

Preferences for Certified Beef with Animal Welfare and Other Credence Attributes in Australia

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ABSTRACT

Concerns over livestock production practices have resulted in increased consumer preferences for certified products. Australian beef buyers' survey data revealed the preferences of consumers who would buy differentiated beef based on animal welfare, safety, health, or environmental-friendly considerations. Female respondents are more likely to buy certified animal welfare products. Buyers with children, and those who value branded beef, are more likely to buy products differentiated by a bundle of credence attributes. Given that Australian beef consumers eat similar amounts, there are opportunities for differentiating beef products according to credence attributes and offering them in a range of retailers.

Keywords: consumer preferences; animal welfare; propensity to buy; logistic regression

JEL Codes: Q13; D12; C25

1 Introduction

Concerns about animal welfare have influenced food and livestock markets lately, as consumers are increasingly aware of some production techniques used by agro-food companies, called factory farming, and have product preferences influenced by ethical aspects of food production. These aspects include effects on rural communities, the environment and animal mistreatment (Chen, 2016; Heise and Theuvsen, 2017; Lusk and Norwood, 2012; Rovers, Christoph-Schulz and Brümmer, 2019; Verbeke and Viane, 1999; Winter *et al.*, 1998). Consequently, preferences and demand have increased for beef with animal welfare and other credence attributes certified, including safety and health for humans, and being produced in an environmentally friendly manner (Liljenstolpe, 2008; Loureiro and Umberger, 2007; Purwins and Schulze-Ehlers, 2018; Umberger, Thilmany McFadden and Smith, 2009).

Information asymmetry exists when consumers have limited information about the way an animal was raised, fed and slaughtered. Therefore, they are unable to verify the production methods at the point of sale and must rely on labelling schemes that communicate the attributes of products to correct this market failure of asymmetry of information (Akerlof, 1970; Grunert, Bredahl and Brunso, 2004; Kehlbacher, Bennett and Balcombe, 2012). Labelling allows the industry to identify certified products to consumers willing to pay more for beef products with their production process meeting the requirements of specified animal welfare standards, and capture the benefits when labelling helps to highlight this certification as a private good (Dankers, 2003; Lundmark *et al.*, 2018; Hirsh *et al.*, 2019). Labelling attracts premiums and in some cases, products not meeting animal welfare standards could be excluded from some points of sale, depending on the strategy of the retailer and the characteristics of its consumer segments. The premiums paid by those consumers play a key role in incentivising livestock farmers to produce in accordance with animal welfare standards when they are big enough to offset additional production costs (Grunert, Bredahl and Brunso, 2004; Lusk, Nilsson and Foster, 2007; Viegas *et al.*, 2014).

The objective of this research is to contribute to the literature identifying the potential, preferences and characteristics of Australian beef buyers who would buy differentiated beef that has animal welfare certification or other credence attributes. The results of this research are relevant for all actors in the Australian beef industry, as the differentiation alternatives and relevant attributes that are revealed could lead to the successful introduction of new branded beef products. In that way, the beef industry will be more sustainable, because animal welfare and other credence attributes, including environmentally friendly, are more valued by the society, then they will represent additional income for the industry and the potential that companies can sell their production in increasingly more restrictive markets.

In the next section, we review relevant previous studies; then, we outline the data used in this research. After that, we describe the empirical methodological framework used in this research. Then, we present the estimation results obtained using logistic regression modelling, where the dependent variable in the regression models are whether the respondent would buy differentiated beef for animal welfare or credence attributes reasons, the last alternative includes animal welfare, safety, healthy and environmentally friendly reasons. Finally, we discuss the main conclusions derived from the findings of this study and implications for the Australian beef industry.

2 Literature review

Based on certification and labelling of credence attributes, the Australian beef industry could develop new differentiated products as a way to capture premiums and to increase the chances of their products being selected by consumers (Gracia *et al.*, 2014). In recent years, the processing and quality evaluation systems of the Australian beef industry have improved through the introduction of the Meat Standards Australia (MSA) grades, which allows the industry to guarantee the eating quality of each cut sold in tenderness, flavour, juiciness and overall satisfaction (Polkinghorne *et al.*, 2008). The increasing media attention on cases of animal mistreatment and concerns raised by consumers in several countries, including Australia, about animal conditions and other ethical motives suggest a potential to offer products with certified animal welfare and other credence attributes (Chen, 2016; Heise and Theuvsen, 2017).

Certification of animal welfare standards could help the Australian beef industry to increase profits through premiums and access to points of sale where only certified products are accepted¹. The current animal welfare situation in beef production varies depending on the area where cattle are raised, the time required to travel to sale points or abattoirs and the practices used in different abattoirs. However, the beef industry has neglected this alternative to differentiate its production that could increase profits for the whole chain by responding to the ethical concerns of consumer segments influenced by altruistic motivations (RSPCA Australia, 2013). This strategy is contrary to the trend observed in other meat industries, such as chicken and pork, the most relevant meat industry competitors, where companies offer meat to consumers with certified credence attributes, including animal welfare, as in the case of meat certified by the Royal Society for the Prevention of Cruelty to Animals (RSPCA) (RSPCA Australia, 2013).

Meta-analysis studies, including Lagerkvist and Hess (2011), Clark et al. (2017), and Yang and Renwick (2019), have summarised the evidence of several empirical studies in different countries, indicating that groups of citizens and consumers are willing to pay premiums for certified animal welfare, among other valued credence attributes, including environmentally friendly and hormones/antibiotic-free. Consumers have also demonstrated they are willing to pay premiums for guaranteed tenderness, naturally produced and Angus breed attributes in Canada (Froehlich *et al.*, 2009), for grass-finished beef in the USA (Umberger *et al.*, 2009), for country of origin in the USA (Loureiro and Umberger, 2003; Tonsor *et al.*, 2013), for animal welfare in Sweden (Carlsson *et al.*, 2007) and in Germany (Purwins and Schulze-Ehlers, 2018), and for other credence attributes, including animal welfare, food safety and environmental protection in Portugal (Viegas *et al.*, 2014) and in the USA (Lusk and Norwood, 2012). According to these studies, those credence attributes are often identified as less intensive systems, and are generally perceived to be environmentally friendlier, provide higher levels of animal welfare and offer higher safety. In addition, Viegas *et al.* (2014) found evidence of substitution effects on willingness-to-pay premiums between these credence attributes, while Gracia *et al.* (2014) and Onozaka and McFadden (2011) identified several interaction effects for a range of products among production claims such as organic, fair trade, carbon footprint and location claims. Considering these substitution effects on willingness to pay, the industry could explore the alternative of offering products with bundled credence attributes, including animal welfare, safety, health and environmentally friendly, (Del Giudice, Cavallo and Vecchio, 2018), as a way to maximize profits, and to aim for a broader potential market segment.

