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TRADE-OFFS BETWEEN CONSUMER CONCERNS: AN APPLICATION FOR PORK PRODUCTION

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Abstract

This paper studies multiple attributes of pork production and analyses the trade-offs that consumers make between them. Results show that without considering the trade-offs, animal welfare and food safety are on average perceived as the most important attributes. However, including trade-offs, Taste and Price become major concerns. Conclusions are nuanced as for a number of segments and specific trade-offs Taste and Price are relatively less important. Results support the implementation of differentiated chain designs with distinct and innovative decisions for trade-offs to be made.

Key words:

Customised conjoint analysis; Segmentation; Pork production

1. Introduction

In redesigning supply chains, trade-offs need to be made between different consumer concerns, for instance between aspects of animal welfare and food safety. An adequate technique for analysing such trade-offs is conjoint analysis. Previous work in this field considers however only a limited number of aspects. For instance, Halbrendt et al. (1995) deal with pST pork, Den Ouden et al. (1997) focus on animal welfare, Frewer et al. (1997) analyse different processing technologies and Walley et al. (1999) study specific quality assurance schemes. The goal of this paper is to study consumer trade-offs for multiple production attributes, covering all stages of the supply chain and various consumer concerns including price. We focus on pork production in the Netherlands.

Section 2 describes the materials and methods. Section 3 discusses consumer concerns about pork production resulting from “non-trade-off methods”. In section 4 we discuss our trade-off results and compare them with findings from literature. In section 5, we show that, for specific segments, results from trade-off analyses can be very different from the overall picture. Section 6 comprises the discussion and conclusions.

2. Materials and methods

Data were gathered through a computerised questionnaire. Besides introductory questions and questions on socio-economic characteristics, the main parts of the questionnaire were (1) the elicitation of consumer concerns with various “non-trade-off methods”; and (2) a customised conjoint analysis task for the trade-off part.

The first “non-trade-off method” was a frank and open-ended question in the very beginning of the questionnaire (after some introductory questions): “Are you concerned about certain aspects of the pork sector in the Netherlands [yes/no]? If so, please specify your concerns”. In addition, there was a question in which a hypothetical budget had to be allocated to various areas of concern in the pig sector, i.e. food

safety, sensory quality, the environment, animal welfare and naturalness. Naturalness was described as down-to-earth, traditional and uncomplicated. Next, after some other questions in between, we had a willingness-to-pay (WTP) task. This task started by establishing an individual's reference price. The WTP was then elicited for "pork that is produced in such a way that specific consumer concerns are dealt with following latest scientific developments and according to government and consumer organisations". The consumer concerns referred to the same 5 areas mentioned in the budget allocation question, i.e. food safety, sensory quality, environment, animal welfare and naturalness. We framed the WTP questions in two different ways with one consisting of one question and the other of two questions. Respondents were randomly assigned to one of the two ways:

- | | | | |
|-------|--|---------|---------|
| (1) | For this pork, I am willing to pay <i>extra</i> : | + | Euro/kg |
| (2.a) | Up to this <i>total</i> price I am <i>certainly</i> buying the pork: | | Euro/kg |
| (2.b) | From this <i>total</i> price on I am <i>no longer</i> buying the pork: | | Euro/kg |

This way of framing led to 5 and 10 WTP-questions for method (1) and (2) respectively. Method (2) aimed at better triggering people's personal budget limitations. For this reason, i.e. stimulating people to realistically trade-off their WTP for pork against other personal spendings, this task should technically not be classified as a "non-trade-off method". Also, for the question about the budget allocation, people will make some trade-off between their concerns: the part of the budget spent on one concern cannot be spent on another. Still, both methods are considered here as "non-trade-off methods".

