SESSION 9. PRODUCTION MANAGEMENT AND PROCESS CONTROL

REVIEW: SELECTED ECONOMIC ASPECTS IN THE MEAT BUSINESS - A REVIEW, ACTUAL PROBLEMS AND PROSPECTS FOR THE FUTURE

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The session production management and process control which will deal with the investigation of economic aspects in slaughtering, cutting and meat processing is a new theme in the congress. This introductory paper to meat business economics therefore aims primarily at giving a broad overview over the prevailing economic problems in the meat business.

The focus will be on systems analysis approaches, at first, on the meat industry macro level and then will quickly turn to the micro level, that is the aspects of how the single industries plan and control their economically critical operations and how they have been acting on market prices up to now, which will be referred to as 'PRICE COORDINATION'.

A. THE MEAT INDUSTRY AS A MACRO MODEL - TOTAL SYSTEM ANALYSIS APPROACHES

Since the appearance of the standard book of Baumol on Economic Theory and Operations Analysis (7), a number of attempts have been made to simultaneously analyse the MEAT PRODUCTION SYSTEM by system analytical methods ((1)-(6)). As shown in FIG. 1 the MEAT PRODUCTION SYSTEM consists of breeders, producers, feeders, packers, meat processors, distributers and finally the consumer. It is dependent on a multitude of influences, such as genetic change, technological change, as well as a change of consumer attitudes.

To outline an optimal COORDINATION POLICY for the total meat production system, it is necessary to transform this extremely complex reality into a meaningful abstract mathematical model of lower magnitude in order to be able to evaluate the model and to identify critical system parameters. In this way we may be able to gain a feedback information on how the production system could in reality be operated most efficiently.

The preconditions are:

1. Exact definition of the goal (overall profit maximisation) REMEMBER: ONLY BY SHOWING A PROFIT A FIRM OR INTEGRATED INDUSTRY IS ABLE TO STAY IN BUSINESS.
2. Selection of model parameters which are supposed to be critical.
3. Description of the techniques and economics involved.
4. Definition of system restrictions.

All of these are necessarily expressed in the stringent form of mathematical terms (mostly linear (in-)equations). This helps to maintain logical consistency.

If we are lucky and such an analytical model can be solved by an adequate method - such as linear, integer or quadratic programming techniques - we have the chance to obtain deeper insight into how the system works in reality. But due to necessarily made simplifying assumptions in model building, we do not get the exact outline of an optimal policy as a result, we just get the direction for improvement. So some system analysts state, that the goal of these macro models is insight, not numbers.

Additionally, since in reality there is generally no existing coordinating body for a total sector - (except in vertically integrated enterprises (U.S.A) and enterprises in state capitalistic environment (U.S.S.R.)) - there is no responsibility for operating the total system optimally. Thus, very little of the system insight to be gained will lead to action.

What is prevailing in Europe up to now are highly unrelated enterprises which make decisions of their own. These are mostly based on (simple?) PRICE COORDINATION. The single industries are opponents in the market and act accordingly with an "us" and "them" attitude. If we want to improve the total meat production system by POLICY COORDINATION, we at first have to gain a complete insight into how the single industries are being managed (by controlling their critical parameters) and how they have been cooperating by mere price coordination up to now.

B. THE MICRO ECONOMICS OF THE SINGLE INDUSTRIES INVOLVED IN MEAT PRODUCTION

Slaughterhouse operations lie in the center of the total meat production system. They are the binding element and should consequently play a dominant role in transforming economic information between the market segment on the one hand and the animal production segment on the other. It is exactly here where economic information of upmost importance for the related sectors could be gained - but mostly will not (among other reasons because of the "us" and "them" attitude). To construct a meaningful information system in the slaughter area from a scientific point of view we must be fully aware of the kind of information which is necessary in managing the slaughter area itself as well as the pre- and post-areas (FIG. 2).

The first look, therefore, will be at the micro-economics of a pig enterprise as an example for the production sector.

B.1 THE MICRO ECONOMICS OF ANIMAL PRODUCTION - THE MODEL CASE OF A PIG ENTERPRISE

In contrast to macro models, the chance of influencing a production process positively by systems analysis is far more likely on the micro level. This is due to a reduced problem (model) complexity, the principal access to process data and, last but not least, an identifiable responsibility for operating an enterprise with success. Economic factors, that have an impact on the costs and returns of a pig enterprise and consequently on the

resulting profits are shown in FIG. 3. In this production system, the pay-out price of the slaughterhouse per pig delivered is the most important factor.

In this environment the set of optimal parameters can be calculated by linear programming (LP) techniques. The kind of questions which could be answered by such an LP approach (dependent on the time horizon being modelled) are:

1. What breed to select? 2. What feeding regime to apply?. 3. Which is the optimal slaughterweight? 4. Where to invest scarce capital first (building/stock/manpower)?

