Summary
Forecasting the pig market situation

At the beginning of April 1994 25.4 million head of pigs were counted in Germany; 1 million or 3.6 % less than one year before. The stock of pregnant sows decreased by 6 %. Whereas in Western Germany the stock of pigs diminished only by 2.3 %, in Eastern Germany a diminution of 10.7 % took place.

In the period April 1993 to March 1994 gross domestic production of pigs amounted to 40.07 head, which is 0.6 % less than one year before. The export surplus of piglets reached 0.96 million head. The demand for pig meat in the year 1993 increased by 2 %. The average annual producer price in 1993 reached 2.46 DM/kg slaughter weight excl. VAT, 25 % less than one year before.

For the period April 1994 to March 1995 it is expected that gross domestic production of pigs will drop by 3.4 % to 38,7 million head in Germany. The production of slaughter pigs in the EU will decrease insignificantly. The average annual producer price in Germany will stay on a high level.

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Diskussionsbeiträge

*Ausgestaltung des Prämiensystems als Mittel zur Steigerung der Effektivität von Extensivierungs- und Vertragsnaturschutzprogrammen**

Comment

CAREL P.C.M. VAN DER HAMSVOORT and JAN LUIJT

In the article by LATACZ-LOHMANN (Agrarwirtschaft 42 (1993), Heft 10, S. 351 ff.) different bid systems and fixed premium systems are compared for their impact on the effectiveness of a nitrogen-extensification program. For both a risk-neutral and a risk-averse farmer, decision making rules – whether or not to participate in the program – are deducted. Next, model calculations are carried out with hundred farms of each hundred hectares of cereals, which the farmers could decide to put into the program or not (on an all or nothing basis). The analysis of LATACZ-LOHMANN is an important contribution to the work in this field. However to our opinion the decision rule for the risk-averse farmer can be perfected.

1 Decision making in case of a risk-averse farmer

LATACZ-LOHMANN rightly stated that the extensification premium is a non-stochastic income component (no risk involved). A risk-averse farmer will, when deciding to participate in the program or not, also take into account possible modifications in the variability of his income. He will only participate if the certainty equivalent of his expected income increases. In case of a bid system the farmer also has to form expectations about the probabilities of different bid levels to be accepted and especially about the level above which bids are excluded from the program. He increases his bid when the difference in income between participating and not participating increases. However at the same time the probability that the bid will be accepted decreases. Therefore the farmer faces a maximization problem, as he should choose the bid whereby the expected value of the difference between participation and non-participation will be maximized. As to our opinion LATACZ-LOHMANN correctly derived the decision rule for the risk-neutral farmer, we will focus on the maximization problem for the risk-averse farmer, which is given in formula (9) of the article of LATACZ-LOHMANN (LL):

$$(1)\ \max ER_{r\ a}^{\ v} = [(E(G_1) + S - RP_1(S)) - (E(G_0) - RP_0)] * (mS + b)$$

Taking the first derivative of (1) to "S" LATACZ-LOHMANN finds the optimal bid of a risk-averse decision maker (formula (11) of LATACZ-LOHMANN):

$$(2)\quad S(LL)_r{}^*{}_a = \tfrac{1}{2}\,[(E(G_0) - RP_0) - (E(G_1) - RP_1)] - b/2m$$

The bracketed part is defined as the "changeover costs" and the other part (–b/2m) as a "threshold premium". The threshold premium is defined as the compensation a farmer without changeover costs requires in order to participate. It is derived from the farmer's expectations about the probability of acceptance of each bid. However, while taking the first derivative of (1) to "S" Latacz-Lohmann did not take account of the presence of "S" in the risk premium in case of participation in the program (RP_1). If this is still done, a more complicated optimal bid function (3) results[1]), which we denote as (HL).

$$(3)\ S(HL)_r{}^*{}_a = [1/(1 + (1/\sigma^2{}_1) * RP_1{}^2(S))] * \tfrac{1}{2}[(E(G_0) - E(G_1)) - (RP_0 - RP_1(S))] - (b/2m) * [2 - 1/(1 + (1/\sigma^2{}_1) * RP_1{}^2(S))]$$

The second derivative of (3) is smaller than zero. So a maximum exists.

