

Consumer preferences for pork supply chain attributes

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Abstract

Based on an extensive customized conjoint analysis with 24 attributes of pork production, covering issues from feed to fork, we identified six consumer segments: *ecologists* (17%), *tradition-minded consumers* (17%), *animal friends* (16%), *health-concerned consumers* (18%), *economists* (12%) and *unpronounced consumers* (20%). Typically all segments prefer pork originating from the Netherlands and a zero risk of *Salmonella*. Discriminating items between segments include issues of pig breeding, housing, farm-level handling of pigs, safety aspects such as residue levels and irradiation of pork, and taste and price. Segments were furthermore found to differ on issues such as willingness to pay for pork production improvements and pork label perception. From our findings we recommend decision-makers in pork supply chains to no longer market pork as a bulk product as there are distinct requirements for pork and the way it is produced. Also, there seems to be sufficient financial room to invest in each of these segments. At the same time, however, it should be noticed that consumers have difficulties with distinguishing between different labels and that they generally have limited knowledge about basic pork production and safety issues.

Additional keywords: market segmentation, customized conjoint analysis, mixture regression models, willingness to pay, pork labels

Introduction

Producing food in chains and networks started mainly from a business economics perspective, amongst other to reduce transaction costs (Williamson, 1985; Boehlje & Lins, 1998). Encouraged by quality assurance schemes, tracking and tracing systems, and increasing requirements for transparency, the 'feed to fork' principle is now standard in many regulations. For instance, the European General Food Law (Anon., 2002) explicitly addresses the traceability of food (ingredients) throughout the entire

supply chain. However, in contrast to 'business to business transparency', the communication of production issues to consumers still is very limited. Consumer information is generally restricted to country of origin and country of packing (Meuwissen *et al.*, 2003). Specific labels, for instance from organically produced products, provide somewhat more information to consumers, but market shares of such products generally are very small (Yussefi, 2006).

This also holds for pork in the Netherlands. The majority of fresh pork is retailer-branded or labelled as Integrated Chain Control (IKB) and the combined market share of special labels such as EKO (organic), Free range and Biodynamic (also organic) is less than 1% (Anon., 2006). On the basis of consumer studies that closely mimic actual pork buying behaviour, Meuwissen & Van Der Lans (2005) concluded that consumers generally base their buying decisions on product characteristics such as taste and price. On the other hand, there have also been studies pointing to the increasing relevance of production attributes (see amongst other ones Verbeke, 2001). So we hypothesize that, despite current bulk markets, there are (groups of) consumers who are interested in pork production issues and greater 'business to consumer transparency'. Within this framework, our paper aims at (1) identifying consumer segments, based on numerous pork production attributes covering the entire supply chain; and (2) describing these segments amongst other things with respect to current consumption of labelled pork, perception about existing pork labels, knowledge about pork production, and willingness to pay for production improvements. We shall focus on pork production in the Netherlands, which is characterized by very intensive, mostly indoor, farming, very high pig densities, high export figures (in the Netherlands the degree of self-sufficiency for pork is 230%) and much public attention for animal welfare, food safety and environmental issues.

Previous consumer studies about production attributes of meat focus only on a limited number of aspects, or discuss these aspects qualitatively or at an aggregate level. For instance, Nayga (1996) studied consumers' perceptions of hormone use, antibiotics, irradiation and feed from grain produced using herbicides. Den Ouden *et al.* (1997) focused on perceptions about animal welfare issues only. Hoffmann (2000) studied perceptions about the country of origin of fresh meat. Also Dransfield *et al.* (2005) considered the country of origin, complemented by information on indoor or outdoor raising of the animals. Ngapo *et al.* (2003) qualitatively discussed consumer perceptions of pork production through focus group discussions. Aggregated concepts such as 'animal friendly', 'environmentally friendly' and 'safety' were studied by Schifferstein *et al.* (1998) and Verbeke & Viaene (1999). Krystallis & Arvanitoyannis (2006) considered detailed aspects of food safety (*Salmonella*, dioxin, hormones, antibiotics) but addressed consumers' interest for 'production method information' at an aggregate level.

In contrast to these studies, our study incorporates 24 attributes of pork production, including 62 attribute levels, referring to issues from feed to fork and addressing consumer concerns such as food safety, animal welfare and sensory quality. Meuwissen & Van Der Lans (2005) reported on general concerns about pork production and the overall ranking of the 24 attributes, whereas the current paper focuses on the details of the attribute *levels* and market segmentation.

Materials and methods

Consumer data were gathered using a computerized questionnaire. In addition to introductory questions and questions on socio-economic and (pork) consumption characteristics, the questions covered four themes: (1) preferences for pork-production attributes, (2) knowledge of pork production, (3) willingness to pay for pork-production improvements, and (4) perception of currently existing pork labels. Throughout the questionnaire we furthermore addressed a number of societal issues related to pork production. Below are discussed the elicitation of preferences and willingness to pay, the way the data were collected and the segmentation method to cope with the large amount of pork-production attributes. The questions about knowledge, perception and citizen issues are described along with the answers.

Elicitation of consumer preferences

For eliciting consumer preferences we used the customized conjoint analysis (CCA) as described by Srinivasan & Park (1997). The CCA analysis included 24 attributes, which together with their levels are listed in Figure 1, grouped under 'feed and breed', 'farm' and 'processing and retail'. There are 22 attributes on the pork-production process and 2 product attributes: taste and price. The attributes had two, three or four levels, as shown in Figure 1 (the remainder of the figure is explained in the Results section). In developing the computerized CCA analysis, the procedure as described by Hensel-Börner & Sattler (2000) was used as a basis. Some modifications were implemented, as described below.