In Australia, Morales *et al.* (2013) found that beef buyers are more likely to buy differentiated beef if they have medium to high income levels, they are a small household, they shop at butchers, they have experienced and appreciate beef brands, there is information and assistance at the purchase point, they are more interested in quality than size of cuts, and they are interested in healthiness and the intrinsic quality of the product. In Belgium, Verbeke and Vackeir (2004) segmented the beef market, reporting that those who have families with children and female consumers perceived higher consumption risks and were more cautious when purchasing beef products. Across Europe, Grunert and Valli (2001) found a consumer segment highly concerned about animal welfare, including young people with high incomes and high educational levels. In addition, other studies in Europe found that sensitivity to animal welfare varies with gender, education level, occupation, and place and country of residence (Bernués *et al.*, 2003; María, 2006). According to María (2006), young consumers, women, students and professionals exhibit a higher animal welfare sensitivity, while Bernués *et al.* (2003) found that those living in medium to big cities are more concerned about animal welfare.

Beef quality has different dimensions for beef consumers. In Australia, eating quality, related to eating experience, has been the main focus of the beef industry, using the Meat Standards Australia (MSA) grades to guarantee consistent eating quality among beef cuts. In addition, breed and organic certifications have been also introduced in the market, with all certifications receiving different premiums by consumer segments willing to pay for those attributes. Despite the experience in other meat industries, so far the Australian beef industry has not explored the alternative to introduce a certification for products meeting animal welfare standards and other credence attributes, also including safety, healthy and environmentally friendly.

¹ We recognize the value of animal welfare as a public good for the society; however, this study centers on the value of animal welfare and other related credence attributes for the Australian beef industry, as a way to differentiate its production and capture premiums beyond the current focus on eating quality. In addition, some retailers, depending on their strategies as a way to be perceived by the society, could require certification of animal welfare standards to accept beef products being sold in their stores, similarly to the cases observed in other meat industries.

3 Methods

3.1 Modelling consumer preferences

The theoretical framework of consumer preferences and, consequently purchase decisions, used on the empirical analysis conducted in this study, is based on consumer preferences with different characteristics and perceptions about product attributes. The socio-demographic and attitudinal characteristics of the respondent and the perceptions about the product attributes affect the utility that each person perceives from a beef product with specific attributes. The influence of these variables on the utility can be modelled using a utility function in attributes space, as specified by Carlsson *et al.* (2003); and Tonsor *et al.* (2005):

$$U_i(a) = \alpha + \beta A_i + \gamma C_i + \varepsilon_i \quad 1$$

where $U_i(a)$ is the consumer's utility function in product attributes space; α is a constant of consumer's beef preferences; A_i is a matrix of perceptions about beef attributes; β is a vector of the influences of beef attributes on the utility perceived by consumer i , C_i is a matrix of the characteristics of the individual consumer i ; and γ is a vector of the influences of these characteristics on the utility of consumer i . Finally, ε_i is a stochastic error component.

The final purchase decision will be influenced by socio-demographic and attitudinal characteristics, quality dimensions sought and quality cues used. Based on the utility approach, if beef buyer i chooses a differentiated product (x_1), this decision is based on that person perceives a higher utility of this product compared with the alternative product (x_0), as modelled by Greene (2017):

$$U_i(x_1) > U_i(x_0) \quad 2$$

Hence, a probability function that buyer i prefers a differentiated product x_1 (or propensity to buy product x_1), which has certified attributes, can be built using a non-linear relationship using as determinant variables the socio-demographic and attitudinal characteristics, and perceptions about the product attributes, given the effect of a variable on the probability to buy product x_1 is not constant. More details about the model of propensity to buy a differentiated beef with credence attributes, using a logistic probability function, are presented in Appendix 1.

3.2 Survey data collection

An online survey collected data across Australia to explore the potential of selling branded beef during January 2010². Residents 18 years old or over who indicated they make beef purchase decisions for their households were interviewed. These beef buyers are expected to represent the preferences of all beef consumers as they shop for beef that is acceptable to all members of their households³. A marketing research company randomly selected respondents from a panel of approximately 300,000 people, therefore, food-survey specialists and groups of consumers concerned about animal welfare were not overrepresented. To improve the level of response rate, incentives were offered to answer the questionnaire⁴. First, 1,985 people were invited by email to answer the questionnaire. From them, 1,883 persons accepted the invitation and the terms presented in the Information Sheet for Participants and Consent, giving a response rate of 94.86%. From those who answered the questionnaire, 405 completed only demographic questions, 394 answered the questionnaire partially or in an inconsistent way, and 1,084 respondents completed the whole questionnaire and provided consistent answers using check questions. Given the characteristics of the online survey, respondents had the opportunity to access multiple times to the website and answer the questionnaire; therefore, the response time was not controlled in this study. Quotas related to the demographics of Australian beef consumers were established to achieve a sample that represents the population under analysis. The alternative of

² Current consumer preferences towards credence attributes of meat products are expected to be similar to those captured by the sample, considering the data was collected in a moment without a major event in the media coverage about cattle cruelty. According to Meat and Livestock Australia (MLA) (2019) and the Better Beef Cattle Welfare Report prepared by RSPCA Australia (2013), preferences for certified animal welfare meat is a growing trend in Australia.

³ At the time of data collection, 16,371,920 Australian consumers were 18 years old or older. From them, an estimated 15,045,794 were beef consumers, and from them 9,539,033 were beef buyers, those who were the purchase decision makers.

