COSTS, BENEFITS AND TRANSFER PRICES IN DIFFERENTIATED PRODUCTION-MARKETING CHAINS FOR FRESH PIG MEAT

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1. INTRODUCTION

There is a growing tendency for single enterprises to intensify vertical cooperation within agricultural production-marketing chains. Reasons for this involve both specific characteristics of agricultural food chains and changes in market circumstances (Den Ouden et al.[1]). Nowadays, increasingly diverse consumers are showing a growing interest in product quality as well as in the production and distribution process, food safety issues, quality and convenience factors, animal welfare and environmental pollution (Anonymous[2]; Barkema[3]; Miller[4]). This creates opportunities for selecting market segments to which more value can be offered through product differentiation. Simultaneously, these changed preferences have, above all, to be transmitted to farm stages, highlighting the level and smoothness of vertical coordination and communication. In the Dutch pork industry, differentiated chains have been developed, which make special demands add costs to the production process to guarantee final products that meet these specific consumer demands.

Especially in the case of product differentiation, it is desirable to gain insight into the way costs and benefits along the various stages of the chain are influenced and distributed. These insights may help to develop effective - transfer pricing - instruments. Since prices are considered to be efficacious incentives in affecting economic decisions, they can be used to serve as appropriate signals to transmit consumer preferences throughout all stages of the vertical system. In this paper an economic pork chain simulation model is used to quantify the effects of two differentiated pork chain concepts. Compared with standard pork production, the differentiated pork concepts were characterized by specific-record keeping requirements to provide additional information on origin of the animals, hygiene and drug use; and by special feeds, housing and handling systems to improve the pigs' welfare. Effects on technical performance, additional costs and chain benefits were quantified. Although one differentiated pork concept incurred additional chain benefits, results showed an unbalanced distribution of extra costs and benefits. The effects of varying market circumstances on chain profitability and distribution of profits and losses are demonstrated as well. Furthermore, a conceptual framework is presented and used to study and quantify the effects of several transfer pricing keys. Various so-called 'cost-plus' based transfer keys proved

to have a considerable though smaller impact on the calculated transfer premiums than did the varying market conditions. This highlights the importance of a profound analysis of expected market share and regular updating of transfer prices. Different ways of sharing or transferring market and production risks proved to have major consequences. Although generally accepted criteria for choosing a 'fair' transfer pricing key seem to be lacking, the premiums calculated based on either absolute or relative transfer keys were found to be rather stable.

2. MATERIAL AND METHODS

2.1 Pork chain simulation model

Basically the purpose of the probabilistic pork chain simulation model is to simulate technical and economic performance of individual stages and pork production-marketing chains as a whole. Special emphasis is put on the economics of interstage relations and product differentiation. Economics are presented per animal or per carcass sold where costs incurred are split up over labour costs, interest, depreciation, raw material costs and sundry costs.

Input variables of the model involve economic items such as feed prices, interest rates and depreciation times and technical items such as farm lay-out, culling and reproduction policies, assumed daily gain etc. The farm lay-out, including housing and feeding facilities, is related to the labour required for handling the animals in the farm stages. In the default situation, feeding is assumed to be either a semi-automated or non-automated activity. Technical and economic output is calculated based on the input values. An important item in the farm stages is a farm's scale, which represents the number of animals one full time equivalent can handle. The farm scale is related to the efficiency of fixed assets such as housing facilities. Moreover, together with output on matters like the number of production cycles realised per year, it determines how many pigs can be sold annually. In turn, the number and live weight of pigs sold per time unit influences transportation efficiency and costs. At the slaughterhouse, pigs are slaughtered and carcasses are further processed. The quality of a carcass is related to the live weight of the pig and is further based on its weight, lean meat percentage and overall body composition. Based on demand specifications, the carcass quality classes are related to the processing options applicable to the carcass and therefore to the processing costs and the potential value of the carcass. A comprehensive description of the model structure and behaviour is presented in Den Ouden et al.[5].

