P_w(\theta, \phi)] \approx P_w(\bar{\theta}, \bar{\phi}) + \frac{1}{2} \text{var}[\theta] \cdot \frac{d^2}{d\theta^2} \cdot P_w(\bar{\theta}, \bar{\phi}) \\ + \frac{1}{2} \text{var}[\phi] \cdot \frac{d^2}{d\phi^2} \cdot P_w(\bar{\theta}, \bar{\phi}) \\ + \text{cov}[\theta, \phi] \cdot \frac{d^2}{d\theta d\phi} \cdot P_w(\bar{\theta}, \bar{\phi})$$

$$\begin{aligned}
(20) \quad \text{var} [P_w(\theta, \phi)] &\approx \text{var} [\theta] \cdot \left[\frac{d}{d\theta} P_w(\theta, \phi) \right]^2 \\
&+ \text{var} [\phi] \cdot \left[\frac{d}{d\phi} P_w(\theta, \phi) \right]^2 \\
&+ 2 \text{cov} [\theta, \phi] \cdot \left[\frac{d}{d\theta} P_w(\theta, \phi) \cdot \frac{d}{d\phi} P_w(\theta, \phi) \right]
\end{aligned}$$

Using the implicit function rule for derivations of P_w with respect to the stochastic disturbances θ and ϕ one gets:

$$\begin{aligned}
(21) \quad E [P_w(\theta, \phi)] &\approx P_w(\theta, \phi) + \frac{1}{2} \text{var} [\theta] \cdot \left[- \frac{f_{\theta\theta} \cdot DN - f_{\theta} \cdot f_{P_s\theta} \cdot kP_w}{DN^2} \right] \\
&+ \frac{1}{2} \text{var} [\phi] \cdot \left[\frac{h\phi\phi \cdot DN - h\phi \cdot hP_w\phi}{DN^2} \right] \\
&+ \text{cov} [\theta, \phi] \cdot \left[- \frac{f_{\theta} \cdot hP_w\phi}{DN^2} \right]
\end{aligned}$$

$$\begin{aligned}
(22) \quad \text{var} [P_w(\theta, \phi)] &\approx \text{var} [\theta] \cdot \left[- \frac{f_{\theta}}{DN} \right]^2 \\
&+ \text{var} [\phi] \cdot \left[+ \frac{h\phi}{DN} \right]^2 \\
&+ 2 \text{cov} [\theta, \phi] \cdot \left[- \frac{f_{\theta} \cdot h\phi}{DN^2} \right]
\end{aligned}$$

where $DN = f_{P_s} \cdot kP_w - g_{P_D} \cdot lP_w - hP_w > 0$

f_{P_s} = marginal supply response to producer price changes

g_{P_D} = marginal demand response to consumer price changes

kP_w = marginal producer price response to world market price changes

lP_w = marginal consumer price response to world market price changes

hP_w = marginal export demand response to world market price changes

Hence, expected mean and variance of world market prices depend on:

- the variances of both stochastic disturbance terms;
- the interaction of those terms (related, unrelated);
- the nature of the stochastic impact (additive, multiplicative);
- various response variables of the agents.

To illustrate this, consider a model which seems to be most plausible in agricultural production. It is characterized by loglinear functions, multiplicative disturbance terms, and all second derivatives to be sufficiently small. In that case, one can arrive at:

$$(23) \quad cv_{P_w}^2 = \frac{cv_{\theta}^2 \cdot q_s^2 + cv_{\phi}^2 \cdot q_{ED}^2 - 2 cv_{\theta} \cdot cv_{\phi} \cdot r \cdot q_s \cdot q_{ED}}{[\epsilon \gamma q_s + |\eta| \beta q_D + |\omega| q_{ED}]^2}$$

where

ϵ = supply elasticity

η = demand elasticity

ω = export demand elasticity

γ = price transmission elasticity with respect to producer prices

β = price transmission elasticity with respect to consumer prices

r = coefficient of correlation

$cv_{(\cdot)}$ = coefficient of variation of the relevant variable

From equation (23) one can derive some interesting results. All other things being equal, world market prices are the more volatile, the

- higher domestic production fluctuations;
- higher export demand fluctuations;
- more disturbance terms are negatively correlated;
- less elastic all responses of private agents;
- less world price changes are allowed to be transmitted into the domestic market.

In addition, it has to be noted that in case of multiplicative stochastic terms even the absolute levels of production and export demand matter, to the extent that they affect the instability of world market prices as weights of the disturbance terms. If a country completely insulates its domestic market, as the EC does, and the stochastic disturbances are unrelated ($r = 0$), then equation (23) reduces to:

$$(24) \quad cv_{P_w}^2 = \frac{cv\theta^2 \cdot q_s^2 + cv\phi^2 \cdot q_{ED}^2}{|\omega|^2 q_{ED}^2}, \text{ showing an increasing variability}$$

of world market prices compared to open markets, unless price transmission elasticities are negative in the initial situation. The price transmission elasticities in equation (23) allow to include all kinds of trade and domestic policies (i.e., producer subsidies, quotas, stock policies, import levies, etc.) and their values and signs are most important for the impact the EC has on the world market.