As for the customised computerised conjoint analysis (CCC), CCC as described by Hensel-Börner and Sattler (1999) was used as a starting point, but, due to the large number of attributes (i.e. 24), some modifications were necessary. The CCC task in our questionnaire consisted of two main parts, i.e. a self-explicated task and a conjoint task. Modifications mainly refer to the second part. The self-explicated part is a single attribute rating task, in which for each attribute both the attribute *levels* are evaluated and the *attribute* itself. For the attribute levels, respondents first had to indicate their most and least preferred levels. Next, the other levels (if any) had to be rated in between these two extremes, which were set to 10 and 0 respectively. The importance of the attribute itself was derived from the perceived importance (on a scale from 0 to 100) of the difference between the extreme levels. Results from the single attribute rating task are discussed together with the other "non-trade-off methods" (section 3). In the conjoint task, (i) we did not ask for single profile evaluations, but for graded paired comparisons; ii) we did not only include most important attributes, but also an attribute of moderate importance; and iii) the attributes Taste and Price were always included in the conjoint task, but were left out in the self-explicated task.

Based on the CCC-data, a segmentation analysis was carried out. For this, a mixture regression model (see Wedel and Kamakura, 2000) was adapted to cope with customised-conjoint data. Six segments turned out to be convenient for interpretation: Environmentalists, Ecologists, Animal-friends, Health-concerned, Unpronounced and Economists, as described in detail by Meuwissen et al. (2004).

Data were gathered in November 2001. There were 1444 respondents, from which 1199 fully completed the CCC-part. Only this group is considered in this paper. Although there were vegetarians and people not consuming pork, the sample of 1199 includes only people consuming pork. 57% is male, the average age is 47.3 years and 13% is older than 65. Comparing the sample with the Dutch population, our respondents have on average more children and a much higher income and education. Also, in our sample people buy more expensive pork chops, buy more frequently at the butcher and consume relatively more labelled pork.

3. Consumer concerns

In response to the open-ended question, 513 respondents, i.e. 47%, indicated to be concerned about the production of pork (Table 1). Of this group, 43% specified concerns with respect to animal welfare, including terms such as "animal welfare", "housing", "handling", "diseases", "transport" and "export". Concerns about the environment, the industrialised character of pork production, and aspects of food

safety (“hormones”, “antibiotics”, “medicines”, “feed”) were mentioned by 17%, 12% and 10% respectively. Aspects of sensory quality were not referred to at all.

In the hypothetical budget allocation both animal welfare and food safety were considered as important: both topics of concern would receive about 28% of the budget (Table 1). For the sensory quality of pork consumers would only spend 12%.

Table 1. Consumer concerns about pork production.

	Spontaneous (n=513)	Budget allocation (n=1199) ¹	Willingness to pay (% in addition to reference price)		
			Certainly ¹	No longer ¹	Extra
			(n=617)	(n=617)	(n=608)
Animal welfare	43 ²	28.0 ^a	30.9 (n _{≥0} =393) ³	53.7 (n _{≥0} =409)	44.8
Food safety	10	27.2 ^a	27.9 (n _{≥0} =385)	49.7 (n _{≥0} =407)	42.1
Environment	17	18.5	25.9 ^a (n _{≥0} =367)	44.7 ^a (n _{≥0} =401)	38.3 ^a
Naturalness	-	14.0	24.9 ^a (n _{≥0} =372)	45.8 ^a (n _{≥0} =395)	39.6 ^a
Sensory quality	-	12.3	22.6 (n _{≥0} =344)	41.2 (n _{≥0} =383)	33.1
Bio-industry	12	-	-	-	-

¹Superscript characters indicate means that are *not* significantly different (P≤0.05).

²Includes “animal welfare”, “housing”, “handling”, “diseases”, “transport” and “export”.

³For the total-price-questions (“certainly” and “no longer”), a number of respondents indicated a price below their reference price, resulting in a WTP<0. Only respondents with WTPs≥0 are included here.