But even these somewhat simpler models require a sound data base which must be obtained from all involved elements - which is very cumbersome and costly.

For this reason, the calculation routines in this sort of enterprise are a lot cruder. FIG. 4. shows how the calculation of margins for pigs of different genetic origin is currently being made in the evaluations of a german Extension Service.

In these calculations the slaughterhouse pay-out prices per pig are reduced by the variable and fixed costs resulting in a margin per pig, which is then corrected by the turnover rate and results in a margin per feeding place.

Again we notice that the coordination with the subsequent slaughterhouse industry is simply made by simple PRICE COORDINATION (by means of the pay-out price per slaughter pig). An understanding of how pay-out prices are actually determined by slaughterhouse operators is, therefore, urgently needed. More so when we notice the evaluations depicted in FIG. 4. assume that the value of a breed is a function of the grading system applied - be it a visual or an apparative classification. In contrast to that - from a slaughterhouse operator point of view -the possible pay-out price for a slaughter animal/carcass always has to be seen in close connection with the real use of the specific animal/carcass (=returns per animal/carcass and the related cost of processing it). This aspect forces us to have a deeper look into the micro-economics of a slaughterhouse.

B.2 MICRO ECONOMICS OF SLAUGHTERHOUSE OPERATIONS

In contrast to financial bookkeeping procedures, sound managerial cost accounting procedures for an industry are always closely related to the production process to which they apply, they are almost a 1:1 projection of technology in economic data. For slaughterhouse operations this is demonstrated in FIG. 5.

The backward orientated calculation (Greer (23)) starting with the returns gained from a specific animal, subtracts all variable costs which are due to processing the animal (this defines a short term max. pay-out price), makes allowances for fixed cost elements (such as depreciation and interest) and a planned profit. Thus, it traces back to a planned (normal) pay-out value for a specific animal/carcass of a certain grade.

These are firm internal values for an animal/carcass which are calculated principally for single pigs/carcasses, per purchase and per grade and which in principle could be additionally distinguished due to different genetic origin (breeds) - if this information is saved. For the evaluation of economic breeds, the different short term max. pay-out prices are, in my opinion, the best means, because they are not distorted, for example, by different rates of depreciation and different profit margins.

Despite this possibility I did not find publications which do this with the required economic depth.

Additionally, slaughterhouse operators, in general, are not in the frontline of developing sophisticated accounting systems. Mostly they just have financial bookkeeping procedures and some cost tests/cut out tests. But, hopefully, there are exceptions.

Recently in West Germany I noticed a small slaughterhouse operation with an excellent management that runs a highly sophisticated direct costing system which by far exceeds the system which I had proposed at the EMRW congress in 1984 (24). This self-developed accounting system is based on a data base system and is evaluated on a multitude of objectives, such as the determination of grade related (planned) pay-out prices, buyer performance, seller performance, market-shares by animals dealers, customer preferance of grades (origins), as well as, of course, the assembly of the grade related profit statement.

In contrast to the Germans, some American and Danish slaughterhouse operators run (weekly) linear programming models for production planning (20, 21), which apply when several bottlenecks exist.

But even when running such highly sophisticated systems - which, as a general rule, are not discussed publicly, the basic aspects of (internal) value determination remain valid; the main factor being that no slaughterhouse operator can pay out more for an animal/carcass than he gets on the market less the costs of converting the animal to saleable products (19, 22, 53). We recapitulate that the economic value of a specific animal/carcass in a slaughterhouse is defined as shown in FIG. 6.

Unfortunately, research workers very seldom have access to these firm internal data, so that they seem to be forced to use proxies in determining economic value. Thus, in literatur the value of (pig) carcasses/animals is mostly supposed to be a function of lean meat percent (pl) and the combined effect of quality parameters q_i.

This approach which prevails in Europe has many disadvantages from an economic point of view:

1. It is not quite clear how to determine this function exactly. Mostly a negociated (not calculated) base price for a so-cal-

led standard pig is taken for granted; additionally price differentials for a deviation from standard lean meat percent are set in a free mode.

2. There is no direct interaction with the customer markets. Since industries only produce for the markets, only the markets can give a feedback of what is demanded.

3. It is an artifical value determination which implicitly assumes, that lean in a (pork) belly is worth the same money as the lean of the (pork) filet. The market prices do not support this assumption; additionally lean meat anywhere is a totally other conception than lean meat somewhere.

4. A selection of animals from different genetic origins is not possible for farmers, when these show approximately the same lean meat values and are paid the same price. The goal of producing lean meat type pigs has already been achieved. In Germany, for instance, more than 70 percent of the pig carcasses are classified in the best category (E) of the grading system, so that for the majority of the farmers new economic signals are needed in the process of breed selection more than ever.