Whereas uncertain world market prices affect other exporting and importing countries' border prices more or less equally, the domestic price, welfare, and food security effects differ largely depending on how LDCs transmit those fluctuations to their

own domestic markets, how risk averse consumers, producers, and taxpayers are, and how the world market price risk interacts with other risk sources within the country. Obviously, LDC's can generally not be considered either as passive actors, completely insulating their national economy, or as enthusiastic adherents of liberalized trade. Rather, they react similarly to what politicians in developed countries do pursuing their individual objectives. Assume a policymaker in an LDC who seeks to maximize utility from net government receipts (GR) and foreign exchange earnings (FE) (see Hammer and Knudsen, 1990, p. 392):

$$(25) \quad U = U [FE, GR] \rightarrow \text{Max.}!$$

under the constraint:

$$(26) \quad FE (P_d, P_w) - GR (P_d, P_w) - X (P_d) \cdot P_d = 0,$$

where

P_d, P_w domestic and exogenous world market price

X net export quantity

then the optimal level of domestic prices (control variable) chosen is:

$$(27) \quad P_d^{\text{opt}} = \frac{\left[1 + \frac{MV_{FE}}{MV_{GR}} \right]}{[1 + \omega^*]} \cdot P_w$$

where

$MV_{FE, GR}$ marginal value of foreign exchange earnings and net government receipts, respectively

ω^* export supply elasticity with respect to domestic prices

(For a simultaneous estimation of multiple price transmission equations of type (27) see Hausner, Schmitz, and von Witzke, 1991, forthcoming.)

Assuming a relative high preference for budget receipts and an export supply elasticity of one, implies the typical discrimination policy against agriculture which is found in most LDCs.

In order to get reasonable price transmission elasticities for individual countries, the basic constrained maximization approach in (25) to (27) has to be extended to consider the dynamic nature of policy decisions as well as the cross price effects among commodity markets (see Hausner, et. al.). Only in that case the welfare and food security effects of individual agents within the Developing Countries can be properly derived.

Moreover, it is especially worth noting that external risks (i.e., world market price risks) do not simply disappear even if trade policy completely isolates the domestic market. Although consumers and producers are then prevented from facing external price risks, risk is nevertheless reflected in the government budget in that case, thus throwing the burden on taxpayers. Hence, market insulation generally implies simple redistribution of risk. In order to evaluate both the mean and variance effect of prices on welfare, including the risk aversion component, a group-wise accounting could be used following the equations (4) and (10) and extended by an equivalent taxpayer's term.

$$(28) \quad \hat{w} \approx E [U (\pi)] + E [U (MM)] + E [U (GR)]$$

\bar{w} Sum of terms of certainty equivalent real incomes

GR Net Government Receipts including the costs of the stabilization policy

This indicator can be used to calculate the welfare and food security effects when world market prices are changed with respect to both their mean and their variance. The impact of changes in the price variance on agents' welfare has been mostly neglected in the literature although the price variability has proven to be very sensitive to agricultural trade policies (Anderson and Tyers, 1990). The EC's agricultural and trade policy contributes a lot of the price variability on world agricultural markets and thus at least potentially aggravates the LDC's food security issue. Moreover, it increases the costs of protecting LDC's domestic consumers and producers from the volatile world market and where this is not sufficiently successful it might have severe adverse long-term effects on production and investment decisions in agriculture. Compared to the impacts of the EC's commodity programs on LDCs the efforts in EC's food aid policy (Franco, 1988) have only negligible positive effects if at all.

5. CONCLUSIONS

Although the food security discussion has given more emphasis on the individual (household) level as the proper unit of analysis, it still suffers from applying inappropriate indicators, which are mostly quantity oriented, instead of relying on more recent results of the literature that it is purchasing power or real income that matters. In addition, it has not been made clear so far how food security corresponds to the welfare status of agents. Since food security can more or less be associated with an uncertain world this should at least be reflected in the value function of individuals who are generally risk averse.

Therefore, it is proposed in the paper that the measurement of both food security and welfare should be based on the probability distribution of adjusted real household income over time on a daily basis. Food security can then be defined as the probability of any agent's real income exceeding a critical level, whereas the welfare status is measured as the agent's expected utility of this real income. Special formulas are developed in this context [equations (4) and (10)] which allows one to calculate producer's and consumer's welfare under price uncertainty and risk aversion separating the risk response effect as well as the mean income moving effect of price fluctuations. All these indicators should be used when comparing and evaluating food security or food insecurity of any agent in whatever region.

Applying this concept to the paper's question of how the EC contributes to food security one can conclude that

- EC-producers are affected directly by higher and stabilized producer prices inducing an improved welfare and food security position of the small group of farm households;
- EC-consumers, as a large group, suffer from EC's price policy in welfare and food security terms because the price increasing effect is fully transmitted from the wholesale to the retail level and stable consumer prices for food occur even without any producer price stabilization;
- the CAP with its strongly isolating character (low price transmission elasticities) has decreased and destabilized world market prices of agricultural commodities eroding at least potentially the most important source of real income earnings in

LDCs, namely agricultural production;

- the CAP-induced negative income and food security effects for producers have been even aggravated by the fact that most LDCs apply sector-specific and macroeconomic policies which, in addition, heavily discriminate against agriculture and severely endangers the access to enough and healthy food;
- the potential welfare and food security gains of price level reductions for consuming and for importing agents are probably compensated by increasing price and income risks.

However, the real effect of the CAP on individual domestic agents in LDCs very much depend on how the distorted probability distribution of world market prices is transmitted into the country and how this affects agent's real income probability distribution. Also in that context the paper stresses the importance of the nature of price transmission and a brief indication is given on how to derive multiple price transmission equations empirically based on a theoretically reasonable optimization behavior. The knowledge of vertical, interregional and intertemporal price transmission seems to be crucial for the analysis of food security issues.

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