Willingness to pay figures are in line with the budget allocation: for all WTP questions, numbers are highest for animal welfare and lowest for sensory quality. The n_{≥0} between brackets (for “certainly” and “no longer” questions) also indicates that for animal welfare the number of people with a WTP≥0 is highest. For instance, for animal welfare, 393 consumers (i.e. 64%) will certainly consider to buy at some price above the reference price, while for naturalness (n_{≥0}=372), environment (n_{≥0}=367) and sensory quality (n_{≥0}=344) this is 60%, 59% and 56% respectively. For welfare pork the average certainly-price is 30.9%, while for prices of 53.7% above the reference price people indicated to stop buying the pork. Comparing the average certainly-price with the extra-price, Table 1 shows that the certainly-prices are always below the extra-price levels. This is likely to be explained by the different framings. The relatively large numbers of people with negative WTPs may be due to the low-quality-low-price image of pork (Lans, 2001).

Table 2 show the attributes included in the Customised Conjoint task. Attributes are grouped under animal welfare, food safety, environment, origin of pork and choice in store, and, for the conjoint part, price and taste. Results from the self-explicated task (“single attribute rating”) show that space for pigs, application of medicines, the use of bone meal in pig feed and pigs’ living surface are on average perceived as the most important attributes. Again, animal welfare comes out as an important field of concern. However, results also indicate that this is not true for *all* animal welfare aspects, as pig handling issues, such as castration, teeth clipping and tail docking score much lower.

4. Trade-offs between consumer concerns

Table 2 shows that incorporating the results from the trade-off task (last column), Taste becomes on average the most important attribute, followed by price. Also the other “store attributes”, i.e. traceability and pork choice and origin become more important. Furthermore, most food safety attributes lose importance while some welfare attributes gain importance, as indicated by the standardised scores. A high importance of the attribute Price was also described by Frewer et al. (1997) who studied consumers’ perceptions about cheese processing technologies. They however did not mention Price but Costs. Other trade-off analyses for livestock products considering price are a study by Halbrendt et al. (1995) about pST pork in Australia, a study by Lusk et al. (2003) about beef from cattle for which growth hormones

and GM feed are applied, and a study by Novoselova et al. (2002) dealing with the safety of milk. These studies all found high importances for the food safety issues considered.

Table 2. Attributes and attribute levels per consumer concern and mean attribute importances for single attribute rating and with trade-off analysis (n=1199). Rankings between brackets.

	Single attribute rating	Including trade-offs ¹
<i>Animal welfare</i>		
Space (more; less)	5.22 (1)	5.20 (6)
Medicines (curative; preventive and curative; no; also for growth promotion)	5.18 (2)	5.30 (5)
Living surface (straw; concrete; grid floor; sand/mud)	5.15 (4)	5.38 (3)
Housing of pigs (individual; in groups)	4.75 (10)	4.63 (15)
Breeding goal (variety; productivity; disease resistance; sensory quality)	4.66 (12)	4.72 (9)
Housing of pigs (inside; outside; inside plus ² ; 50% inside-50% outside)	4.63 (13)	4.71 (11)
Castration to prevent strong meat odor (yes; no)	3.96 (19)	3.95 (22)
Teeth clipping to protect udder of sow (yes; no)	3.95 (20)	3.95 (21)
Tail docking to prevent tail biting (yes; no)	3.92 (21)	3.93 (23)
<i>Food safety</i>		
Bone meal in pig feed (yes; no)	5.16 (3)	5.34 (4)
Chance of Salmonella in pork (small chance; zero)	4.90 (5)	4.71 (10)
GM in breeding (yes; no)	4.88 (6)	4.95 (7)
Residues of medicines in pork (small chance; zero)	4.86 (7)	4.70 (12)
Residues of herbicides in pig feed (small chance; zero)	4.78 (9)	4.67 (14)
GMO substances in pig feed (yes; no)	4.69 (11)	4.69 (13)
Guarantee for food safety (extra cooking required; no extra cooking)	4.28 (16)	4.05 (19)
Irradiation of pork to increase its safety (yes; no)	4.01 (17)	3.97 (20)
Residuals of human food industry in pig feed (yes; no)	3.47 (22)	3.36 (24)
<i>Environment</i>		
Requirements for pig husbandry (no; legal minimum; extra severe)	4.83 (8)	4.84 (8)
<i>Origin of pork and choice in store</i>		
Traceability (to farm; to region; to country; no traceability)	4.40 (14)	4.44 (17)
Choice for pork chops (one quality one price; multiple qualities and prices)	4.31 (15)	4.44 (16)
Home country of pig (Netherlands; other EU-country; outside EU)	4.00 (18)	4.08 (18)
	100	100
<i>Price</i> (reference price; minus Euro 1.36; plus Euro 1.36)	-	5.44 (2)
<i>Taste</i> (possibly somewhat disappointing; sufficient; excellent)	-	6.46 (1)