2.2 Differentiated chain concepts

Various pig chain concepts have been developed in the Netherlands (Den Ouden et al.[1]). The two examples described in this paper are based on concepts practised on the Dutch market. The first and most common concept in pig production is called 'Integrated Quality Control' (IQC). It was designed to provide consumers with guarantees on hygiene, food safety and origin of the pork (Den Hartog et al.[6]; Anonymous[7]). Key issues involve the recording

of information and its exchange between the different stages in the pig chain. Moreover, only a limited number of medicines have been approved for use over a limited period of the production cycle. It is in practice since 1992 and includes pig farrowing (from 1993), pig fattening and pig slaughtering. Covering already about 45% of the pigs produced in the Netherlands in 1995, it is growing rapidly to its goal of becoming the national standard. As such it will also be the basis from which consumer labelled pork products will be developed. An example of consumer labelled pork described is based on the 'outdoor' pig concept. It pursues an amelioration of the pigs' welfare through adjustments in the housing, handling and feeding of pigs (Anonymous[8]). This concept involves pig farrowing, fattening and slaughterhouses. As there was no data available about the slaughtering stage, this stage is not considered in the analysis of the outdoor concept. In Table 1 the specific production conditions of the two chain concepts are presented as opposed to the input values of the default pig chain. All data refer to the 1992/1993 situation. Although they relate(d) to real-life chain concepts, simplifications were made for illustrative reasons and reasons of simplicity and confidentiality.

Regarding the IQC concept, the additional record-keeping tasks were assumed to take about a quarter to half an hour extra per week. Moreover, twice a year, each farm is submitted to a routine check assumed to take a whole morning or afternoon. In return for the extra information a premium was paid of Dfl. 1.0 per feeder pig and Dfl. 4.0 per fattened pig sold (Table 1). The premiums were paid for all fattened pigs supplied regardless of whether or not they fulfilled all concept specifications. Only boars and pigs that were condemned during ante mortem inspection at the slaughterhouse, were not rewarded with the premium price. This meant, for example, that pigs that had been given drugs after the allowed production period also received the bonus even though those carcasses could no longer be sold under the concept specifications. The reason why this was done was to assure the supply of sincere information.

Table 1. Major technical and economic input values of the farrowing, fattening and slaughtering stages of the standard (default), the IQC and the 'outdoor' pig chain concepts.

Variable	Default	IQC	Outdoors
Farrowing stage			
group housing non-lactating sows	No	-	Yes
concrete floor space nursery (m^2)	0	-	+4
total floor space nursery (m^2)	3.75	-	+2.75
outdoor space (m^2)	0	-	+10
straw supplied (kg/sow/day)	0	-	+0.3-1
concentrate-roughage ratio	5:0	-	5:1
pre weaning mortality rate (%)	13.2	-	+2.8
weaning age piglets (days)	28	-	+14
special record keeping requirements	No	Yes	Yes
control chain concept requirements	No	Yes	Yes
contribution price (dfl./feeder pig)	0	-	+2.80
premium price (Dfl./feeder pig)	0	+1.0	+23.38
Fattening			
concrete:total floor space (m^2/pig)	0.32:0.74	-	0.625:0.95
outdoor space (m^2/pig)	0	-	+0.625
straw supplied (kg/pig/day)	0	-	+0.1
concentrates-roughage ratio	10:0	-	10:1
average daily gain (grams/day)	719	-	-30
feed conversion ratio	model[1]	-	+0.15
special record keeping requirements	No	Yes	Yes
control chain concept requirements	No	Yes	Yes
price finishing feed (Dfl./100 kg)	44.7	-	-
contribution price (Dfl./pig)	0	-	+2.80
premium price (Dfl.)	0	+4/pig	+0.91/kg
Slaughtering			
price of earmarks (cents)	3.83	+1.55	-
% pigs condemned ante mortem	1.50	-0.2	-
carcass weight (kg)	83	-	-
% best body composition-quality	14	+2	-
control chain concept requirements	No	Yes	-
Premium price (Dfl./kg)	-	+.25/kg	-

