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Beijing beef consumer consumption behaviours and product preferences: A Latent Class Analysis

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Contents

List of Tables

List of Figures

Key Points

- The Agribusiness and Economics Research Unit (AERU) at Lincoln University with the support of research partners under the *Unlocking Export Prosperity from the Agri-food Values of Aotearoa New Zealand* research programme has estimated willingness-to-pay (WTP) values for selected credence attributes of beef tenderloin products by Beijing (China) consumers, with a focus on identifying preferences for attributes considered *distinctively New Zealand.*
- Preferences for many of the credence attributes considered here are not readily observable from market prices and so the non-market valuation method of Choice Experiments was used. This involved an online survey of Beijing residents in December 2019, using a research panel. The survey process achieved 1,001 responses with suitable representation of key population demographics.
- As well as WTP values, this survey reports on:
    - Consumption frequency
    - Purchase frequency by beef cut, and by country-of-origin
    - Prices paid by beef cut
    - Country-of-origin quality ranking
    - NZ beef purchases by cut
    - Reasons for buying NZ beef
    - Substitute protein purchasing frequency
    - Perceptions and attitudes related to beef production
    - Use of digital media and smart technologies for beef shopping
- New Zealand beef tenderloin was the second most purchased by country of origin after China followed by Australian sourced beef. New Zealand was ranked the highest of the countries included for quality. These qualities included safe, 100 per cent grass fed, no added antibiotics, no GM feed, no hormones and organic.
- Twenty three per cent of respondents shopped on line domestically for their beef. Fifteen per cent use hypermarkets and the same number specialty stores. Seven per cent shopped on line from overseas outlets.
- The survey included a choice experiment to assess the Willingness to Pay by consumers for different attributes associated with beef mince. The consumers were then segmented, using a latent class model, into 3 classes each with different characteristics and preferences.
- The results showed that consumer group three (the smallest group at 12 per cent of the sample) were willing to pay the most for beef tenderloin from New Zealand, with a premium of nearly per cent, and similar for New Zealand beef raised on Māori farms.
- Group two have a higher WTP for beef raised in Australia at 135 per cent and is also willing to pay a premium of 74 per cent for feedlot raised beef, 70 per cent for carbon neutral beef and 42 per cent for water quality protection. Group one is willing to pay the highest premium for 100 per cent grass fed tenderloin, prefers China as the country of Origin but also willing to pay for feedlot raised beef.

- The average percentage marginal willingness-to-pay (WTP) was:

Beef Tenderloin Attribute	Group One (71% of consumers)	Group Two (17% of consumers)	Group Three (12% of consumers)
Organic	15	0	30
Enhanced Animal Welfare	8	0	0
GMO-free	19	0	0
Carbon Neutral	21	70	0
Biodiversity Enhancement	24	0	0
Water Quality Protection	0	42	0
Feedlot Raised	94	74	0
100% Pasture Raised	17	37	0
No added antibiotics	0	0	0
No added hormones	16	8	20
Social responsibility	0	30	0
Traceability	0	13	20
100% Grass-fed	111	0	8
Grain-fed	8	0	0
Chilled	9	55	0
Fresh	13	48	0
Raised in China	56	0	0
Raised in Australia	42	135	0
Raised in USA	43	0	0
Raised in Argentina	33	0	53
Raised in NZ	52	0	99
Raised on Māori farms in NZ	22	45	98

Chapter 1
Introduction

This study is part of a research programme entitled *Unlocking Export Prosperity from the Agri-food Values of Aotearoa New Zealand*. It is funded by the Ministry of Business, Innovation and Employment (MBIE) Endeavour Fund for science research programmes.

The research aims to provide new knowledge on how local enterprises can achieve higher returns by ensuring global consumers understand the distinctive qualities of the physical, credence and cultural attributes of agri-food products that are "Made in New Zealand".

Agricultural exports are an important contributor to the New Zealand (NZ) economy. While NZ historically relied on key markets such as the United Kingdom for export trade, NZ has more recently significantly expanded its export markets and China has become established as an important beef product destination. It is critically important for NZ exporters to understand export markets and the different cultures and preferences of those consumers to safeguard market access, and for realising potential premiums.

This report describes the application of a survey of Beijing beef tenderloin consumers that is designed to examine consumption behaviour and consumer Willingness-to-Pay (WTP) for credence attributes. While search attributes such as price or colour can be observed directly, and experience attributes such as flavour can be assessed when consumed, credence attributes such as environmental sustainability cannot be immediately seen or experienced at the point of sale. For products promoting credence attributes, the role of verification, including labelling, is of significant importance.

Our approach is to apply a Choice Experiment (CE) economic valuation method, analysed using a statistical approach called Latent Class Modelling that describes profiles for different consumer segments identified in the data and provides estimates of attribute WTP across these segments.