⁴ The incentive for a completed questionnaire, which represents the maximum, was of AUD1.50, which at that time was equivalent to USD 1.3659, considering an average exchange rate for January 2010 of 1 AUD being equal to 0.9106 USD.

recruited Internet samples allows a higher capacity to monitor the process and select respondents using quotas (McDaniel and Gates, 2014). The main advantages of these type of online surveys are lower administration costs, a reduced data collection period, and higher response rates. The main disadvantages of this alternative are concerns about privacy of sensitive data, and when respondents do not represent the whole population (McDaniel and Gates, 2014; Rea and Parker, 2014). Therefore, recruited Internet samples will work only for populations with appropriate access, which is the case of the Australian population. According to Rea and Parker (2014), considering the large size of the population under analysis, the sample collected can be considered as representative given its size is bigger than the minimum required with a 95% confidence level and 3% margin error.

4 Results

A comparison between the demographic characteristics of the sample of 1,084 respondents and the Australian population is presented in Table 1.

Table 1.
Comparison of Socio-demographic Characteristics between the Australian Population and Survey Respondents
(n = 1,084)

Variable	Total (percentage of Australian 14+)	Sample (percentage)
<i>Gender</i>		
Male	49.40	49.00
Female	50.60	51.00
<i>Age</i>		
14 to 24 years old (18 to 24 in sample)	18.00	11.00
25 to 34 years old	16.50	21.00
35 to 49 years old	26.90	31.00
Over 50 years old	38.60	37.00
<i>Marital status</i>		
Single	36.70	36.00
Married/de facto	63.30	64.00
<i>Household size</i>		
1-2 people	40.80	46.00
3-4 people	43.00	39.00
5 people or more	16.20	15.00
<i>Children</i>		
No	62.90	64.00
Yes	37.10	36.00
<i>Occupation</i>		
Working full-time	39.30	43.00
Working part-time	20.60	20.00
Not employed	40.10	37.00
<i>Education level</i>		
Some secondary school/Tech.	17.00	17.00
Finished Tech./HSC/Year 12	19.60	20.00
Have diploma or degree	33.50	61.00
<i>Income level (before taxes)</i>		
Under AUD20,000	18.80	9.00
AUD20,000 to AUD29,999 (AUD20,001 to AUD40,000 in sample)	11.80	17.00
AUD30,000 to AUD49,999 (AUD40,001 to AUD60,000 in sample)	25.90	18.00
AUD50,000 to AUD69,999 (AUD60,001 to AUD80,000 in sample)	18.70	16.00
AUD70,000 or more (AUD80,001 or more in sample)	24.80	41.00

Even though not all socio-demographics were classified in the same categories, Table 1 demonstrates the sample proportions follow a similar distribution to the Australian population. The survey questionnaire consists of 27 questions divided in six sections: general characteristics, attitudes towards meal preparation and beef, attributes sought and beef perceptions, beef shopping preferences, branded beef perceptions and premiums, and demographics. Table 2 presents the questions included in each section of the questionnaire.

Table 2.
Survey Questionnaire

Section A. General characteristics

- 1) Do you eat beef cuts such as scotch fillet, sirloin, porterhouse or rump at home? (No/Yes)
 - 2) Do you decide most of the time the quality of beef that is bought for your household? (No/Yes)
 - 3) Considering all main meals in an average week, how often are beef products prepared and eaten in your main meal at home? (Less than once per week/1-2/3-4/5-6/7 or more times per week)
 - 4) How much home-cooked beef does your household consume per week? (in kilograms)
-

Section B. Attitudes towards meal preparation and beef

- 5) The following is a list of statements regarding your beliefs about beef. Please indicate how strongly you agree or disagree with each one. (7-points Likert Scales)
 - 5a. My understanding of the most appropriate cuts of beef for different recipes is high.
 - 5b. When preparing household meals, my main concern is to do so as efficiently as possible.
 - 5c. Eating beef gives me great pleasure.
 - 5d. To avoid disappointment I often buy cuts of beef that I suspect are better than I really need for meals.
 - 5e. I generally buy beef without information about origin or processing.
 - 5f. I do not spend time trying to find cuts that are clearly the freshest.
 - 5g. Beef is a routine part of my diet.
 - 5h. I do not have the time to fiddle about with new recipes during weekdays.
 - 5i. I am not concerned about the fat content of beef cuts.
 - 5j. Beef is an important component of my diet.
 - 5k. Beef represents an important part of my expenditure on food.
 - 5l. Beef is just another ingredient of a meal.
 - 5m. I am generally looking for products reduced in fat.
-

Section C. Attributes looked for and beef perceptions

- 6) The following is a list of statements regarding your perceptions about beef. Please indicate how strongly you agree or disagree with each one. (7-points Likert Scale)
 - 6a. I find the beef I buy to be satisfactory consistently.
 - 6b. The difference in quality between the best and worst beef I have cooked is considerable.
 - 6c. From one purchase to the next, the quality of the beef I buy seems to vary.
 - 6d. I find specials on beef prices very attractive.
 - 6e. I find meats useful that are pre-prepared, with sauces, coatings etc.
 - 6f. The price of beef is a good indicator of its quality.
 - 6g. Time pressures make it hard for me to buy the quality of beef I prefer.
 - 6h. I usually buy beef at supermarkets.
 - 6i. When cooking any specific cut of beef, the quality of the meal I prepare depends heavily on the quality of the beef I buy.
 - 6j. Stand-alone butcher shops have better quality beef than supermarkets.
 - 6k. I would like to get more information about beef products.
 - 6l. I appreciate assistance with choosing beef of the right quality.
 - 6m. I would value a brand of beef that provided consistent quality meat.
- 7) When I compare really good beef meals to not-so-good ones, the aspects of the beef that usually differ noticeably are: (Fattiness/Tenderness/Intense Meat Flavour/Juiciness/Serving Size/Other Factors)
- 8) What do you look for when you buy beef? The following is a list of attributes that you may look for when purchasing. Please indicate the desirability of each feature with an "X" for each attribute. (7-points Likert Scale)
 - 8a. Bright Red Colour.
 - 8b. High Percent Lean.
 - 8c. Specific Cut.
 - 8d. Low Fat Content.
 - 8e. Highly Marbled.
 - 8f. Bought in Butcher Store.
 - 8g. Beef Coming from a Specific Area.
 - 8h. Quality Assured
 - 8i. Long Time to the Expiration Date.
 - 8j. Packaging that suits my needs.