¹Mean weighted importances from self-explicated and conjoint tasks.

²Inside plus was described as: inside, but with lots of daylight and fresh air.

Table 3 gives a short overview of the literature on consumers' trade-offs for concerns about livestock products. The table lists the attributes considered and indicates with an asterisk which attribute(s) came out as most important. The last row shows the results of Frewer et al. (1997). The table illustrates that in some studies trade-off analyses are used to analyse consumers' perceptions within a specific area of concern. For instance, Den Ouden et al. (1997) study multiple aspects of animal welfare. Valeeva et al. (2003) use conjoint analysis to analyse trade-offs between various aspects of food safety in the dairy production chain.

Table 3. Attributes in trade-off analyses for various livestock products and countries¹. Most important attribute(s) are indicated with an asterisk.

	Sensory quality	Food safety	Animal welfare	Environment	Price and other
a) Pork (Australia)	Leanness	pST*			Price
b) Pork (NL) ²			Housing* Handling* Supply of straw*		
c) Beef (US, France, UK, Germany)	Marbling Tenderness	Growth horm.* GM feed*			Price
d) Beef (UK)	Leanness*				Price Brand name Quality assur. Packaging
e) Chicken (NL) ³			Crating* Climate control* Litter*		
f) Milk (NL)		Contamination*			Price Label*
g) Milk (NL) ⁴		Medicines* Feed* Manure*			
h) Cheese (UK) ⁵	Flavour* Nutritional value	Gen. engineering Listeria	Animal welfare	Environment	Production time Costs*

¹References are a) ³Halbrendt et al. (1995); b) Den Ouden et al. (1997); c) Lusk et al. (2003); d) Walley et al. (1999); e) Maurice et al. (1999); f) Novoselova et al. (2002); g) Valeeva et al. (2003) and h) Frewer et al. (1997).

²Among 36 welfare attributes (including breeding, transportation and slaughtering) group housing of sows, pig handling during transportation and slaughtering, and supply of straw to hogs were considered as most important.

³Among 26 welfare attributes (including rearing, laying, broiler farms and transport to slaughterhouse) crating of broilers, climate control in slaughterhouse and provision of litter to broilers are considered as most important.

⁴Among 101 food safety attributes (including feed, dairy farm, processing and consumers) identification of treated cows, quality assurance of compound feed, and medicine withdrawal periods are considered as most important for chemical hazards. For micro-biological hazards these are the source of manure, action in case of *Salmonellosis* and *M. paratuberculosis*, and acquisition of cattle.

⁵Results refer to three distinguished clusters varying in their most important attributes, i.e. flavour, listeria and costs.

5. Trade-offs in different segments

Table 4 shows the same results as Table 2, but now for different segments (and only attribute rankings, no attribute importances). The characterisation of the various segments was described by Meuwissen et al. (2004). From the various segments, the largest effects of including the trade-off results are found for the Economists and Unpronounced, i.e. Taste is ranked 1st by the Economists and 3rd by the Unpronounced. Economists have clearly traded Taste off against Environmental requirements for pig husbandry (from 1st rank to 11th), the Chance of Salmonella (from 6th rank to 13th rank) and the use of genetic modification in breeding (from 14th to 24th rank). For the Unpronounced there are not such obvious trade-offs. For Ecologists, trading off the various pork production aspects led to an increased importance of pigs' living surface (from 12th rank to 1st rank), pigs' home country (from 20th to 4th rank) and the environmental requirements for pig husbandry (from 8th to 21st rank). In trading off the various attributes, Animal-friends further stress the importance of animal welfare aspects. The Health-concerned have clearly traded off animal and human health against environmental health, which moves from a 10th to a 24th rank.