*) Comment and response on the article in Agrarwirtschaft 42 (1993), Heft 10, S. 351-358.

1) In formula (3), "S" appears on both sides of the equation. Rearranging the equation in order to arrive at an expression with "S" appearing only on one side, results in a cubic equation. Solving the cubic equation results in maximally three very complicated optimal solutions for "S", of which (dependent on the values of the parameters and variables) maximally two are relevant (the other one results in a negative value for "S"). It is stressed that there are maximally two optimal solutions as "S" must be within the bounds of Smin and Smax. With reasonable values for the parameters and the variables (reasonable refers here to: quite close to the figures used in the simulation of LATACZ-LOHMANN), it can however be proved that there is only one optimal solution for "S". Without actually describing it here, it can also be proved that an iterative trial and error procedure with equation (3), starting with Smin and going up to Smax will result in exactly the same optimal "S" (also in case of two optimal solutions) as would be achieved with the complicated cubic equation (under the condition of Smin < S < Smax). The optimal solutions of the cubic equation are however not interpretable and cannot be compared with the optimal bid formula for a risk-averse farmer as derived by LATACZ-LOHMANN (2), where "S" (as in the new formula) appears on both sides of the equation. The new formula (3) gives the same relevant optimal solutions for "S" as the complicated cubic equation, is easier to interpret and comparable to the formula of LATACZ-LOHMANN.

2 Consequences for the model results

In order to determine the consequences of the new decision rule for the model results, information is required about the position of our optimal bid curve (3) with regard to the optimal bid curve of LATACZ-LOHMANN (2). Also it is important to know the intersection of both the optimal bid curve of LATACZ-LOHMANN and our optimal bid curve with the curve of the changeover costs. In order to deal with the first issue both equations are simplified:

(2') $S(LL)_r{}^*{}_a = ½[B - C] - D$

(3') $S(HL)_r{}^*{}_a = A * ½[B - C] - D*[2 - A]$

where:

$A = 1/[1 + (1/\sigma^2{}_1)*RP_1{}^2(S)]$ $\quad B = (E(G_0) - E(G_1))$

$C = (RP_0 - RP_1(S))$ $\quad D = b/2m$

From (2') and (3') it can very easily be seen, that there will be no difference, when "A" is equal to one, i.e when the risk premium ($RP_1(S)$) in case of participating is zero. However this is not very plausible. If, as can be expected, $0 < A < 1$, the changeover costs ($A * ½[B - C]$) in (3') are smaller than the changeover costs in (2'). The reverse applies to the threshold premium. Whether the total bid according to (3') will be higher or lower than the bid according to equation (2') depends on the absolute level of the two factors the formula consists of. So, it is important to know whether there is an intersection between the new optimal bid curve (3') and the optimal bid curve of LATACZ-LOHMANN (2'), or mathematically:

(4) $A * ½[B - C] - D * [2 - A] = ½[B - C] - D$

Rearranging this equation one finds:

(5) $-D = ½[B - C]$

Filling-in into the optimal bid formulas and substitution of the letters finally results in the intersection of the two curves:

(6) $S(HL)_r{}^*{}_a = S(LL)_r{}^*{}_a = -b/m$

To the right of the intersection, the new decision rule leads to a lower optimal bid than the optimal bid LATACZ-LOHMANN deducted while to the left of the intersection, our optimal bid is higher.

(7) If $-D < ½[B - C]$ then $S(HL)_r{}^*{}_a < S(LL)_r{}^*{}_a$,

If $-D > ½[B - C]$ then $S(HL)_r{}^*{}_a > S(LL)_r{}^*{}_a$.