The CCA analysis consists of three parts. The respondents were first asked to give *self-explicated desirability ratings* for the 22 production attributes. Attributes were categorized under different topics, i.e., pig feeding, breeding, farming, processing and retail. The desirability of the levels was rated per attribute on a scale from 0 (least desirable level) to 10 (most desirable level). That is, respondents had first to select the level they liked most and the level they liked least. The most desirable level was assigned a score of 10 on a 0–10 rating scale, the least desirable level a score of 0. Next, respondents were asked to rate the other levels on the same scale. In case of an attribute with only two levels, respondents had to select the level they liked most. After the self-explicated desirability ratings were given, respondents were asked to give *self-explicated importance ratings*, i.e., to rate the importance of the difference between the most and the least desirable level for each of the subsequent production attributes on a scale from 0 (not important at all) to 100 (very important). The midpoint of this scale (50) was labelled 'reasonably important'. Next, as a small check, respondents were asked whether they thought any important pork production attributes had been left out. Ten per cent of the respondents replied affirmatively, in spite of the fact that most of the issues that were indicated had been included in the questionnaire already.

In the third part of the CCA analysis, respondents continued with *graded paired comparisons* in which they had to indicate their preference for one partial pork profile description over another one on a scale from 1 (strong preference for the one profile) to 9 (strong preference for the other profile). These partial profiles were described for

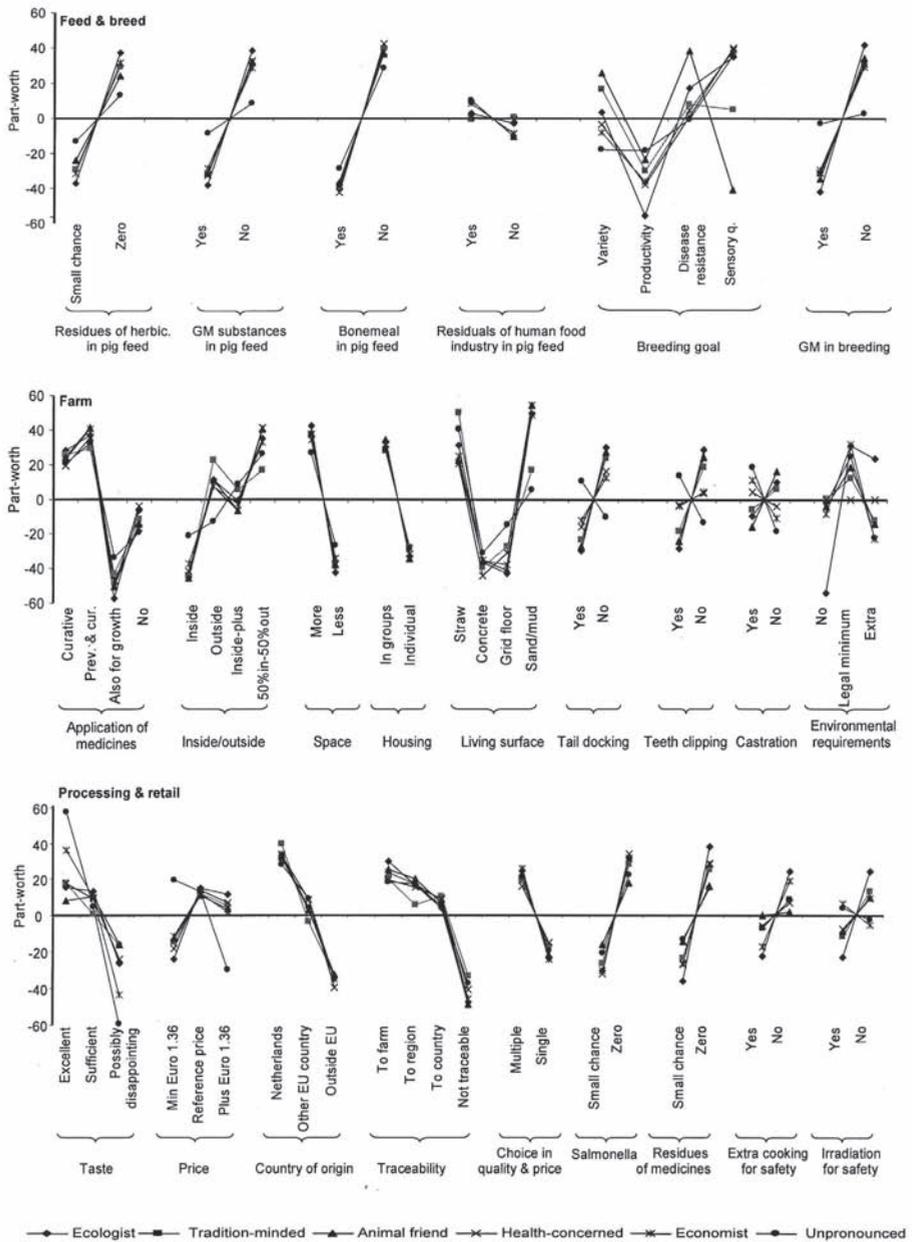


Figure 1. Pork production attribute-level part-worth estimates per segment.

seven attributes: the two product attributes price and taste, four of the most important production attributes and one moderately important production attribute. If the production attributes could not be uniquely determined due to equal importance ratings, then a random selection was drawn from the equally rated most important and moderately important attributes, respectively. Pairs of partial profiles were based on a fractional-factorial main-effects design (Hair *et al.*, 1998) in combination with a cyclic design (Huber & Zwerina, 1996). Inadmissible combinations like 'pork originating from the Netherlands' and 'no traceability', were excluded beforehand.

The CCA procedure mainly differs from the computerized procedure of Hensel-Börner & Sattler (2000) on two important aspects. Firstly, we did not ask for single-stimulus partial profile evaluations but for graded paired comparisons. Making such comparisons more closely resembles the actual shopping situation, and explicitly confronts respondents with different levels of production attributes. Secondly, the attributes taste and price were always included in the conjoint analysis, but were excluded from the self-explicated parts. In our questionnaire design we decided to do so because otherwise the generally high importance of taste and price might have masked subtle differences between the generally less important production attributes. Taste and price were always included in the graded paired comparisons to provide a common baseline against which the importance of the production attributes could be evaluated.

Towards the end of the questionnaire, following some questions about demographic and socio-economic characteristics, three choice sets with three partial pork profiles each were presented to the respondents. Respondents were asked to choose one partial pork profile from each choice set. The choices were used to assess the internal predictive validity of estimated part-worths, or utilities (Hair *et al.*, 1998). These partial profiles were based on production attributes only, i.e., they did not include taste and price, and they were the same for all respondents.