- 8k. Low Priced.
- 8l. Quick Preparation Time (pre-processed or marinated).
- 8m. Environmentally Friendly Production Methods.
- 8n. Information about the Way the Animal was Fed.
- 8o. Specific Breed (eg: Angus).
- 8p. Specific Brand.
- 8q. Nutritional Value Information
- 8r. Certified Organic.
- 8s. Short Time Since the Product was Processed.
- 8t. Certified Free of Unhealthy Chemicals (eg: hormones, additives, etc.).
- 8u. Information about the Way the Animal was Slaughtered (eg: halal).

Section D. Beef shopping preferences

- 9) Considering the attributes you look for when you buy beef for consumption at home. Please tick the most important attribute and those attributes you may also consider when you are making a regular beef purchase decision and when you buy beef for a special occasion. (Attributes presented in question 8)
- 10) Where do you buy your beef? (Main Source-Sometimes a Source-Never) (Supermarket/Stand-alone butcher/Farmers' market)
- 11) I think that people who insist on buying fresh food elsewhere than in a supermarket. (Have time to spare/Are health conscious/Are snobs/Are connoisseurs/Are well off/ Value high quality fresh foods/Get a special kick out of preparing meals)

Section E. Branded beef perceptions and premiums

- 12) Can you recall the names of any specific brands of beef that you have come across?
- 13) Have you bought branded beef? (No/Yes)
- 14) I am confident that a brand of beef would worth more than unbranded beef. (7-points Likert Scale)
- 15) Would you buy branded beef products at supermarkets and other retailers if they were available across Australia and offering the attributes you are looking for? (No/I do not know/Yes)
- 16) What is the main reason you would buy branded beef? (Higher safety for my family/Healthier for my diet or body/Better taste or eating experience/Higher environmentally friendly standards/Better animal welfare standards of production/Easier to prepare at home/I enjoy buying luxury products/Other reasons)
- 17) For rump or sirloin/porterhouse that I believed was ideal for my purposes I would pay an extra per kilogram of: (Nothing/1-4 dollars/5-9 dollars/10-14 dollars/15-19 dollars/20-24 dollars/25-29 dollars/30-34 dollars/35-39 dollars/40 dollars and more)

Section F. Demographics

- 18) I am in the age group of: (18-24/25-34/35-44/45-49/50-54/55-64/65 or more)
- 19) My gender is: (Male/Female)
- 20) The highest level of education I completed is: (Primary School or Some Primary School/Some Secondary School/Finished Year 12/Diploma from CAE or TAFE/Graduate Degree from University or TAFE/Postgraduate Degree (Grad. Dip., Masters or Ph.D.))
- 21) My marital status is: (Single, divorced or widowed/Married or de facto)
- 22) The number of people living in my home is:
- 23) The number of children (under 18 years old) living at home is:
- 24) The number of children in my household in each of the following age categories is: (Up to 4 years old/5-12 years old/13-17 years old)
- 25) Currently I am: (Working full time/Working part time/A full time student/A part time student/Both working and studying/Retired/Engaged in full time home duties/Not in paid work but looking/On a pension (other than age pension))
- 26) My postcode is:
- 27) The total annual income, before tax, of all members of my household is in the category of: (Up to \$20,000/\$20,001 – \$40,000/\$40,001 – \$60,000/\$60,001 – \$80,000/\$80,001 – \$100,000/\$100,001 – \$120,000/ \$120,001 – \$150,000/\$150,001 – \$200,000/Over \$200,000)

As presented in Table 2, in question 15 respondents were asked if they would buy differentiated beef for any reason, and those who said yes were asked to indicate the main reason why they would buy these products in question 16. The categories of reasons include taste, animal welfare, safety, healthy, produced in an environmentally friendly manner, easy to prepare, luxury product or other reason⁵. These questions were not subject to any condition about price. Fifty-five percent of the respondents interviewed were willing to buy branded products, and 9% of this group would buy differentiated beef for

⁵ Given the branded beef products explored in this study were not available in the market, data of revealed preferences was not available and it was considered more suitable to follow a contingent valuation method. The disadvantage of the CV method is the hypothetical bias that could result in higher values of willingness to pay for differentiated products (Murphy and Stevens, 2004); however, there is no evidence this bias could affect the propensity of consumers in their decision to buy differentiated products with specific attributes.

animal welfare reasons. Combining the groups that would buy differentiated beef based on either animal welfare, safety, health, or environmental-friendly considerations, the proportion of beef buyers who would buy this product with bundled attributes was 20.80% of the complete sample of respondents⁶. Table 3 presents the numbers and proportions of beef buyers willing to buy branded beef products, indicating the main reason, the maximum premium for branded beef and the average beef consumption per household member, measured in kilograms per week.

Table 3.
Beef Buyers Willing to Buy Differentiated Beef, Main Reason, Average Maximum Premium for Branded Beef and Average Beef Consumption per Household Member

	Number of respondents	Percentage of sample	Percentage of buyers willing to buy branded beef	Average maximum premium for branded beef (in \$/kg)	Average beef consumption per household member (in kg/week)
<i>Total sample</i>	1084	100	-	-	0.945
<i>Willing to buy branded beef</i>	592	55	100	4.82	0.954
<i>Main reason for preferring branded beef</i>					
Taste	294	27	50	4.40	0.994
<i>Credence attributes</i>	225	21	38	5.58	0.936
Animal welfare	51	5	9	4.81	1.011
Safety	51	5	9	6.69	1.031
Health	97	9	16	6.15	0.875
Produced in an environmentally friendly manner	26	2	4	2.73	0.828
<i>Other attributes</i>	73	7	12	4.20	0.850
Easy to prepare	11	1	2	8.55	0.880
Luxury product	14	1	2	3.29	0.783
Other	48	4	8	3.47	0.863

Note: There was no indication about a potential price change on the question. Respondents were asked subsequently about the maximum premium per kilogram they would pay for their ideal beef. There is no evidence of lower average beef consumption per household member among consumers who would buy branded beef for credence attributes, which make these products an attractive option for the industry, as those consumers eat similar amounts of beef than other groups.

In contrast to the results reported by Kayser, Nitzko and Spiller (2013) in Germany, among Australian beef consumers there is no evidence of lower beef consumption between those who would buy branded beef for animal welfare reasons respect to other attributes. This outcome corroborates the findings of Chen (2016), who indicated that even though most Australians eat meat, there is concern about animal welfare conditions. In addition to the level of consumption and the relevant proportion of the sample that would buy branded beef for credence attributes, the maximum premium that could be paid for branded beef certified with credence attributes in overall is higher than taste, which makes this potential branded product an attractive alternative to be explored by the Australian beef industry.