The intersection of the optimal bid curve of LATACZ-LOHMANN (2') with the curve of the changeover costs [B – C], can be found by equalizing (2') with [B – C]:

(8) $S(LL)_r{}^*{}_a = ½[B - C] - D = [B - C]$

Solving this equation and substitution of the letters gives:

(9) $[(E(G_0) - E(G_1)) - (RP_0 - RP_1(S))] = -b/m$

From (6) and (9) we can derive that our optimal bid curve intersects the optimal bid curve of LATACZ-LOHMANN and the curve of changeover costs at the bid -b/m. However, lacking the data, the exact position of our optimal bid curve with regard to the optimal bid curve of LATACZ-LOHMANN remains unknown (figure).

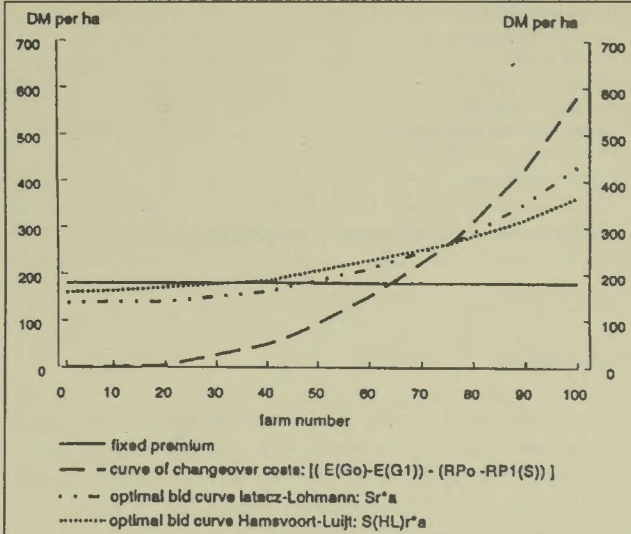

Figure: **Participation of risk-averse farmers in an extensification program in relation to the premium received in case of both an overall fixed premium system and a bid system.**

In the optimal bid curve of LATACZ-LOHMANN the threshold premium (–b/m or –D) is constant and only depends on the farmer's expected distribution function of the bids that will be accepted. In the figure this is represented by the horizontal part of the optimal bid curve of LATACZ-LOHMANN up to the point where there are no more farms without changeover costs. In our optimal bid formula however, the threshold premium equals the threshold premium of LATACZ-LOHMANN (–b/2m or –D) multiplied with the factor [2 –A]. The threshold premium in the new formula is therefore no longer constant but depends on both "$E(G_1)$" and "S" (which are part of "A"). The threshold premium in our optimal bid function can be interpreted as the optimal bid of a risk-averse farmer which results in zero changeover costs, [B –C], and equals exactly the factor "–D * [2 –A]". This has two consequences for the position of our optimal bid curve in the figure. First of all, as "S" appears in both the changeover costs and the threshold premium, it is uncertain if the same number of participating farms without changeover costs will result as in the case of LATACZ-LOHMANN's formula. Secondly, it is possible that farmers whose optimal bid according to formula (3) or (3') results in zero changeover costs, require different threshold premiums. In terms of the figure this implies that the part of our optimal bid curve which represents the participating farmers without changeover costs will not be horizontal. This is indicated in the figure by drawing our optimal bid curve not completely horizontally. The position of our optimal bid curve for a risk-averse farmer with regard to the optimal bid curve of LATACZ-LOHMANN affects the model results, as the table indicates (table 2b of LATACZ-LOHMANN).

Table: **Indications for the changes in model results due to a reformulated optimal bid function for a risk-averse farmer**

Aspect	Variants 1	2a	2b	3	4a	4b
1 participating farms	0	0	-	0	0	-
2 reduced production	0	0	-	0	0	-
3 reduced N-emission	0	0	-	0	0	-
4 budget costs	0	+	0	0	+	0
5 switch over costs	0	0	-	0	0	-
6 net-income transfer	0	+	?	0	+	?
7 DM/dt reduced production	0	+	+	0	+	+
8 DM/kg reduced N-emission	0	+	+	0	+	+
9 Effectiveness-index	0	+	+	0	+	+

0 = equal outcome; + = higher outcome; - = lower outcome.