Willingness to pay

The willingness to pay (WTP) part of the questionnaire started by establishing a respondent's reference price for 'frequently consumed pork', thereby referring to answers given in the introductory part of the questionnaire. Next, a respondent's WTP was elicited for 'all consumer concerns' as well as for the four most important individual attributes as derived from the CCA analysis. More specifically, we asked these WTPs for pork "produced in such a way that the concerns, in the opinion of government and consumer organizations, are dealt with according to the latest scientific developments".

WTPs were elicited in two different formats. From half of the respondents we elicited the WTPs by asking how much they were willing to pay *extra* per kg for their favourite kind of pork if the particular concerns would be met. From the other half we elicited the WTPs by asking two questions about the *total* price per kg they were willing to pay for their favourite kind of pork if the particular concerns would be met: (1) the total price at which the respondent would *certainly* buy the pork, and (2) the total price at which the respondent would *no longer* buy the pork. Respondents were randomly assigned to one of the two formats. The first format ('extra') was chosen because in

literature it is the standard format in which WTP-questions are asked. The second format ('total certainly' and 'total no longer') aimed at better triggering respondents' personal budget limitations.

Data collection

Data were gathered in the Netherlands in November 2001 over a period of three days. At that time there were no major crises related to food safety or animal well being. The most recent crisis, due to foot and mouth disease, was half a year before, in April 2001. In developing the questionnaire four focus group discussions were held with people from different regions (rural and urban) in the Netherlands. Also, the questionnaire was pre-tested among 20 households. Then, the actual data gathering was done with CentERpanel, a sample of 2000 households whose panel members frequently fill in questionnaires through internet or set-top boxes (e.g. Donkers *et al.*, 2001). There were 1444 respondents of which 1199 fully completed the CCA analysis. Only this group is considered in this paper. Although there were vegetarians and people who do not eat pork, the sample of 1199 only consisted of people consuming pork. Seventy-five per cent of them were male, their average age was 47.3 years and 13% were older than 65. Compared with the Dutch population, our respondents had on average more children and a much higher income and education. Furthermore, the people in our sample bought more expensive pork chops, bought more frequently at the butcher and consumed (or stated to consume) relatively more labelled pork.

Segmentation analysis

The segmentation of our sample is based on the data from the CCA analysis. We used a multivariate normal finite-mixture regression model (Wedel & Kamakura, 2000) that was specially developed to simultaneously cope with the self-explicated data and the graded paired comparisons (for similar models see Marshall & Bradlow, 2002 and Ter Hofstede *et al.*, 2002). The model yields segment-level estimates of (1) part-worths of the attribute levels, (2) a scaling factor relating the self-explicated ratings to the graded paired comparisons, and (3) three variance parameters (one for the self-explicated desirability ratings, one for the self-explicated importance ratings, and one for the graded paired comparisons). Multivariate normal finite-mixture regression models were fitted with 2 to 10 segments. Models were fitted, using the EM-algorithm, with an alternating least-squares sequence in the maximization step (De Soete & Heiser, 1993; Wedel & Kamakura, 2000). To avoid local minima, the EM-algorithm was started from 100 different random starts for each number of segments and the best solution was retained.

In choosing the number of segments we used three criteria: a measure of internal predictive validity, the Consistent Akaike Information Criterion (CAIC) as described by Wedel & Kamakura (2000) and the interpretability of segments. The internal predictive validity was assessed by predicting respondents' choices from the three choice sets with the max-utility choice rule (Hair *et al.*, 1998), using the segment-level part-worth estimates of the segment for which a respondent has the highest posterior probability.

For each number of segments, however, the predictive validity turned out to be between 40% and 45%, which is somewhat disappointing compared with the expected predictive validity of 33.33% of a random choice model. These relatively low numbers might be caused by the fact that choice sets were based on production attributes only (i.e., no taste and price). The second criterion, CAIC, suggests that a four-segment model gives the best trade-off between the loglikelihood of the model and the number of estimated parameters. However, there was a lack of interpretability of these segments as they could not uniquely be classified. When comparing the interpretability of the three to six-segment solutions it became clear that the six-segment solution revealed interesting additional insights into the composition of the two largest segments of the four-segment solution. Therefore, the results of the six-segment solution are reported below.

Results

Preferences for pork chain attributes

The part-worth estimates from the CCA analysis for all attribute levels are shown in Figure 1 for each of the six segments. For each attribute the highest part-worth indicates the most preferred level and the lowest part-worth indicates the least preferred level. For instance, for bone meal in pig feed *not using it* is preferred to *using it*. The further

Table 1. Perception scores per consumer segment of specific requirements for pork production in the Netherlands, expressed as percentage of respondents agreeing with the statement ¹.

Statement	Consumer segment					
	Ecologist	Tradition-minded	Animal friend	Health-concerned (%)	Economist	Unpronounced
Pigs should only be kept in designated areas	16.1	24.4* ²	13.4	24.3*	18.3	15.4
Production requirement should be above EU level	56.1*	44.8	52.9	40.4	23.2*	37.0
There should be no export of live pigs	82.4*	66.2	75.4	67.4	50.7*	58.9
The number of pig farms should be reduced	65.4*	49.8	63.6*	47.2	45.8	42.7*

¹ Percentages are for 'fully agree' or 'slightly agree' (other categories were 'slightly disagree', 'disagree', or 'do not know').

² An asterisk indicates a statistically significant ($P \leq 0.05$) chi-square in cross-tabulation analysis and the segments that contribute to this ($|\text{standardized residual}| \geq 1.96$).

Table 2. Socio-economic characteristics per consumer segment, expressed as percentage of respondents, unless stated otherwise.