Aimed at improving the pigs' welfare, the outdoor concept is characterized by additional requirements concerning more indoor and outdoor space, the supply of straw and roughage, group housing of non-lactating sows and an increased age at which piglets are weaned. In the Netherlands, the technical performance of 'outdoor' herds is found to be somewhat lower than average

(Kleijn et al.[9]; Bens[10]). For example, feed conversion ratio and daily gain are assumed to be respectively 0.15 higher and 30 gram per day lower than average (Table 1). Besides the premiums received for the animals reared and sold by this method a contribution per animal to was paid to the foundation of international outdoor produced meat as well (Anonymous[8]) (Table 1).

To be able to recognize and separate pigs reared in various ways, and pigs that did not meet the concept specifications, different coloured earmarks were used in the slaughterhouse (Table 1). Besides, several other precautions and activities were necessary to keep the carcasses and meats of the various systems separated during slaughtering and processing and to switch between types. For example, small numbers of slaughter hooks were deliberately left open to visually mark the switch to slaughtering pigs of another type. Additional efforts were required in processing the supplied information, visiting the suppliers for routine checks twice a year and checking of the slaughterhouse itself each six months.

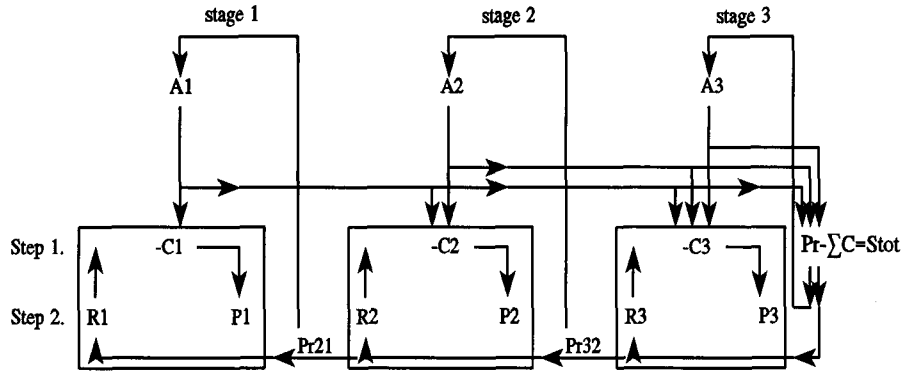
IQC pigs were found to have a somewhat higher carcass quality compared with default. The percentage of carcasses rated in the best body composition class increased from 14% (default) to 16% (Table 1). The increased attention for the health status of the pigs might have contributed to a lower percentage of pigs condemned at ante mortem visual inspection. Of course, the assumptions made with respect to input values will determine the output obtained. However, the big advantage of using the simulation model is that it is flexible enough to allow the user to adapt input values to production and market circumstances worldwide.

2.3 Conceptual redistribution framework

In accordance with transfer pricing theory, effective payment systems should (1) lead to economic decisions that positively affect chain performance, and (2) give the separate participants the feeling that they are being fairly rewarded for the contribution they are making to the chain result (Eccles[11]). Schematically a conceptual framework for the analysis of transfer pricing keys is given in Figure 1.

Figure 1 represents a hypothetical chain consisting of three successive stages. Costs, returns and profits or losses at stage i are denoted by the symbols C_i, R_i, and P_i respectively. Activities performed at stage i, denoted A_i, may influence both costs incurred at that stage and performance at subsequent stages. Together, the combined activities performed determine the bundle of characteristics of the product finally sold to the end buyer. In this way the