According to the theoretical framework, the variables used in this study are perceptions about beef attributes and consumer characteristics, the latter comprising purchase behaviours, shopping preferences, perceptions about quality and differentiated beef, and soci-demographics. Using *principal component analysis*, perceptions about 21 beef attributes were grouped into 5 beef components using Varimax orthogonal rotation to avoid multicollinearity problems while modelling⁷. This method allows highly correlated variables to be gathered into a set of uncorrelated components (Hair *et al.*, 2010), as the ones presented in Table 4.

⁶ A total of 51 participants indicating they would buy branded beef for animal welfare reasons is expected, given the proportion they represent of the population, and consequently of the total sample (5%). Due to this small amount could be not relevant to justify the introduction of a differentiated product, an alternative approach was considered to combine all credence attributes, which together represent 225 respondents, equivalent to 21% of the sample, which is a target segment far more attractive for the beef industry.

⁷ More details about the principal components analysis are available from the authors upon request.

Table 4
Components of Perceptions about Beef Attributes, Main Loadings per Attribute and Proportion of Total Variance (63.2% in Total)

	Component 1: 'Credence attributes'	Component 2: 'Healthiness and intrinsic quality cues'	Component 3: 'Freshness and packaging'	Component 4: 'Marbling and beef source/origin'	Component 5: 'Price and cooking convenience'
Proportion of total variance	0.215	0.128	0.118	0.098	0.073
Attribute					
Information about the way the animal was fed.	0.808				
Certified organic.	0.780				
Information about the way the animal was slaughtered (e.g. halal)	0.710				
Environmentally friendly production methods.	0.682				
Specific breed (e.g. Angus)	0.670				
Specific brand	0.657				
Nutritional value information	0.645				
Certified free of unhealthy chemicals (e.g. hormones, additives, etc.)	0.587		0.543		
High percent lean		0.861			
Low fat content		0.817			
Bright red colour		0.635			
Specific cut		0.607			
Long time to the expiration date			0.685		
Quality assured			0.639		
Short time since the product was processed	0.519		0.550		
Packaging that suits my needs			0.533		
Highly marbled				0.746	
Bought in butcher store				0.571	
Beef coming from a specific area				0.547	
Quick preparation time (pre-processed or marinated)					0.813
Low priced					0.588

Note: This rotated factor matrix was estimated using the VARIMAX method. Only component loadings above 0.5 are presented to facilitate interpretation. Kaiser-Meyer-Olkin (KMO) test 0.900, Bartlett's test of sphericity with a p-value lower than 0.001, Cronbach's alpha test 0.895 in overall, and between 0.456 and 0.893 for individual components.

Previous researchers, including Morales *et al.* (2013), and Heise and Theuvsen (2017), have used psychographic factors and clusters of respondents to agglomerate several attitudinal characteristics and purchase behaviours. Using that approach, the results obtained are statistically sound but they provide limited insights for the industry. Therefore, instead of using these data agglomeration alternatives for consumer characteristics, the current research utilises purchase behaviours, shopping preferences, perceptions about quality and differentiated beef, and demographics. Table 5 presents descriptive statistics of the variables used in the models for those respondents who would and would not buy differentiated beef products.

Table 5
Descriptive Statistics and Test of Differences between Potential Branded Beef Buyers and Non-Beef Buyers

Variable	Type	Potential branded beef buyers (n = 592)		Non branded beef buyers (n = 492)		P-values of independent samples t-test
		Mean/Decimal [†]	SD	Mean/Decimal [†]	SD	
Would buy branded beef for animal welfare reasons (1 if yes)	BN	0.086	0.281	0.000	0.000	<0.0001
Would buy branded beef for bundled reasons (including safety, health, produced in an environmentally friendly manner and animal welfare) (1 if yes)	BN	0.380	0.486	0.000	0.000	<0.0001
Would buy branded beef for taste reasons (1 if yes)	BN	0.497	0.500	0.000	0.000	<0.0001
Would buy branded beef for other reasons (including easy to prepare, luxury product and other) (1 if yes)	BN	0.123	0.329	0.000	0.000	<0.0001
Perceptions about beef attributes - component 1: 'Credence attributes'	RS	0.097	1.016	-0.116	0.969	<0.0001
Perceptions about beef attributes - component 2: 'Freshness and packaging'	RS	0.065	1.000	-0.078	0.995	0.019
Perceptions about beef attributes - component 3: 'Healthiness and intrinsic quality cues'	RS	0.060	1.009	-0.072	0.985	0.030
Perceptions about beef attributes - component 4: 'Marbling and beef source/origin'	RS	0.061	1.013	-0.073	0.980	0.028
Perceptions about beef attributes - component 5: 'Price and cooking convenience'	RS	0.021	0.990	-0.025	1.013	0.446
Beef consumption per household member (in kg. per week)	Q	0.954	0.665	0.934	0.715	0.676
Appreciate shop assistance when choosing beef (Likert scale)	O	4.949	1.194	4.504	1.269	<0.0001
Time pressures make it hard to buy the preferred quality of beef (Likert scale)	O	3.507	1.390	3.553	1.331	0.578
Shops for beef mainly in other stores rather than supermarkets (1 if yes)	BN	0.323	0.468	0.394	0.489	0.014
Level of agreement that branded beef is worth more than unbranded beef (Likert scale)	O	4.622	1.228	4.035	1.117	<0.0001
Previous experience with branded beef (1 if yes)	BN	0.340	0.474	0.148	0.356	<0.0001
Age of the respondent (in categories)	O	3.791	1.930	3.902	2.004	0.352
Gender of the respondent (1 if female)	BN	0.492	0.500	0.528	0.500	0.227
Education (in categories)	O	3.946	1.242	3.805	1.287	0.068
Marital status (1 if married/de facto)	BN	0.628	0.484	0.657	0.475	0.336
Household size (number of persons)	Q	2.936	1.363	2.967	1.437	0.712
Children at home (1 if yes)	BN	0.356	0.479	0.364	0.482	0.801
Household income (in AUD categories)	O	4.213	2.062	4.016	2.167	0.129

BN = binary nominal; O = ordinal; Q = quantitative; and RS = ratio scale.