Characteristic	Consumer segment					
	Ecologist	Tradition-minded	Animal friend	Health-concerned (%)	Economist	Unpronounced
<i>Males</i>	48.3* ¹	58.7	50.3	57.8	77.5*	54.1
<i>Age (years)</i>						
< 35	18.5 ab ²	13.9 acdef	24.6 cg	17.9 dghi	27.5 fi	28.0 beh
35-65	71.7	62.7	65.8	64.7	56.3	62.2
> 65	9.8	23.4	9.6	17.4	16.2	9.8
<i>Annual gross income (€)</i>						
< 10,000	10	14 ab	13 c	12	7 b	9 ac
10,000-22,000	13	10	13	14	8	8
22,000-33,000	21	26	24	22	26	21
33,000-44,000	16	22	19	20	22	22
> 44,000	40	28	32	32	37	40
<i>Level of education</i>						
Low	6.3 abcde	25.0 aefgh	11.8 bf	18.3 c	12.9 eh	11.4 dgi
Medium	25.4	38.5	34.4	36.2	30.7	30.6
High	68.3	36.5	53.8	45.4	56.4	58.0
<i>Profession</i>						
Industry	13.2	12.5	14.0	14.2	23.6*	17.1
Government, services	46.8*	27.5*	44.6*	34.4	30.0*	42.9
Housewife, houseman	15.1	19.5*	12.9	15.6	7.9*	14.3
Retired	12.7	26.0*	12.9	20.6	20.7	12.2*
No. of children per household ³	0.80	0.56 ab	0.68	0.76	0.92 b	0.95 a

¹ An asterisk indicates a statistically different ($P \leq 0.05$) chi-square value in cross-tabulation analysis and the segments that contribute to this ($|\text{standardized residual}| \geq 1.96$).

² Percentages or numbers in the same row, followed by the same letter are statistically different ($P \leq 0.05$).

The differences between percentages refer to differences between series of ordinal values (Mann-Whitney U; $\alpha = 0.025$).

³ Statistical differences are between arithmetic averages.

apart these part-worth estimates, the more important the attribute. For instance, when comparing the distance between the most and least preferred levels of the attributes *bone meal in pig feed* and *residuals of the human food industry in pig feed* the first one is generally perceived as more important. Other issues on which consumers fairly agree can be found at farm level: consumers generally prefer more space for pigs to less space and housing in groups rather than individual housing. At processing and retail level consumers agree on the relatively low importance of choice in quality and price and they all prefer pork from the Netherlands, and a zero chance of *Salmonella* and residues of medicines.

Besides these similarities, Figure 1 also shows differences between segments. These differences formed the basis for classifying the segments. For instance, segment 1 (n = 205, 17%) is classified as *ecologists*. This segment is most strongly against many non-ecological aspects of production, such as genetic modification in breeding, herbicide residues in pig feed, irradiation for safety and medicine residues at retail level. Also, at farm level they most strongly prefer pigs to have more space and they have little against extra environmental requirements. In segment 2 (n = 201, 17%), classified as *tradition-minded*, consumers typically prefer pigs to be raised in the Netherlands and they like pig breeders to focus on increasing the variety among pigs. At farm level, they prefer pigs to live on straw and they like them to be kept fully outdoors. Segment 3 (n = 187, 16%) was classified as *animal friends*. They very much like pig breeders to focus on disease resistance, and at farm level they attach a relatively high importance to aspects of animal housing and handling. At the same time, at the processing and retail level they find issues of taste and safety relatively less important. Segment 4 (n = 218, 18%) was classified as the *health-concerned*, with health referring to human health (zero *Salmonella*, no bone meal in pig feed) and pig health, and not to environmental health. The latter is illustrated by the complete irrelevance of environmental requirements at farm level. Segment 5 (n = 142, 12%) was called *economists*. At the feed and breed level the economists attach little importance to issues of genetic modification, and at farm level they favour tail docking, teeth clipping and castration. At the processing and retail level they strongly prefer an excellent taste and they are the only ones who favour a low price. Segment 6 (n = 246, 20%) was classified as *unpronounced*, considering that the consumers had no specific requirements for any of the chain attributes, not at the feed and breed level, nor at the farm or processing and retail levels.

Answers to a number of 'pork-related citizen issues', presented at the end of the questionnaire are mostly in line with the CCA outcomes and therefore support our classification of the six segments (Table 1). For instance, *ecologists* are in favour of enforcing production requirements above the EU ones, they are firmly against export of live pigs and they would favour a reduction in the number of pig farms. On the other hand, the segments *unpronounced* and *economists* less often agree with these issues.

Not in line with CCA outcomes is the relatively high preference of the *tradition-minded* segment for designated pig areas (24.4% agrees with the statement). This segment, however, may have had a (wrong) idea of these areas. They may have thought in terms of some large outdoor free-range areas for pigs, whereas after two major

Table 3. Consumption characteristics per consumer segment.

Characteristic	Consumer segment					
	Ecologist	Tradition- minded	Animal friend	Health- concerned	Economist	Unpronounced
	(%)					
<i>Frequency of pork consumption (% resp.)</i>						
4–7 times per week	13.2 abc ¹	19.4 ad	16.6	21.6 b	30.3 d	19.9 c
1–3 times per week	54.6	57.2	58.8	60.6	53.5	59.3
1–3 times per month	21.5	16.9	18.2	12.8	13.4	15.0
< once per month	8.3	4.5	5.3	4.1	1.4	2.8
do not know	2.4	2.0	1.1	0.9	1.4	2.8
<i>Pork chops most frequently consumed (% resp.)</i>						
Shoulder (€ 6 per kg) ²	41.0	57.2	47.6	55.0	53.5	45.9
Steak (€ 8 per kg)	40.5	46.3	28.9 ^{*3}	39.4	47.9	44.7
Cutlet (€ 10 per kg)	28.3	35.8	29.9	26.6	39.4	37.4
Filet (€ 11 per kg)	44.4	47.3	48.1	46.8	47.9	49.2
Tenderloin (€ 12 per kg)	52.7	60.2	57.8	64.2	66.9	63.0
Other	20.8	15.4	14.4	16.1	11.4	21.8
<i>Most frequent purchasing place (% resp.)⁴</i>						
Supermarket	66.3	64.7	69.0	69.3	66.2	79.7 [*]
Butcher	27.8	32.3 [*]	23.5	25.7	29.6	18.3 [*]
<i>Pork consumption per label (% pork)⁵</i>						
Regular pork (no label)	61.7	48.2 a	63.3	54.4	68.0 a	60.6
Integrated Chain Control	13.2	19.0	13.9	18.9	16.4	21.0
Free range	3.2	6.6	2.1	3.0	1.6	1.8
BestMeat ⁶	0.7	2.0	0.7	1.1	1.7	0.3
EKO (organic)	18.0 a	17.3	15.3	12.7	7.0 a	10.0
Environmental quality	2.2	3.8	3.7	9.1	4.6	6.7
Biodynamic (organic)	1.0 a	3.1 abcde	1.0 b	0.7 c	0.8 e	0.3 d

¹ Percentages in the same row, followed by the same letter are statistically different ($P \leq 0.05$). The differences between % respondents (% resp.) refer to differences between series of ordinal values (Mann-Whitney U; $\alpha = 0.05$).