Thus, a grading system probably might be overloaded, if it is simultaneous:

1. to classify carcasses due to economically relevant traits (such as cut out (51, 53) and type (57),
2. to calculate the pay-out prices directly,
3. to direct production into more desirable areas,
4. to inform customers about all the multiple quality aspects involved.

Thus, according to Sim (54), we use proxies for the most critical information interface (=grading and price formation) of the process of converting livestock into meat, which might be at the disadvantage of all industries involved.

A solution for this problem could be to apply different methods for obviously different purposes, which might be:

1. to determine as accuratly as possible cut out values with apparative methods (rather than the proxy lean meat percent, which could additionally be given) as this is the most important trait for the slaughterhouse customers (especially meat cutters),

2. to determine economically meaningful pay-out prices by means of backward orientated calculations (this calculation could be supported by a price reporting system on the wholesale cut level, as proposed by Bache (46)),

3. to ask slaughterhouse managements for value differences of animals of different origin, which they might evaluate by higher sophisticated accounting methods based on data base systems,

4. to offer customers/consumers products of different quality which are labeled and priced accordingly. Thus, the consumer can decide on whether to spend more money for a better quality or not. This consumer decicion leads to different returns for higher/lower quality meats and, thus, gives a clear signal for an economically meaningful production direction.

Thus, the prices paid by customers determine (to an extraordinary high degree) the pay-out ability of a slaughterhouse and can, if evaluated in an adequate manner, show ways for a more profitable animal/meat production.

B.3 THE MICRO ECONOMICS OF THE MEAT PROCESSING INDUSTRIES

Between 60 and 80 percent of the total cost of a meat processing plant are raw material cost. Thus, for a firm it is extremely important to control raw material cost by adequate planning and control procedures. To achieve optimal input-output decisions in a meat processing plant (in the U.S., not so often in Europe) linear programming models are usally used. Mostly, in the reference literature single formula optimization and sometimes multiple formula optimization are described (IBM (61, 62), Kramlich et al (64), Lorenz (66)), which should lead to effective (cost minimal) use of raw material.

But, if a purchase already has been made, there is no chance of influencing the raw material cost decisively. What then remains, is just to standardize the products, so that the powerful tool of linear programming is not used to its full advantage. Additionally, formulas which are optimal in terms of single (multiple) formula optimization are not necessarily optimal with respect to the total material balance. So what should be done more often is to plan the purchases ahead which optimally fit into the firm's total production/sales program. In such planning models which enclose the whole material balance of a firm (Thormählen (71), Müller (69)), changing raw material prices lead to an other optimal combination of purchases. This fact again underlines the dominating principle of PRICE COORDINATION - here between the slaughterhouse and the meat processing industries.

From a topological point of view the production process of sausage manufacturing is a complex disassembly - assembly process (FIG. 7), which, when described in linear (in-) equations could not be resolved either by the final products nor by the raw material input - as outlined by Müller-Merbach (33).

In consequence, only optimizing a target function (minimizing raw material cost or alternatively maximizing profits (sales)) above the given simplex (set of (in-)equations defining the production system) seems to be possible from a scientific point of view (Müller-Merbach (33, 68)). Examples of how such models could be constructed are given in Müller-Merbach (68), Müller (69), Thormälen (71).

A reason for the relative neglect of this powerful tool in West-Germany is, that traditional processors fear that they might not be

able to maintain their quality standard when formulas are calculated by a computer. So, in Germany, the aspect of integrating 'quality' in linear programming models seems to play a key role. To be able to do this, the interaction of raw material use and technology applied on the one hand, and resulting quality on the other hand, has to be completely examined and understood. Studies which I found very interesting in this respect are, for example, carried out by MacDougall and Allen (72), Bristol and Hammer in Kulmbach (73). This area may constitute a fertile field of further research, as it is of methodological (research) and of practical interest (industry).

C. CLOSING REMARKS

The aim of this introductory paper on meat economics was to give an insight into the basic economic concepts that principally exist (but are not always recognized) for the single industries which convert meat animals to meat products. In a capitalistic economy for each and every firm involved in that process the goal of staying in business can only be achieved when a profit is made. Thus, the interaction of the technical structure of the production processes and the necessarily resulting structure of profit planning/accounting procedures to be applied in these industries were outlined. A complete understanding of the micro economics of all industries involved in the conversion process is one necessary precondition in order to move from the actual PRICE COORDINATION to a scientifically more desirable POLICY COORDINATION. However, the degree to which POLICY COORDINATION in the (far) future may apply to the animal/meat industry depends on the ability of principally independant decision makers in these industries to work together. This cooperation is difficult, since it means that additional profits (losses) resulting from such a cooperation have to be determined and shared. Even though the micro economics of the single industries have not been outlined as accuratly as necessary for this purpose, a great deal of research still has to be done.

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