Table 4. Attribute rankings from single attribute rating (S) and with trade-offs (T) for six pork segments.

	Environ- mentalists (n=205)		Ecologists (n=199)		Animal- friends (n=187)		Health- concerned (n=218)		Un- pronounc. (n=246)		Economists (n=140)	
	S	T	S	T	S	T	S	T	S	T	S	T
	<i>Animal welfare</i>											
Space	1	5	2	3	1	5	1	6	3	8	8	9
Medicines	3	1	5	5	3	2	6	2	2	1/2	3	3
Living surface	4	2	12	1	2	1	5	1	1	1/2	5	2
Inside/outside housing	14	14	9	10	6	8	12	10	10	14	2	6
Breeding goal	10	3	14	15	10	4	14	5	9	5	7	8
Ind./group housing	12	8	13	6	4	3	11	4	13	6	15	12
Castration	19	23	22	23	19	18	17	21	19	21	12	15
Teeth clipping	16	17	18	16	16	13	19	22	20	24	19	17
Tail docking	15	16	16	14	17	12	21	17	21	19	22	19
<i>Food safety</i>												
Bone meal	5	7	1	2	7	7	2	3	4	4	4	5
Salmonella	11	15	3	11	9	16	4	8	8	11	6	13
GM breeding	6	6	6	8	5	9	8	12	7	12	14	24
Res. medicines	7	11	10	13	13	19	3	14	5	16	10	16
Res. herbicides	9	12	4	9	14	14	7	11	6	10	16	18
GMO substances	8	9	7	7	8	11	9	9	14	13	18	21
Guarantee	17	20	11	22	20	24	13	20	16	18	11	22
Irradiation	20	19	17	20	18	23	15	19	18	23	20	23
Residuals food industry	22	24	21	24	22	22	20	23	22	22	21	20
<i>Environment</i>												
Requirements	2	4	8	21	12	17	10	24	11	15	1	11
<i>Origin and choice</i>												
Traceability	13	10	19	12	15	6	16	13	12	7	13	7
Choice	21	18	15	17	11	15	18	18	15	17	9	14
Home country	18	13	20	4	21	10	22	7	17	9	17	4
Price	-	22	-	19	-	21	-	16	-	20	-	10
Taste	-	21	-	18	-	20	-	15	-	3	-	1

Table 4 provided insight into consumer trade-offs between attributes. Table 5 shows the results of specific trade-offs for attribute *levels*: in scenarios 1, 2 and 3 aspects of animal welfare are traded off against aspects of food safety. Scenario 4 deals with animal welfare versus sensory quality. Scenarios 5 and 6 focus on animal welfare and scenarios 7 and 8 place the origin of pork against its traceability and price respectively. In general, food safety dominates animal welfare (1a-1b, 2a-2b and 3a-3b), but welfare prevails above taste (4a-4b). As for the origin of pork, consumers generally prefer pork from the Netherlands, even if it is not traceable to farm or region (7a-7b), or has a higher price (8a-8b). Trade-off results per segment are generally in line with the mean results. For Animal-friends, however, animal welfare dominates food safety: Animal-friends accept a small chance of Salmonella and a small chance of residues of medicines, as long as pigs live outside and medicines are used in both a preventive and curative way. Economists are the only people whose preference for excellent tasting pork is stronger than their preference for “happy pigs living in groups and on straw”. Also, Economists clearly don’t mind to use genetic modification to breed for more disease resistant pigs.

Table 5. Trade-offs in specific pork production scenarios, mean (n=1199) and per segment¹. The most preferred scenario is indicated with a +.