² The prices were not made known in the survey.

³ An asterisk indicates a statistically significant ($P \leq 0.05$) chi-square value in cross-tabulation analysis and the segments that contribute to this ($|\text{standardized residual}| \geq 1.96$).

⁴ Other suggested purchasing places, such as organic butcher, open market and farm, all scored very low.

⁵ Statistical differences are between arithmetic averages.

⁶ Non-existing pork label.

livestock epidemics these areas were planned to be confined industrial-like areas comprising feed companies, large pig farms and slaughterhouses in order to reduce the amount of transport throughout the Netherlands.

With respect to the socio-economic characteristics of the segments (Table 2), *ecologists* were mostly female whereas *economists* were mostly male. With respect to age, *tradition-minded* were somewhat older whereas *unpronounced* were relatively young. The number of children and the level of income were highest for the segments *unpronounced* and *economists*. With regard to the level of education, *ecologists* turned out to be relatively highly educated. With respect to people's profession, we found that industry relatively often employs *economists*, and governments employ *ecologists* and *animal friends*. *Tradition-minded* consumers were relatively often found in the categories housewife/houseman and retired. Hardly anybody worked in the agricultural sector or had any close relationship with it (not shown in Table 2).

In order to further characterize the six segments, people's stated consumption of fresh pork was analysed (Table 3). *Ecologists* consumed pork less frequently than *tradition-minded*, *health-concerned* and *unpronounced*. With respect to the consumption of various types of pork chops, segments hardly differed. With regard to pork consumption per label, all segments mostly consumed non-labelled pork, ranging from 48.2% for *tradition-minded* to 68.0% for *economists*. EKO pork was consumed most by *ecologists*: 18.0% of their total pork consumption. Biodynamic pork was consumed most by *tradition-minded* (3.1%). The fake label BestMeat was hardly stated to be consumed at all, which indicates proper awareness among respondents.

Knowledge about pork production

People's perceptions about pork production or specific pork labels might be influenced by their knowledge about aspects such as pigs' living circumstances and pork production techniques. We therefore recorded consumers' knowledge about such issues just before the CCA analysis. Four multiple choice questions and eight statements were used. These statements had to be evaluated twice: once for regular pork and once for EKO pork. Table 4 shows the percentages of correct answers that were lowest for the statements ('do not know' was considered an incorrect answer).

In relation to the multiple choice questions, people appeared to know more about the age of slaughter pigs and the percentage of pigs kept outside than about farm-gate price levels and the number of litters per sow per year. (More than one third of the respondents believed sows to give birth four times a year.) With respect to the statements there were, for both regular and EKO pork, only three issues to which more than half of the consumers gave the correct answer. For regular pork these were the aspects about *not* having the obligation to use organic feed, to enable pigs to go outside and to only use homeopathic medicines. For EKO pork more than half of the consumers only knew about feeding organic feed, using feed without antibiotics and the obligation to provide pigs with outdoor facilities. However, most consumers did not know that with EKO pork the use of homeopathic medicines is not compulsory either. Four other items about which consumers hardly knew whether regular pork and EKO pork were comparable included (1) that not only ingredients from their own country can be used

in the feed, (2) that the use of hormones is not allowed, (3) that irradiation of meat is not allowed, and (4) that artificial insemination is allowed.

Knowledge scores (lower part of Table 4) are based on all statements; the Cronbach's alpha (Hair *et al.*, 1998) for the statements on regular and EKO pig farming systems was 0.82 and 0.90, respectively. Based on the knowledge scores, we conclude that *tradition-minded* had relatively little knowledge about regular pig farming and that none of the segments was discriminating on knowledge with respect to EKO farming. Also, pair-wise comparisons (not indicated in Table 4) show that all segments, except *tradition-minded* and *health-concerned*, knew more about regular pig farming than about EKO farming.

Table 4. Knowledge per consumer segment about pork production in the Netherlands, expressed as percentage respondents (% resp.) giving the correct answer.

Items	Consumer segment					
	Ecologist	Tradition-minded	Animal friend	Health-concerned	Economist	Unpronounced
	----- (%) -----					
<i>Correct answers to multiple choice questions¹</i>						
<i>(% resp.)</i>						
1. Age of slaughter pig (6 months)	95 [*] 2	86 [*]	90	90	96 [*]	84 [*]
2. Pork price at farm gate (€ 1.36 per kg)	67	58	61	61	76 [*]	63
3. Percentage pigs raised outdoors (5%)	95 [*]	86 [*]	91	88 [*]	94	95 [*]
4. No. of litters per sow per year (2)	56	60	55	58	60	54
<i>Correct answers to statements³ (% resp.)</i>						
1. Only feed without antibiotics (no ⁴ – yes)	25 – 72 [*]	22 – 56 [*]	34 [*] – 67	20 [*] – 61	23 – 62	26 – 70
2. Only ingredients from own country (no – no)	45 – 28	29 [*] – 18 [*]	45 – 22	41 – 25	44 – 26	42 – 31 [*]
3. Compulsory use of organic feed (no – yes)	80 [*] – 75 [*]	59 [*] – 63	66 – 73	62 – 62 [*]	68 – 63	78 [*] – 72
4. Pigs must be able to go outside (no – yes)	83 [*] – 62	63 [*] – 57	69 – 64	64 [*] – 55	74 – 52	80 [*] – 58
5. Artificial insemination allowed (yes – yes)	4 [*] – 18	11 – 22	7 – 24	12 [*] – 26	9 – 20	9 – 24