price the final buyer is willing to pay will be affected as well. In analyzing the transfer pricing systems of - differentiated - products, first (step 1) total - additional - costs ($\sum_i C_i$) and - extra - buyer price (Pr_B) are combined to yield the - additional - net chain result (S_{tot}). In redistributing the buyer price or - additional - chain result, the - extra - costs are compensated. In the next step (step 2), the remaining - extra - net chain result is divided among the chain participants according to a certain transfer pricing key. This redistribution process determines the transfer prices or premiums/discounts ($Pr_{i+1,i}$), resulting in returns R_i and net results P_i of the individual chain participants. In general this type of transfer key based on compensating full - additional - costs plus a part of the net chain result, are denoted as so-called 'cost-plus' transfer pricing systems. In the case of differentiated products, premiums or discounts are usually paid in addition to regular market prices.



Ai = Activities performed at stage i
Ci = Costs incurred at stage i (excl. products received from stage i-1)
Pr = Final buyer Price received at the end of the chain
Stot = Net chain result or chain surplus
Pri+1,i = transfer Price paid at stage i+1 for products received from stage i
Ri = Returns at stage i
Pi = Profit/loss, or net result, at stage i

Figure 1. Conceptual framework for analyzing transfer pricing systems

3. RESULTS

3.1 Differentiated pork chain concepts

In Table 2, the major technical and economic results of the different chain concepts are presented. Regarding IQC and Outdoor, results are presented as

the difference compared with the results of the default chain. With respect to the farm stages, major effects on overall efficiency were found in the outdoor chain. In addition to considerably higher labour requirements, caused especially by having to supply roughage and straw, overall efficiency was further reduced by the decrease in the annual number of production cycles. Primary causes of the latter included the increased weaning age of piglets in the farrowing stage and the lower growth rate of fattening pigs in the fattening stage. As a result, the farm scale dropped from an average of 127 sows and 1466 fattening pigs present in the default situation to 93 sows and 767 fattening pigs respectively. Scale diseconomies were found in labour costs, some general farm costs, and housing costs in particular. At the farrowing stage, feed costs per sow per year decreased however. This resulted mainly from the lower amount of expensive piglet feed as a result of the longer lactation period. In contrast, a lower feed conversion ratio and the extra roughage costs resulted in an increase of feed costs per fattened pig sold. Moreover, although the heating costs declined, total sundry costs increased. This was mainly due to the costs of straw, the contribution paid to the outdoor foundation, increased manure costs and some scale diseconomies in overall farm costs. Because the outdoor space was only partly covered by a roof, rain water caused the total manure-water volume to increase resulting in higher manure removal costs. Smaller batches of feeder pigs caused an increase of feeder pig transportation costs incurred at the fattening stage.

Based on Den Ouden et al.[12], the effects on environmental parameters, such as nitrogen and phosphorus efficiency, were also simulated. In total, the less efficient outdoor performance resulted in approximately 8% higher excretion of nitrogen and phosphorus per pig sold. Combined with relatively big increases in outdoor space, the volatilization of ammonia per pig sold increased by 50% or more. As a result, nitrogen leaching decreased by 25% to 32% per fattened pig and feeder pigs sold, however. With respect to IQC, no significant effects were found on environmental variables in the farm stages.

Table 2. Major technical and economic results of the various pork chain concepts: default, IQC and outdoor. As no data was available on the slaughtering stage of the outdoor chain, results of this stage are omitted.