[†] Decimals are relevant for binary nominal variables.

The independent samples t-test reported are without assuming equal variances. For categorical binary variables, z tests for proportions were also performed and reported similar results Binary logistic models were run for the group of buyers who would buy differentiated beef mainly for 'animal welfare' reasons, and for a 'bundle of credence attributes', including animal welfare, safety, health, and environmental considerations. These models were used to provide estimates of factors that determine the characteristics of potential target markets for alternatives to differentiate beef based on credence attributes. The models presented in Table 6 have a constant and 18 explanatory variables presented in Table 5, including beef attribute components and consumer characteristics.

Table 6.
Binary Logistics Models: Variables Influencing the Odds to Buy Differentiated 'Animal Welfare'
and 'Bundled Credence Attributes' Beef

Variable	'Animal welfare'		'Bundled credence attributes'	
	Coefficient	Odds ratio	Coefficient t	Odds ratio
Constant	-3.819***	0.022***	-2.924***	0.054***
Perceptions about beef attributes - component 1: 'Credence attributes'	0.680***	1.975***	0.518***	1.679***
Perceptions about beef attributes - component 2: 'Freshness and packaging'	0.084	1.088	0.101	1.106
Perceptions about beef attributes - component 3: 'Healthiness and intrinsic quality cues'	-0.193	0.824	-0.101	0.904
Perceptions about beef attributes - component 4: 'Marbling and beef source/origin'	-0.147	0.864	-0.206*	0.814*
Perceptions about beef attributes - component 5: 'Price and cooking convenience'	0.025	1.026	0.118	1.126
Beef consumption per household member (in kg. per week)	0.003	1.003	-0.125	0.883
Shops for beef mainly in other stores rather than supermarkets (1 if yes)	-0.190	0.828	0.060	1.062
Appreciate shop assistance when choosing beef (Likert scale)	0.136	1.146	0.251**	1.286**
Time pressures make it hard to buy the preferred quality of beef (Likert scale)	-0.208+	0.812+	-0.030	0.971
Level of agreement that branded beef is worth more than unbranded beef (Likert scale)	0.128	1.137	0.193**	1.213**
Previous experience with branded beef (1 if yes)	0.018	1.018	0.493**	1.637**
Age of the respondent (in categories)	0.006	1.006	-0.057	0.944
Gender of the respondent (1 if female)	0.551+	1.735+	-0.030	0.970
Education (in categories)	-0.003	0.997	0.028	1.029
Marital status (1 if married/de facto)	0.733+	2.080+	0.199	1.220
Household size (number of persons)	-0.202	0.818	-0.195*	0.823*
Children at home (1 if yes)	-0.302	0.740	0.330	1.392
Household income (in AUD categories)	-0.022	0.978	-0.025	0.975
McFadden R-squared		0.110		0.096
Observations in this group		51		225
Number of observations		1084		1084

Note: 'Animal welfare' includes only that attribute. 'Bundled credence attributes' include safety, health, produced in an environmentally friendly manner and animal welfare. (+), (*), (**) and (***) correspond to significance levels at $\alpha = 10, 5, 1$ and 0.1 percent, respectively. The odds ratio indicates how much the probability that the respondent would be willing to buy a differentiated beef relative to be unwilling will vary when an independent variable changes (Long & Freese, 2014; Greene, 2017).

In both logistic models, the reported p-values associated with the likelihood ratio statistic are close to zero, which demonstrates that they are significant models overall. The McFadden R-squared values are 0.110 in the animal welfare model, and 0.096 in the case of the bundled credence attributes product estimation, which are values within the expected range for models with a limited dependent variable using cross-sectional data (Greene, 2017). Similar significances were obtained from estimations using the Huber and White robust standard errors, which demonstrate that there are no misspecifications in either model. In addition, when the Davidson and Mackinnon (1993) heteroscedasticity test was run for each model, it detected heteroscedasticity in the animal welfare model, but not in the model for the bundled credence attributes. This outcome could be linked to the small proportion of the population that would buy branded beef products mainly for 'animal welfare' reasons, which could affect the distribution of the results obtained⁸.

The animal welfare model indicates that females and those respondents who either are married or in a de facto relationship are more likely to buy welfare-friendly products. In addition, the recognition that time pressures make it hard to buy the preferred quality of beef reduces the probability to buy differentiated 'animal welfare' products. This result demonstrates that consumers willing to spend time to find the quality of beef they are looking for are more likely to buy welfare-friendly products.

In the case of the 'bundled credence attributes' model, consumers who appreciate assistance in-store when choosing beef are more likely to buy this bundled product. They prefer products with certified credence attributes, but the level of marbling reduces the probability that the bundled product is selected. This is an expected outcome given the health concerns included in the bundled attributes. Furthermore, consumers who have had previous experience with branded beef and value branded beef more than unbranded cuts are more likely to buy the bundled-attributes product. Finally, increased household size reduces the odds of buying a product with the bundled credence attributes.

Household income and education were not significant in both models, so the potential buyers of beef products with 'bundled credence attributes' are present in different socio-demographic groups of the population. Moreover, beef consumption per household member was also not significant in both models, which demonstrates that potential purchasers of branded products for animal welfare reasons and other credence attributes consume similar amounts of beef per week as other consumers. Their similar level of beef consumption and their willingness to pay high premiums for branded products make these consumers an attractive group for the Australian beef industry to develop differentiated products. Finally, the main location of beef shopping was not a significant variable, indicating that these branded products could be introduced in different retail stores, including supermarkets, butchers and farmers' markets.

To identify the distinctive features between beef buyers who would prefer alternative types of differentiated beef multinomial logistic models were also estimated. This information aims to provide useful insights for the beef industry to help in the strategies to promote each product. For this purpose, among those buyers who would buy branded beef, the reasons to buy these products were summarised into: 'taste', 'bundled credence attributes', including safety, health, environmental friendliness and animal welfare, and 'other attributes', comprising easy to prepare, luxury product and other reasons. In this analysis, the outcome 'bundled credence attribute' was compared against the outcomes 'taste' and 'other attributes', which were used as base groups. Hence, the models presented in Table 7 aim to identify the influence of the variables included in the theoretical framework on the probability that a beef buyer who buys a branded product chooses a 'bundled credence attributes' over a product differentiated on 'taste' or "other attributes".