Table 4 (cont'd)

Items	Consumer segment					
	Ecologist	Tradition-minded	Animal friend	Health-concerned (%)	Economist	Unpronounced
<i>Correct answers to statements 3 (% resp.)</i>						
6. Only use of homeopathic medicines (no – no)	76* – 32	60* – 22	69 – 28	62* – 26	69 – 24	76* – 32
7. Use of hormones allowed (no – no)	32 – 6*	29 – 16*	36 – 12	29 – 9	25 – 8	26 – 9
8. Irradiation of meat allowed (no – no)	27 – 8	25 – 15	35 – 12	30 – 14	28 – 8	24 – 9
<i>Knowledge scores 5</i>						
Regular pork	3.7 a ⁶	3.0 abc	3.6 b	3.23.4	3.6 c	
EKO pork	3.43.6	3.73.7	3.53.6			

¹ The correct answers are given in brackets. The possible answers for 1: 6 weeks, 6 months, 18 months; for 2: € 1.36 per kg, € 2.73 per kg, € 5.45 per kg; for 3: 5%, 50%, 95%; for 4: 2, 4, 6.

² An asterisk indicates a statistically significant chi-square value in cross-tabulation analysis and the segments that contribute to it (|standardized residual| ≥ 1.96).

³ The correct answers (in brackets) are for regular and EKO pork, respectively. The possible answers were: yes, no, do not know.

⁴ Although debates about abandoning the use of antimicrobial growth promoters in feed already started in the 1990s, the actual prohibition was only enforced as of 1 January 2006 (EU, 1813/2003, article 11).

⁵ Totalized scores for statements based on a value 1 for each correct answer and 0 otherwise, including 'do not know'.

⁶ Scores followed by the same letter are statistically different ($P \leq 0.05$).

Willingness to pay for improvements in pork production

Table 5 summarizes the results of our WTP analysis. Consumers' reference prices for pork were between € 7.90 per kg for *tradition-minded* and € 9.00 per kg for *ecologists*. On top of the reference prices and given that 'all concerns' would be properly addressed, people were willing to pay from € 2.90 (*unpronounced*) to € 5.20 per kg pork (*tradition-minded*). In case *individual* concerns as derived from the CCA analysis would be met, these amounts ranged from € 4.00 per kg for *unpronounced* to € 7.00 per kg for *animal friends*. For all segments the extra price on top of the reference price was highest for dealing with individual concerns. Only for *economists* the individuality of the concerns did not influence their willingness to pay. With respect to the total prices, 'certainly' prices were below the 'no longer' prices. However, some of the certainly

Table 5. Pork prices per consumer segment and willingness to pay (WTP), addressing ‘all concerns’ or ‘individual concerns’.

	Consumer segment					
	Ecologist	Tradition-minded	Animal friend	Health-concerned	Economist	Unpronounced
	(€ per kg)					
Reference price	9.0	7.9	8.4	8.1	8.1	8.5
<i>WTP for all concerns</i>						
Extra price on top of reference price	3.7 ^{* 1}	5.2 ^{* a 2}	4.8 [*]	5.1 ^{* b}	3.4	2.9 ^{* ab}
Total price ‘certainly’	8.0	6.9 ab	8.8 ^{* ac}	8.0	6.9 cd	8.5 ^{* bd}
Total price ‘no longer’	9.6	8.4 a	10.1 ^{* b}	8.7 c	7.8 bd	10.4 acd
<i>WTP for individual concerns</i>						
Extra price on top of reference price	4.9 [*]	6.5 ^{* a}	7.0 ^{* bc}	6.3 ^{* d}	4.2 c	4.0 ^{* abd}
Total price ‘certainly’	8.7	7.1 ab	9.8 ^{* a}	8.3	7.9	9.1 ^{* b}
Total price ‘no longer’	9.8	8.5 a	11.3 ^{* a}	9.3	8.5	11.0

¹ Prices in the same column, followed by an asterisk are statistically different ($P \leq 0.05$) for similar WTP framings.

² Prices in the same row, followed by the same letter are statistically different ($P \leq 0.05$).

prices were also below reference price levels. Some people clearly did not exactly recall their own reference price – or believed that the price they usually paid was too high and that they now had a chance to express that. Total prices were relatively high for *animal friends* and *unpronounced*.

Instead of looking at average willingness-to-pay numbers as presented in Table 5, it is also interesting to consider the underlying range of values. This has been worked out for WTPs addressing *individual* concerns and only for extra and certainly numbers. In order to directly compare these WTPs, both have been recalculated to *percentages* on top of an individual’s reference price (Figure 2). We distinguished between four WTP-categories starting at 0% (including WTPs below 0% in case consumers indicated a total price below their own reference price) up to WTPs above 75% of an individual’s reference price.

The upper part of Figure 2 illustrates that in case of the ‘extra framing’ more consumers were found in the 25–75% and > 75% WTP-categories than in the case of the ‘certainly framing’. With extra framing these categories in all segments comprised more than half of the consumers, whereas with certainly framing this was reduced to less than half of the consumers, again in all segments.