3 Conclusions

The new decision rule for a risk-averse farmer decreases the effectiveness of the various bid systems compared to the results of LATACZ-LOHMANN to a limited extent. It also affects the number of participating farms, the reduced production and the reduced N-emission in case of bid systems with a budget limitation. Although the effectiveness of a bid system compared to a fixed premium system will be a bit smaller than indicated by the model results of LATACZ-LOHMANN, to our opinion, a bid system remains more favourable than a fixed premium system. In this connection we support LATACZ-LOHMANN's conclusion 'that the best results are achieved with a bid system with regionally set levels for the exclusion of bids'. However, we have some doubts when he adds to this conclusion 'or by a system with regionally fixed premiums'. According to LATACZ-LOHMANN, in the latter system the premium can only be fixed in the right way when information is available about the changeover costs of the individual farms in the region (in order to calculate an average premium). But the model is based on some extreme assumptions and simplifications. For instance the changeover costs depend only on the region (as an indicator for the quality of the land). The changeover costs are then calculated as the change in market income, whereby this market income is equal to the difference between the turnover of agricultural products per hectare less the costs of nitrogen input. However, even within a region there will be differences in the quality of the land, leading to different production levels per hectare among farmers. Moreover when also other costs besides nitrogen costs are included in the calculation of the market income, the differences among farmers in a region will be even larger. The larger these differences the more variation there will be around the estimated average changeover costs. As a consequence the 'theoretical' advantages of the regionalized fixed premium system will largely vanish. A second important simplification of the model is that farmers in the model decide on a bid for their total acreage only. So, either 0 hectares or 100 hectares will be offered to the program and accepted or not. However, in practice a farmer produces different agricultural products with different profit potentials and most likely offers only part of his acreage to the program. Thus, besides the bid level, also the number of hectares is a decision variable. This again will complicate the calculation of the changeover costs in a regionally fixed premium system. In a bid system however the number of hectares being offered to the program will be part of the bid.

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Response

UWE LATACZ-LOHMANN

I appreciate the comments by C. VAN DER HAMSVOORT and J. LUIJT. Their thorough inquiry helped uncover an error in the optimal-bid formula for a risk-averse farmer. VAN DER HAMSVOORT and LUIJT develop a modified formula and draw conclusions about how the new formula is likely to affect the results of the model calculations carried out in my article. To my understanding, their formula is correct. VAN DER HAMSVOORT and LUIJT do, however, draw the wrong conclusions.

1 Reviewing the problem

The risk premium, as defined by formula (13) of my article, is (besides other variables) a function of the level of income. As income in the case of participation is the sum of market income [$E(G_1)$] and the conservation subsidy (S), the risk premium is also dependent on S. VAN DER HAMSVOORT and LUIJT point out correctly that this fact has to be taken into account when taking the partial derivative of my equation (9) with respect to S in order to determine the optimal bid of a risk-averse farmer. As a matter of fact, I failed to consider the presence of S in the formula for the risk premium. The equation to determine the optimal bid for a risk-averse farmer then becomes:

$$(1) \quad \max_S ER_{ra}^{\ v} = [(E(G_1) + S - RP_1(S)) - (E(G_0) - RP_0)] * (mS+b)$$

as opposed to

$$(2) \quad \max_S ER_{ra}^{\ v} = [(E(G_1) + S - RP_1) - (E(G_0) - RP_0)] * (mS+b)$$

as given by my equation (9).

Taking the partial derivative of equation (1) with respect to S yields – after some steps of rearranging and substituting – VAN DER HAMSVOORT and LUIJT's modified formula for the optimal bid of a risk-averse decision maker (their equation (3)).

After having arrived at that point, VAN DER HAMSVOORT and LUIJT calculate how the modification of the decision rule affects the results of the model calculations. Their first step is to compare both optimal-bid formulas in order to find the location of the new optimal-bid curve relative to the curve derived by the old formula. At this point however,