⁸ The effects of heteroscedasticity on non-linear models such as logit are different from those in linear models. The estimated coefficients derived from the model will be inconsistent, but according to Wooldridge (2002), it is practically irrelevant as the model is expected to produce good estimates of the partial effects.

Table 7.

Multinomial Logistic Models: Variables Influencing the Odds a Branded Beef Buyer Would Prefer a 'Bundled Credence Attributes' Beef with Respect to 'Taste' and 'Other Attributes' Beef

Variable	'Bundled credence attributes' with respect to 'taste'		'Bundled credence attributes' with respect to 'other attributes'	
	Coefficient	Relative-risk ratio	Coefficient	Relative-risk ratio
Constant	0.074	1.077	-2.197+	0.111+
Beef attribute component 1: 'Credence attributes'	0.669***	1.953***	0.283+	1.327+
Beef attribute component 2: 'Freshness and packaging'	0.059	1.061	0.131	1.140
Beef attribute component 3: 'Healthiness and intrinsic quality cues'	-0.093	0.911	-0.175	0.839
Beef attribute component 4: 'Marbling and beef source/origin'	-0.333**	0.717**	-0.061	0.941
Beef attribute component 5: 'Price and cooking convenience'	0.126	1.135	0.043	1.044
Beef consumption per household member (in kg. per week)	-0.167	0.846	0.025	1.026
Shops for beef mainly in other stores rather than supermarkets (1 if yes)	0.356+	1.428+	0.482	1.620
Appreciate shop assistance when choosing beef (Likert scale)	0.149	1.161	0.277*	1.319*
Time pressures make it hard to buy the preferred quality of beef (Likert scale)	0.050	1.052	0.018	1.018
Level of agreement that branded beef is worth more than unbranded beef (Likert scale)	-0.112	0.894	0.485***	1.624***
Previous experience with branded beef (1 if yes)	-0.099	0.906	1.040**	2.830**
Age of the respondent (in categories)	-0.052	0.949	-0.057	0.945
Gender of the respondent (1 if female)	-0.042	0.958	0.205	1.227
Education (in categories)	0.014	1.014	-0.038	0.963
Marital status (1 if married/de facto)	0.329	1.389	0.246	1.279
Household size (number of persons)	-0.182+	0.833+	-0.338*	0.714*
Children at home (1 if yes)	0.275	1.316	0.804*	2.235*
Household income (in AUD categories)	-0.084	0.920	0.038	1.039
McFadden R-squared	0.117		0.117	
Observations in this group	225			
Number of observations	592			

Note: 'Bundled credence attributes' include safety, health, produced in an environmentally friendly manner and animal welfare. 'Taste' includes only that attribute. 'Other attributes' include easy to prepare, luxury product and other. (+), (*), (**) and (***) correspond to significance levels at $\alpha = 10, 5, 1$ and 0.1 percent, respectively.

The relative-risk ratio indicates how much the probability that a potential branded beef buyer would prefer a differentiated 'bundled credence attribute' beef with respect to a differentiated 'taste' and 'other attributes' beef when an independent variable changes

The likelihood ratio statistic of the multinomial models indicates that they are significant overall, with a McFadden R-squared of 0.117. Buyers who mainly shop for beef in stores other than supermarkets are more likely to buy branded 'bundled credence attributes' products with respect to differentiated 'taste' products. As expected, consumers who appreciate certified credence attributes are more likely to buy 'bundled credence attributes' beef with respect to differentiated 'taste' and 'other attributes' beef. In addition, buyers who consider branded beef is worth more than unbranded beef and have previous experience with branded beef are more likely to buy differentiated 'bundled credence attributes' products with respect to 'other attributes'. Furthermore, those consumers who appreciate shop assistance when choosing beef are more likely to select a 'bundled credence attributes' product with respect to 'other attributes' beef; hence, information and in-store support that help them to select their product might be explored by retailers. In contrast, consumers buying branded 'bundled credence attributes' products are less likely to purchase cuts with higher levels of marbling than those who would buy differentiated 'taste' beef. Finally, those with children at home are more likely to select products with bundled credence attributes; however, larger households are less likely to make such purchases.

6 Discussion and conclusions

In this article, we discuss the potential for the Australian beef industry to differentiate products based on animal welfare standards and other credence attributes, as described by Lagerkvist and Hess (2011), Clark et al. (2017), and Yang and Renwick (2019), among other studies, in addition to the current efforts on predicted eating quality. As a modest proportion of potential branded beef buyers are mainly concerned about animal welfare, this study also explores the alternative of offering differentiated beef products with a bundle of credence attributes that are perceived related to animal welfare, which are safety, health and produced in an environmentally friendly manner. Meat and Livestock Australia (MLA, 2019) studies animal welfare of Australian cattle, and there is a guideline provided by RSPCA (2013) on areas animal welfare can be improved and certified, including practices on farm, during transport and at the slaughter. This certification in addition to practices that reduce the impact on the environment and use of chemicals and hormones could support the development of a certification for the credence attributes of animal welfare, safety, healthy and environmentally friendly that are described in this study.

The Australian beef industry has concentrated its efforts on improving the quality evaluation system through the introduction of MSA as a way to guarantee the eating quality of the cuts sold, which could satisfy the segment of consumers who would buy differentiated products for taste reasons. However, given the increasing attention on animal welfare conditions, there is an opportunity for the industry to capture premiums paid by consumer segments for other types of branded beef products, as highlighted by Chen (2016), Heise and Theuvsen (2017) and Hirsh *et al.* (2019). The introduction of products that bundle animal welfare with other credence attributes, including safety, health and produced in an environmentally friendly manner, is explored as a potential alternative for the industry to target different market segments and increase the potential demand for these branded products, as suggested by Lusk and Norwood (2012), and Viegas *et al.* (2014).

The maximum premium that respondents who would buy a branded rump or sirloin/porterhouse for animal welfare reasons were willing to pay is \$4.82 extra per kilogram on average, while those who would buy a bundled credence attributes product were prepared to pay a maximum premium of \$5.58 per kilogram. The empirical results without conditions about price changes demonstrate that female buyers who value branded beef are more likely to buy certified welfare-friendly beef, while those with children are more prone to buy a certified bundled credence attributes product. Household income, education, beef consumption per household member and main location of retail beef purchases are not significant variables among Australian beef consumers, in contrast to the results reported by Kayser *et al.* (2013) in Germany, which supports the potential to introduce these differentiated products in a range of retailers in Australia. These results contrast the findings of Grunert and Valli (2001), and Bernués *et al.* (2003), who reported that income and education affected sensitivity with respect to animal welfare. However, the outcomes of this study corroborate the findings reported by María (2006), who indicated that students, who generally do not have high-income levels, and women are more concerned about animal welfare.