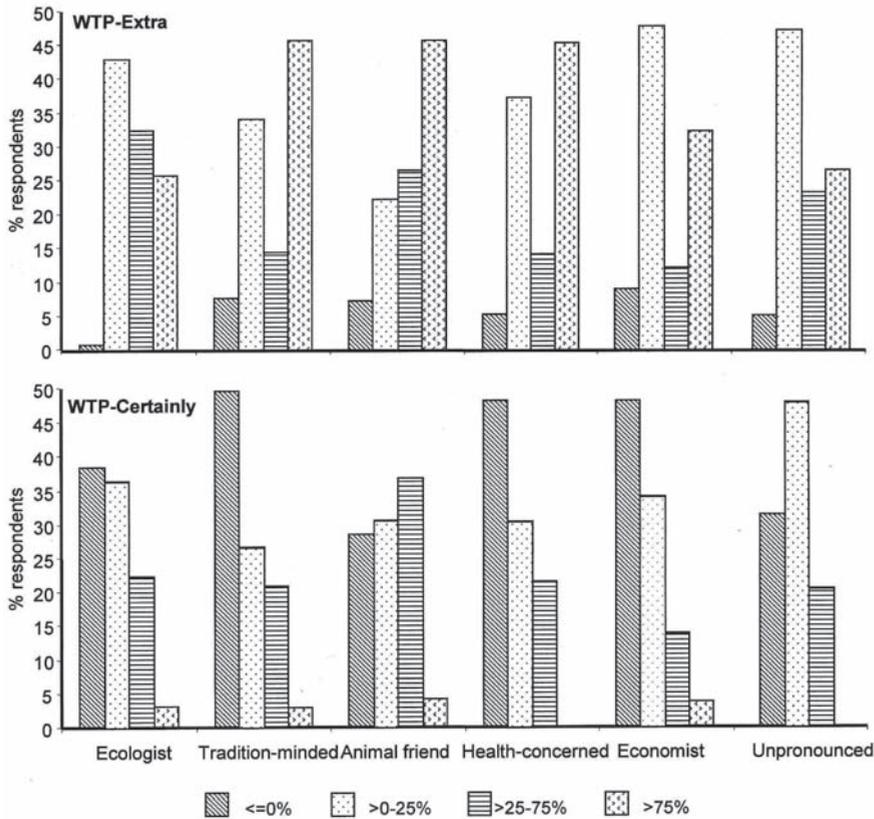


Figure 2. Percentage respondents per segment in the willingness-to-pay (WTP) categories ‘extra’ and ‘certainly’ for pork prices on top of reference prices. WTPs reflect individual concerns.

Table 6. Consumer segment’s opinion about the financial contribution of consumers, government and polluters to improving farm-level pork production methods, expressed as percentage of respondents.

Category	Consumer segment					
	Ecologist	Tradition-minded	Animal friend	Health-concerned	Economist	Unpronounced
	----- (%) -----					
Consumers	34.4 A ¹	29.9 a ²	35.6 A	31.2 b	40.8 abcAB	32.9 c
Dutch government	24.6 abAB	30.9 aA	26.6 AB	31.6 bc	24.6 cA	29.3 A
Polluters ³	39.0 aB	34.8 A	35.9 bB	36.1 c	28.9 abcdB	35.9 dA

¹ Prices in the same column, followed by a common capital letter are statistically different ($P \leq 0.05$).

² Prices in the same row, followed by a common lower cast letter are statistically different ($P \leq 0.05$).

³ Polluters are defined here as pig farmers who do not improve their way of farming.

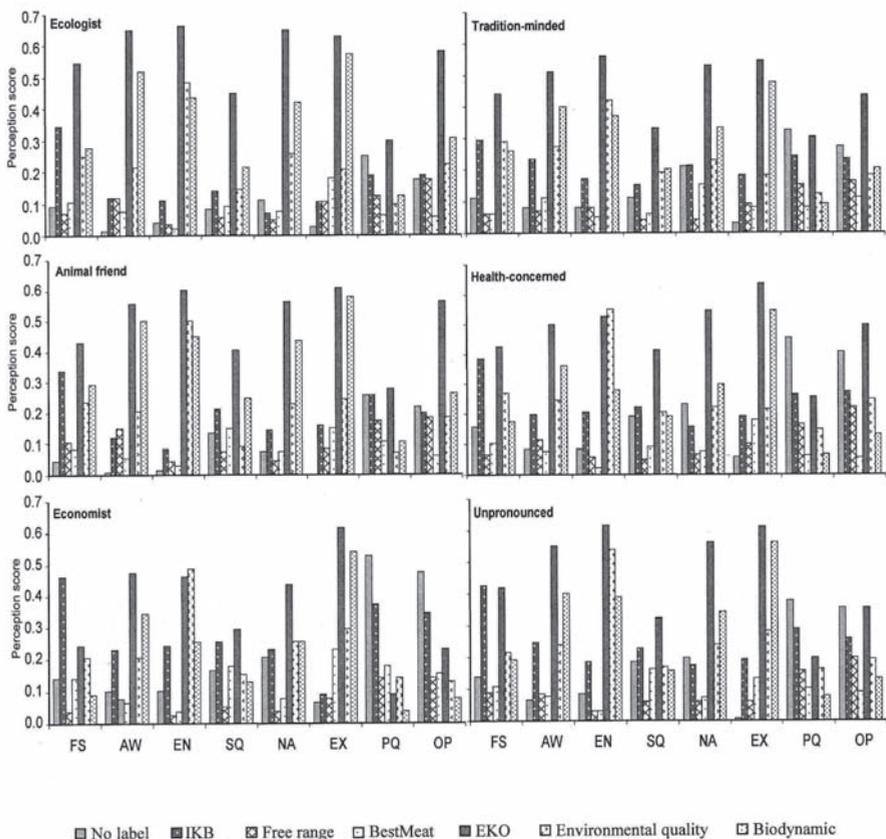


Figure 3. Perception scores per segment for different pork labels and for the consumer concerns food safety (FS), animal welfare (AW), environment (EN), sensory quality (SQ), naturalness (NA), expensiveness (EX), price/quality ratio (PQ) and overall preference (OP).

The considerable number of consumers who indicated a WTP of $\leq 0\%$, especially in the certainly framing, might, besides reasons indicated above, include consumers who are concerned about pork production issues but who perceive that someone else should pay for improving these. Towards the end of the questionnaire we asked respondents to indicate their preferred financial contribution from consumers, Dutch government and ‘polluters’ for improving farm-level pork production methods. The results (Table 6) show, although there is indeed a role for other parties such as government and polluters, that segments also saw a role for consumers themselves.