Technical results	Default	IQC	Outdoor
Farrowing stage			
labour (hours) per sow	18.4	+0.2	+6.8
production cycles pspy[1]	2.29	-	-0.19
feeder pigs sold pspy	21.1	-	-2.38
Fattening stage			
labour (hours)/pig sold	0.5	+0.01	+0.52
feed conversion rate	2.80	-	+0.15
production cycles/year	2.94	-	-0.12
Slaughtering stage			
% pigs receiving a premium	-	97	-
% carcasses receiving premium sales	-	15	-
Economic results	**Default**	**IQC**	**Outdoor**
Farrowing stage			
labour costs/pspy	599.4	+6.3	+222.1
housing costs/pspy	717.7	+0.4	+138.4
feed costs/pspy	834.6	-	-53.6
other cost/pspy	503.5	+0.7	+141.9
Total costs/pfps[1]	125.8	+0.3	+39.95
Revenue/pfps	107.6	+1.0	+23.4
Net result/pfps	-18.2	+0.7	-16.6
Cash flow/pfps[2]	12.0	+0.7	-7.0
Annual farm income[3]	48,406	+2,032	-15,320
Fattening stage			
labour costs/pps[1]	17.0	+0.3	+16.9
housing costs/pps	34.4	+0.05	+8.6
feed costs/pps	111.1	-	+8.2
transport fp/pps	2.4	-	+0.2
other costs/pps	27.1	+0.07	+10.6
Total costs/pps	192.0	+0.4	+44.5
total costs + feeder pig	301.9	+1.4	+68.4
Returns/pps	282.8	+5.2	+72.5
Net result/pps	-19.2	+3.8	+4.2
Cash flow/pps[2]	12.9	+3.9	+11.9
Annual farm income[3]	34,892	+17,517	+35,403
Slaughtering			
transportation/pcs	3.7	-	
Total costs/pcs[1]	48.2	+0.8	
total costs + pig	331.0	+6.0	
Returns/pcs	326.2	+2.2	
Net result/pcs	-4.8	-3.8	
Cash flow/pcs[2]	0.7	-3.8	
Annual income[3]/f.t.e[1]	38,059	-8,801	
Chain			
Total costs/pig	366.0	+1.5	+84.4
Returns per pig	326.2	+2.2	+72.5
Net result/pig[4]	-39.9	+0.7	-11.9

[1] pspy = per sow per year, pfps = per feeder pig sold, fp = feeder pig, pps = per pig sold, pcs = per carcass/cuts sold, f.t.e. = full time equivalent

[2] Cash flow = net result + depreciation + (calculated - paid) interest

[3] Annual income = (net result + labour + (calculated-paid) interest) * the annual number of animals sold or handled per farm or f.t.e..

Table 3. The effect of market risks (selling alternatives) and various buying alternatives, on the premiums and total prices paid and received per average pig, and the net slaughter and chain result (Dfl./head) in the IQC chain.

Alternatives[1]	% Pigs rewarded	Premium (Dfl./head)	Total price (Dfl./head)
Buying			
B_I	97	3.9	288.0
B_{II}	90	3.6	287.7
B_{III}	65	2.6	286.7
Selling			
S_I	15	2.2	328.4
S_{II}	65	9.6	334.5
S_{III}	90	14.2	338.9
Combination		Δ Net result slaughter[2]	Δ Net result chain[2]
$B_I + S_I$		-3.8	+0.7
$B_{II} + S_{II}$		+2.7	+6.8
$B_{III} + S_{III}$		+8.1	+11.2

[1] B_I : all pigs supplied except boars and pigs condemned at visual inspection
B_{II} : B_I without pigs that fail the concept guarantees
B_{III} : B_{II} without pigs that fail certain quality specifications
S_I : assumed customer demand
S_{II} : all carcasses that meet the quality specifications
S_{III} : all carcasses supplied under the concept guarantee, except those with severe pathological lesions or of (too) poor quality

[2] Results represent the difference in Dfl./head compared with the results of the default chain concept.

With respect to the IQC concept only minor effects on labour use and costs were calculated. Consequently, so were the scale diseconomies in housing and sharing other general farm facilities. In total, IQC incurred higher slaughtering and processing costs. As they are slaughtered on a separate, less efficient slaughterline, the lower percentage of pigs condemned at ante mortem inspection did not lead to a decline in the overall slaughtering costs. About 80% of the total extra costs were related to the intensified relations with suppliers, including the twice-yearly IQC chain controls of the farmer-suppliers and the slaughterhouse itself, and the higher degree of further processing of carcasses. The major part of the remaining costs consisted of extra administrative tasks and separation and switching costs during slaughtering.