	Mean	1	2	3	4	5	6
1a Pigs live outside but there is a small chance of Salmonella	-	-	+	+	-	-	-
1b Pigs live inside and there is zero chance of Salmonella	+	+	-	-	+	+	+
2a Preventive and curative use of medicines, but small chance of residues	-	-	-	+	-	+	+
2b No medicines and zero chance of residues	+	+	+	-	+	-	-
3a Breeding for disease resistance, but with genetic modification	-	-	-	-	-	-	+
3b Breeding for productivity, but no genetic modification	+	+	+	+	+	+	-
4a Pigs live in groups and on straw, but may have a disappointing taste	+	+	+	+	+	+	-
4b Pigs live individually on grid floors, but have an excellent taste	-	-	-	-	-	-	+
5a Pigs live in groups, but tails need to be docked	+	+	+	+	+	+	+
5b Pigs live individually, but tails do not need to be docked	-	-	-	-	-	-	-
6a Pigs have more space, but live inside	+	+	+	+	+	+	+
6b Pigs have less space, but live outside	-	-	-	-	-	-	-
7a Pig grown in the Netherlands, but not traceable to farm or region	+	+	+	+	+	+	+
7b Pig grown in another EU-country, but traceable to the farm of origin	-	-	-	-	-	-	-
8a Pig grown in the Netherlands, but more expensive	+	+	+	+	+	+	+
8b Pig grown outside the EU, but less expensive	-	-	-	-	-	-	-

¹Segment 1=Environmentalists (n=205), 2=Ecologists (n=199), 3=Animal-friends (n=187), 4=Health-concerned (n=218), 5=Unpronounced (n=246) and 6=Economists (n=140).

6. Discussion and conclusions

Debates about future developments of livestock production often fall into impasses because of trade-offs that need to be made. For instance, “pig husbandry could stay in the Netherlands, but the produced pork will be more expensive than pork from elsewhere”. Or, “pigs could be kept outside, but there is a higher chance of Salmonella”. The current study shows that consumers’ perceptions about such trade-offs can be quantified, both for consumers in general as well as for specific segments. Trade-offs can be quantified for attributes (e.g., pig housing versus handling) and attribute levels (e.g., breeding for disease resistance but with genetic modification).

Results show that with “non-trade-off methods” animal welfare and food safety are consumers’ major concerns. However, when asking consumers to make specific trade-offs between aspects of animal welfare and food safety versus Taste and Price, the latter two become the most important attributes. These conclusions require some nuances though, since:

- (1) Even in the trade-off analysis, aspects of animal welfare remain relatively important; aspects of food safety loose more of their importance.
- (2) There are clearly segments with different views: Environmentalists, Ecologists, Animal-friends and Health-concerned (in total more than 50% of the sample) specify their top 3 concerns in the field of animal welfare. Animal-friends even explicitly trade-off animal welfare against taste.
- (3) The “non-trade-off methods” did not explicitly refer to aspects of price. For instance, in the budget allocation question there was no specified option to allocate part of the budget to stimulate low-cost pork production. Also, in the single attribute rating task of CCC, Taste and Price were not considered.
- (4) Respondents may have perceived many of the attributes in the single attribute rating task as rather unusual. They may therefore have been relatively strongly focusing on the more familiar attributes of Price and Taste when working on the conjoint task.

The paper demonstrates the feasibility of eliciting trade-offs between multiple pork production attributes and consumer concerns. In total, we considered 24 attributes, covering concerns of animal welfare, food safety, environment, sensory quality, origin, traceability and price. Customised

computerised conjoint analysis shows to be an adequate technique for handling large amounts of attributes.

An interesting “side-result” from our study is that “animal welfare” and “food safety” as such are not very meaningful. Consumer concerns about welfare clearly focus on aspects of pig housing, i.e. amount of space, living surface, individual or group housing and inside or outside housing, and not so much on the handling of pigs (tail docking, teeth clipping and castration). For food safety, consumers are concerned about bone meal in pig feed (not about GMO substances), the use of genetic modification in pig breeding and the chance of Salmonella. Irradiation of pork to increase its safety is not an issue of concern. In our willingness to pay task we anticipated on this “concern differentiation” by framing the WTP-questions as “...according to government and consumer organisations”.

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