The results of the estimated multinomial logistic model confirm the significance of the variables previously discussed and add the positive effect of having children at home on the odds a potential branded beef buyer prefers a bundled credence attribute product versus other differentiated cuts. This finding is consistent with those described by Verbeke and Vackier (2004), who found that consumers who perceive a higher level of beef safety risk and those who have families with children exhibit higher levels of concern about food safety related to beef consumption risks than other consumers. Therefore, this higher perceived risk aversion among consumers with children at home may lead to more cautious decision-making for food products, which

represents an opportunity for differentiated products that guarantee safety standards based on animal welfare and other characteristics of the production process. In addition, consumers who could buy 'bundled credence attributes' beef products are less interested in highly marbled cuts with more intramuscular fat, as they might be deemed fatty or unhealthy by consumers who are considered the target market for the 'bundled credence attributes' products. Finally, beef consumption per household member is not significant, which supports the potential for the industry to offer these branded products in a range of retailers.

Hence, what are the implications of the findings of this study for the beef industry? Its members should explore the introduction of differentiated beef products that comprise key credence attributes, including animal welfare, safety, health and environmental friendliness. The design of branded products that target different market segments is a strategy consistent with the findings of Morales *et al.* (2013), and Heise and Theuvsen (2017), who recommended the introduction of tailored differentiated beef according to the preferences of different niches. Therefore, to satisfy the expectations of consumers who could buy branded beef with bundled credence attributes, the industry could offer low levels of marbling, provide information about the quality features of the products, including certified credence attributes, and highlight certified animal welfare and high safety standards for consumption.

Future research could investigate the influence of pet experiences, moral foundations and shopping conditions on final beef purchase decisions and willingness to pay for differentiated beef cuts. Moreover, the extra costs and potential benefits for those in the beef industry involved in producing welfare-friendly products could also be explored, considering premiums in domestic and international markets, which in future could require imports to be compliant with strict levels of animal welfare standards.

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Appendix 1.

Modelling propensity to buy branded beef with credence attributes using logistic probability functions

During the survey interviews, respondents were asked to indicate if they would buy branded beef products if they were available across Australia and offering the attributes they were looking for. Those respondents who would buy branded beef were asked to indicate the main reason why they would purchase the differentiated product. To study the probability that a beef buyer i prefers the product x_1 that is welfare-friendly (or has a bundle of credence attributes, including animal welfare) versus other products, the following cumulative logistic probability function can be used (Greene, 2017; Long and Freese, 2014):

$$Pr_i = \frac{1}{1 + e^{-(\alpha + \beta A_i + \gamma C_i)}} \quad 3$$

The probability that buyer i prefers a welfare-friendly beef product (or a bundled credence attributes product) x_1 depends on perceptions about product attributes and characteristics of the individual, as presented in the utility function in equation (1). Then, the probability that buyer i prefers other products is:

$$1 - Pr_i = \frac{1}{1 + e^{(\alpha + \beta A_i + \gamma C_i)}} \quad 4$$

Thus, the ratio of both probabilities in favour of the buyer preferring a welfare-friendly product (or with a bundle of credence attributes) to other products is:

$$\frac{Pr_i}{1 - Pr_i} = \frac{1 + e^{(\alpha + \beta A_i + \gamma C_i)}}{1 + e^{-(\alpha + \beta A_i + \gamma C_i)}} = e^{(\alpha + \beta A_i + \gamma C_i)} \quad 5$$

Applying natural logarithms to equation (5), the ratio of respondents who would buy differentiated welfare-friendly beef (or with bundled credence attributes) over other products becomes a linear function of perceptions about product attributes and characteristics of the individual:

$$L_i = \ln\left(\frac{Pr_i}{1 - Pr_i}\right) = \alpha + \beta A_i + \gamma C_i \quad 6$$

The coefficients β and γ represent the change in the odds ratio for a unit change of an explanatory variable (Greene, 2017; Loureiro and Umberger, 2003). As this model is not linear, the odds ratios provide an intuitive explanation of the effect of each variable, reporting an indication of how much the probability of an outcome varies when an independent variable changes (Long and Freese, 2014).

To determine the distinctive features between groups of respondents who would prefer branded beef, a multinomial logistic model helps to identify the probability that a potential branded beef buyer i prefers the differentiated product x_j based on his or her preferences and characteristics, which vary between groups of buyers purchasing alternative branded products for different reasons. Thus, this model simultaneously contrasts among alternatives and is often seen as a set of binary logistic regressions that compares pairs of outcomes with respect to a base or reference category (Greene, 2017; Long and Freese, 2014). Using a matrix z_i that encompasses the perceptions about attributes and characteristics of the individual consumer i , where $z_i = [A_i, C_i]$, this model can be represented as:

$$Pr(x_i = m | z_i) = \frac{e^{(\alpha + \beta_{m|b} A_i + \gamma_{m|b} C_i)}}{\sum_{j=1}^J e^{(\alpha + \beta_{j|b} A_i + \gamma_{j|b} C_i)}} \quad \text{for } m = 1 \text{ to } J \quad 7$$

where m is a specific outcome alternative, which can take values 1 to J , and b represents the base outcome used as a reference for comparison. Applying natural logarithms to equation (7), this model becomes:

$$\ln \Omega_{m|b}(z_i) = \ln \frac{Pr(x_i = m | z_i)}{Pr(x_i = b | z_i)} = \alpha + \beta_{m|b} A_i + \gamma_{m|b} C_i \quad \text{for } m = 1 \text{ to } J \quad 8$$

This model represents the odds that the individual consumer i with a set of perceptions about product attributes and characteristics would prefer product $x_i = m$, to the base alternative product b . The relative-risk ratios present the ratio of the probability of an event occurring in a group to the probability of the event occurring in the base group, which helps to explore how variables affect the choice of one outcome compared with another (base) outcome (Long and Freese, 2014).