In total, the IQC concept incurred an increase in net chain profit of Dfl. 0.7 per pig (Table 2), while the outdoor concept incurred a decrease of the net farrow-to-finish result. With respect to the latter, the fattening stage, however, improved its net result by Dfl. 4.2 per pig sold. Also in the IQC chain the changes in net chain result seemed to be redistributed oppositely, resulting in a decrease in net slaughtering result while the farrowing and fattening stage

gained the benefits. As shown in Table 2, the slaughtering stage paid premiums for about 97% of all IQC pigs supplied. On the other hand, demand conditions were assumed such that only 15% of the carcasses could be sold at a premium value. As a result, Dfl. 5.2 was paid extra per average IQC pig, while an extra value of only Dfl. 2.2 was assumed to be received per carcass/cuts sold. Besides the concept premium of Dfl. 3.9 per average IQC pig, also higher prices were paid for higher carcass quality (see Table 1).

In Table 3 the effects of market risks on the net slaughtering and chain result are further illustrated. Logically if the market shares of IQC were to rise above the assumed 15%, more carcasses could be sold at a higher value. As a result, the premiums received per average carcass/cuts sold and the extra net results increased. At best, 90% of all IQC pigs supplied were assumed to be sold at the higher quality-concept value, which represented all the pigs supplied under the concept guarantees except for pigs with severe pathological lesions or pigs which failed to reach the quality norm (S_{III} Table 3). Based on customer demand specifications, additional quality specifications were assumed to be defined in terms of specified ranges of carcass weights, lean meat percentages, body composition and potential other carcass or meat quality parameters. Supposing that these specifications were taken into account, the saleable volume would be reduced further (S_{II} Table 3). Besides additional marketing efforts to increase market shares, net slaughtering results could also be increased by further restricting the conditions at which premiums are paid (buying alternatives in Table 3). Of course, the latter alternatives will effect the net fattening result reversely. Combining the most favourable market alternative S_{III} with B_{III} (Table 3), the extra net IQC result would increase by Dfl. 8.1 for the slaughtering stage and Dfl. 11.2 for the chain as a whole (Table 3). These results, however, need yet to be corrected for potential additional costs as result of e.g. further processing needs.

3.2 Distribution of benefits or losses

Cost-plus based transfer keys can be based on either the absolute of the relative contribution of each stage to certain total chain costs. In case of relative cost analysis, additional costs are compared with a - predefined - default situation. In Table 4 the effects are presented of several cost-plus based transfer keys on the premiums paid for intermediated products ($Pr_{i,i-1}$ Figure 1) and the resulting distribution of the extra net chain result (P_i Figure 1) of IQC and 'Outdoor'. Besides the absolute and relative transfer keys based on total costs and factor costs, results of a transfer key based on the factors labour and own capital employed were also presented. The latter key is used in the Netherlands for distributing profit or loss in weekly published calculated feeder pig and fattening pig prices. In the case of IQC, results are shown for two possible market situations (Table 3).

In calculating the premiums it was attempted to assure that 1) no opposite changes in net results occurred among chain participants, 2) premiums are corrected for potential benefits in the form of carcass quality premiums, and 3) no discounts instead of premiums are calculated if the extra net chain result is

positive. This implied that in line with the conceptual framework (Figure 1), premiums consisted of a compensation of the additional costs incurred (Step 1 Figure 1) coupled with a share of the extra net chain result (Step 2 Figure 1). The extra net result was divided according to the transfer key chosen and corrected for a potential additional carcass quality benefit.

As might be expected, the market conditions proved to have a great and varying impact on both the total amount and the distribution of profit or loss along the stages of the pork chain concepts. This was clearly reflected in the levels of the premiums calculated (Table 4). Compared with the effects of the various market situations, the effects of the different transfer keys on the calculated premiums were relatively smaller. All transfer keys resulted in a consistent redistribution of the extra net chain result. That is, no longer did reverse changes occur in net results of chain participants. For example, where the slaughtering stage originally incurred an extra loss of 574% of the extra net IQC profit under assumption of S_I, it now incurred a net extra benefit varying from 13% to about 17% depending on the transfer key used (Table 4).