Pork label perception

After having indicated consumption figures per pork label, as shown in the lower part of Table 3, respondents were asked about their pork label perception. Labels had to be

evaluated with respect to animal welfare, food safety, environment, naturalness, sensory quality, expensiveness, price/quality ratio and overall preference. Respondents were asked to indicate the label perceived to score best, second best and third best for each specific item. Answers were dichotomized for subsequent analyses, i.e., a label scores 1 on an item if the label is part of a respondent's top 3, and 0 otherwise (including 'do not know'). Perception scores per segment and label are shown in Figure 3.

Regular pork (no label), which was stated to be consumed most (Table 3), scored high on some items (price/quality ratio and overall preference) and for some segments (especially *economists*) but EKO (organic) generally scored higher (Figure 3). This mostly also held for all other items.

Discussion and conclusions

This paper aimed at identifying consumer segments for pork, based on multiple attributes of the entire pork supply chain. Based on an extensive customized conjoint analysis (CCA) and by developing a finite-mixture regression model, we identified six segments of pork consumers classified as *ecologists* (17%), *tradition-minded* (17%), *animal friends* (16%), *health-concerned* (18%), *economists* (12%) and *unpronounced* (20%). Subsequently, these segments were described on issues ranging from (standard) socio-economic characteristics and pork consumption figures to 'pig farming knowledge scores' and willingness-to-pay numbers for improving pork production practices. Besides, segments were evaluated on a number of 'pork-related citizen questions', such as whether the Netherlands should stop exporting live pigs and whether production requirements in the Netherlands should be above EU-level.

The segment *unpronounced* was not really interested in any of the production items studied (although they had a rather good knowledge of them), and had no strong overall preference for any of the current labels. They mostly bought pork in the supermarket and were willing to pay relatively small amounts of money for production improvements. All other segments were found to be interested in at least some of the production items. For instance, *economists* strongly preferred cheap but excellent tasting pork of Dutch origin. Furthermore, they perceived farm-level traceability as relatively unimportant, did not seem to care about genetic modification in feed or animal breeding and had the highest overall preference for regular pork without any label.

Due to the large number and detailed character of the attributes, our results cannot be directly compared with literature. However, generally, findings are in line with other multi-attribute studies. For instance, Verbeke & Viaene (1999) also indicated the high relevance for Belgian consumers of acceptable pork production methods. With respect to the country of origin, also Dransfield *et al.* (2005) concluded that pork consumers in France, Denmark, Sweden and the UK mostly appreciate pork labelled as 'home produced' or 'outdoor'. In relation to the importance of safety issues, Krystallis *et al.* (2006) identified 'health clusters' as well.

For decision-makers in pork supply chains to start developing specific pork chains and labels based on the attributes and issues studied, we deem four questions crucial: 1. *Are segments valid?* Are consumers able to distinguish between pork production attributes?

To begin with, we found that consumers clearly had different preferences for a number of production attributes. Especially issues of animal welfare and food safety as well as farm-related aspects in general appeared to trigger people's explicit preferences. Also, answers to preference questions in the CCA analysis were mostly consistent with answers to willingness-to-pay and label perception questions. We therefore conclude that the identified segments are rather robust and that consumers are indeed able to express their preference for detailed issues of pork production. On the other hand, we did not have a representative sample, as it was biased towards more wealthy people with higher levels of education and income and with more children than average. Also, there were relatively many male respondents, whereas the daily shopping is mostly done by women. Both issues, however, are not likely to change the existence of the segments, although they might change somewhat their size. Another concern could be that respondents had likely been giving some socially desirable answers, at least in some parts of the questionnaire, as they stated to consume a rather high percentage of labelled pork (40% to 50%), whereas in reality market shares for labelled pork were less than 1%. However, segments are based on data from the CCA analysis, which is specifically designed to reduce problems of overstatements and socially desirable answers.

2. *Can segments be sufficiently targeted?* Given the specific preferences and the socio-economic and consumption characteristics per segment we believe that adequate targeting must be possible. However, with relatively low knowledge scores and some absurd ideas about current pork production and safety issues, care should be taken about how to approach and communicate with consumers. Attention should for instance be paid to the (widespread) import of feed ingredients, the (image of) exporting live pigs, the prohibition to use hormones and irradiation, and the relatively low prices for pigs at farm level. It should also be noted, however, that it is not only 'facts and figures' knowledge that can bring a good image to a label, as illustrated by our EKO pork findings.

3. *What is the financial room for investments?* A pessimistic decision-maker would point to the high preference for current reference prices, the high percentage of people in the $\leq 0\%$ willingness-to-pay categories and the relatively modest role of consumers in financing improvements in pork production methods. But more optimistic decision-makers can see that most segments hardly cared about somewhat higher prices per kg of pork and that a considerable number of consumers were certainly willing to pay more than 25% on top of their current reference price provided that their individual concerns about pork production would be met. This should provide ample financial room for investments, thereby noting that many investments might even be rather subtle given the relatively high perception scores for regular and IKB (bulk) pork, especially on the price/quality item.

4. *What are the practical implications for chain design: six different chains or synergy?* Our finding that consumers' willingness-to-pay numbers were highest when individual concerns were targeted is a strong argument in favour of six different chains. However, there are also arguments in favour of attempting to achieve synergy as: (1) consumers had difficulties with distinguishing between different labels, as was illustrated by our label perception analysis, (2) current legislation reduces differentiation opportunities, i.e., growth promoters in feed, genetic modification in breeding, pork irradiation

techniques and ‘no traceability’ are already forbidden, and the level of genetically modified substances in feed and residues of medicines in pork are already strictly limited; and (3) differences mainly exist at farm level (living surface, outdoor housing, pig handling).

Our main recommendations for decision-makers in pork supply chains can be summarized as follows:

1. Pork should not be marketed as a bulk product. There is a basis for segmentation in the market with distinct requirements for pork and the way it is produced.
2. Although there is financial room for investments into each of the six segments identified, a differentiation up to six labels may be too much. From the consumer perspective it is not likely that people can differentiate between six labels. From the producer perspective the current legal framework does not even allow to respond to each of the segments.
3. The market of fresh pork entails, besides necessary ‘business-to-business transparency’, a viable opportunity for ‘business-to-consumer transparency’, but care should be taken in communicating with consumers.

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