Assuming selling alternative I (IQC), all transfer keys, except the one based on total costs (TC), resulted in an extra slaughtering benefit of 17%. This was due to the fact that the fattening premiums were all set to zero, because the extra carcass quality benefit exceeded the calculated premium. As a result, the extra fattening benefit varied from approximately Dfl. 0.2 to Dfl. 0.4 (Table 4). This represented a share of about 39% to 61% of the extra net chain benefit (Dfl. 0.7). Assuming selling alternative II, the extra net chain benefit of Dfl. 6.8 (Table 3) was redistributed exactly according to the transfer key percentages described at the beginning of each row of Table 4. In general, the IQC premiums calculated under S_I were far below the premiums described in Table 1. Regarding S_{II}, the calculated fattening premiums varied around the original fattening premium (Table 1), while the calculated feeder pig premiums, exceeded the original premium of Dfl. 1.0.

Table 4. The effects of various transfer keys on the premiums paid and the distribution of the additional net result of IQC and Outdoor compared with default. Regarding IQC, the results are presented for two selling alternatives (Table 3). *In italics*, the results of the basic situation (Table 2) are shown.

					Sell alternative I					Sell alternative II				
		%			Premium		Δ Net Result			Premium		Δ Net Result		
Chain	Transfer key[1]	S[1]	F[1]	Sl[1]	S	F	S	F	Sl	S	F	S	F	Sl
IQC	-	*100*	*574*	*-574*	*1.0*	*4.0*	*+0.7*	*+3.8*	*-3.8*	*1.0*	*4.0*	*+0.7*	*+3.8*	*+2.4*
	TC	34	53	13	0.6	0.02	+0.2	+0.3	+0.1	2.7	5.5	+2.3	+3.5	+0.9
	TFC	43	35	22	0.6	0	+0.3	+0.3	+0.1	3.3	4.9	+2.9	+2.3	+1.5
	L35C	44	32	24	0.6	0	+0.3	+0.2	+0.1	3.3	4.8	+3.0	+2.2	+1.6
	ΔTC	22	28	50	0.5	0	+0.1	+0.4	+0.1	1.8	2.9	+1.5	+1.9	+3.4
	ΔTFC	24	28	48	0.5	0	+0.2	+0.4	+0.1	2.0	3.1	+1.6	+1.9	+3.2
	Δl35c	24	27	49	0.5	0	+0.2	+0.4	+0.1	2.0	3.1	+1.6	+1.8	+3.3
Out-door	-	*134*	*-34*	-	*23.4*	*0.91*	*-16.6*	*+4.2*	-					
	TC	41	59	-	34.7	-	-5.2	-7.4	-					
	TFC	53	47	-	33.2	-	-6.7	-5.9	-					
	L35C	54	46	-	33.1	-	-6.9	-5.7	-					
	ΔTC	47	53	-	34.0	-	-6.0	-6.7	-					
	ΔTFC	49	51	-	33.8	-	-6.2	-6.5	-					
	Δl35c	49	51	-	33.8	-	-6.2	-6.5	-					

[1] TC = Total Costs, TFC = Total Factor Costs, L35C = labour costs + interest over 35% of capital employed, ΔTC = Extra total costs compared with total costs default, ΔTFC = Extra factor costs compared with default, Δl35c = Extra labour & interest (35% CE) compared with default, S = Sow stage, F = Fattening stage, Sl = Slaughtering stage

With respect to the outdoor pork chain concept, all transfer keys resulted in a sharing of the extra net chain loss, instead of the favourable position of the fattening stage in the original situation (Table 2). The calculated feeder pig premiums considerably exceeded the originally paid premium of Dfl. 23.4. As all transfer keys showed about equal distributions of benefits or losses, with shares ranging between 41% and 59%, the calculated feeder pig premiums were found to be fairly stable.

4. DISCUSSION

Differentiated chain concepts

Using an economic pork chain simulation model, the effects were analyzed of two differentiated pork chain concepts on both stage and chain profitability. Regarding the outdoor chain concept, results obtained resembled those of other published materials (Kleijn et al.[9]; Bens[10]). However, when comparing the sources of the extra costs, it seemed that the 37% additional sow farm labour resembled the 35% Bens[10] described, but was higher than the 25% Kleijn et al.[9] assumed. The biggest difference however was found regarding the fattening stage, where we calculated almost a doubling of labour required. Daily supply of roughage, straw and the access to outdoor space already increased labour needs per pig sold by about 60%. Further increases originated, from the smaller scale, a higher rate of record keeping tasks, and the longer production period per pig sold. The latter sources, seemingly, were not considered by Bens[10] and Kleijn et al.[9].

In practice, outdoor producers may be triggered to - sooner - automatize labour-intensive activities such as feeding. As a result, some components of the extra costs of outdoor pig production calculated in this paper may be lower in practice. On the other hand, larger transportation distances, higher feed prices, lower carcass quality and less quota premiums due to smaller batch sizes of outdoor pigs when compared to regularly produced pigs (Kleijn et al.[9]) may imply extra disadvantages in practice which were not considered in our calculations.

With respect to IQC, no published materials were available and data was obtained from commercial data bases. The improved carcass quality data obtained for the IQC concept, however, may have resulted from the early IQC adopters possibly consisting of relatively better performing farms.

In total, additional chain production costs amounted to Dfl. 1.5 and Dfl. 84.4 per carcass or pig bred according to the IQC and Outdoor pork concept respectively. Combined with the extra buyer value, IQC resulted in an increase in net chain results while the net farrow-to-finish result of the simulated outdoor concept further decreased. The benefits were distributed disproportionately among the chain members however. Whereas the farm stages in the case of IQC, and the fattening stage in the case of the outdoor chain, accrued all the benefits, the slaughtering stage and the farrowing stage, suffered disproportionately high losses. Moreover, with respect to IQC, the slaughtering stage seemed to incur the majority of the market risks and part of the production

risks. When restricting the conditions at which premiums were paid or when increased sales to the end buyer were supposed under the assumption of a - short-term - price-inelastic demand, net slaughtering results increased. The latter also caused the net chain result to increase without affecting the net results of the supplying farm stages.

Distribution of benefits or losses

The concept premiums were recalculated based on compensation of the additional full costs plus a share of the extra net chain result. Under the assumption of relatively low market sales, it was found that IQC premiums paid per feeder pig and per fattened pig sold, were too high to insure each chain member a proportionate part of the net chain benefit. Calculated premiums equalled approximately half of the original premiums. The IQC fattening pig premium was even set to zero as the additional carcass quality premium already by far exceeded the extra costs incurred. In contrast, the original outdoor feeder pig premium proved to be too low. Recalculated premiums were about Dfl. 10 per feeder pig higher. This corresponds to outdoor feeder pig premiums Kleijn et al.[9] described. With respect to IQC, recalculated premiums were only at the original level or higher under the assumption of better market conditions, i.e. higher sales.

The different transfer keys used had varying effects on the transferred premiums calculated. However, 'no single transfer policy is an ultimate solution for every situation once and for all' (Eccles[11]). Although generally accepted criteria for choosing the best solution for a 'fair' key, seem to be lacking, variation in calculated premiums seemed to be less within groups of either absolute or relative cost-plus based keys. Based on the findings in this paper, it is concluded that decisions about the sharing of market and production risks may have a bigger impact on the level of premiums paid than the choice of the various presented 'cost-plus' based transfer keys. Profound market analyses and sales estimates and regular evaluation of chain profitability and transfer prices, will be very important (Eccles[11]).

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