Chapter 2
Beef Consumer Survey

To understand how consumers value NZ credence attributes, this study used a structured self-administered online survey that included a Choice Experiment, conducted in Beijing in December 2019. The survey was administered through Qualtrics™, a web-based survey system, and had a sample size of 1,001 beef tenderloin consumers.

The survey was developed by the research team drawing from a literature review on consumer trends for beef products, results from previous surveys examining consumer attitudes in overseas markets, a scoping survey of 200 Beijing beef consumers (November 2019) and consultation with industry partners and stakeholders, especially those on the AERU's advisory board.

Sampling involved recruiting participants from an online consumer panel database provided by an international market research company (dynata.com). Panel members are recruited by online marketing across a range of channels and panels are profiled to ensure adequate representativeness. Panels are frequently refreshed, with the participation history of members reviewed regularly. Respondents for each survey are compensated with a retail voucher for completing a survey. Potential respondents were recruited by e-mail and were screened out if they purchased beef tenderloin less than monthly.

2.1 Using Choice Experiments to examine consumer preferences

Choice Experiments are a survey-based valuation approach that has been widely used to value consumer preferences for food product attributes. They are particularly useful for examining the role of new attributes, and attributes that are not easily observable in market prices, such as the attributes explored in the current report. The ability of this method to identify which individual attributes are more important in consumer choices, and to estimate consumers' WTP for these.

Designing a Choice Experiment survey involves deciding which product attributes are of interest, combining these into different product offerings, and asking consumers to pick which offering they prefer from a range of alternatives. In this study, alternative beef tenderloin products are described by production practices, freshness and price (Table 2.1). Attribute selection was primarily informed by the scoping survey that used a combination of open text and structured questions to identify which attributes Beijing consumers considered distinctive of NZ beef.

Table 2.1 Beef tenderloin attribute descriptions used in the choice experiment

Beef tenderloin attributes	Attribute descriptions
Animal Feed	**100% Grass-fed** beef is lower in calories, contains more healthy omega-3 fats, vitamins A and E, beta-carotene and antioxidants. **Grain fed** beef have higher fat content and marbling which can produce a richer taste.
Environmental Sustainability	Environmentally sustainable farms actively minimise the environmental effects of beef production. The beef may be labeled as being produced using a system that is either **Carbon Neutral**, **Enhances Biodiversity** or **Protects Water Quality**
Antibiotics & Hormones	Beef may be raised with or without added antibiotics and/or hormones.
Traceability	The animal can be traced back to the farm where the animal was born.
Social Responsibility	Socially responsible farms actively include public interest into decision making.
Product Origin	Beef consumed in China comes from domestic cattle as well as from other countries.
GMO-Free	Animals are not genetically modified, and do not consume genetically modified feed.
Animal Housing	Animals can be raised mainly in feedlots, or mainly in pastures.
Māori Production	The beef may be labeled as being produced on Māori farms. Māori, New Zealand's indigenous people value sharing food with family, friends and visitors. For Māori, sharing food is more than just good hospitality but is viewed as an essential component of society and of individual prestige, with the food representing a gift that binds people together.
Organic	No synthetic fertilisers, hormones, antibiotics or animal by-product supplementation during the entire life of the animal including in their feed.
Animal Welfare	Animal welfare practices can be enhanced above the minimum legal standards.
Freshness	The beef may be either frozen, chilled or fresh
Price	¥ per kilogram

Changes in beef attributes are described using the levels presented in (Table 2.2). Price levels were determined by market prices, and from what scoping survey respondents said that they usually paid. Countries of origin were selected based on volumes of sales in China for 2019.

An example of alternative product offerings presented to respondents is shown in (Figure 2.1). Each set of offerings comprises three options, of which respondents chose their preferred one. Two options present alternative beef tenderloin products, while the third is a 'none of these' option. Each respondent answered ten choice sets, generating 10,010 completed choice sets over the total sample.

Table 2.2 Beef tenderloin attribute levels used in the choice experiment

Beef tenderloin attributes	Attribute levels						
Enhanced Animal Welfare	No Label	Certified					
Organic Production	No Label	Certified					
GMO-free	No Label	GMO-free					
Traceability	No Label	Traceable					
Social Responsibility	No Label	Certified					
Additives	No Label	No Added Antibiotics	No Added Hormones				
Animal Housing	No label	100% Pasture Raised	Feed-lot raised				
Animal Feed	No label	100% Grass-fed	Grain-fed				
Freshness	Frozen	Chilled	Fresh				
Environmental Sustainability	No Label	Carbon Neutral	Biodiversity Enhancement		Water Quality Protection		
Origin	No label	China	USA	Australia	Argentina	NZ	Māori
Price ¥ per kg beef tenderloin	¥40	¥80		¥120		¥160	

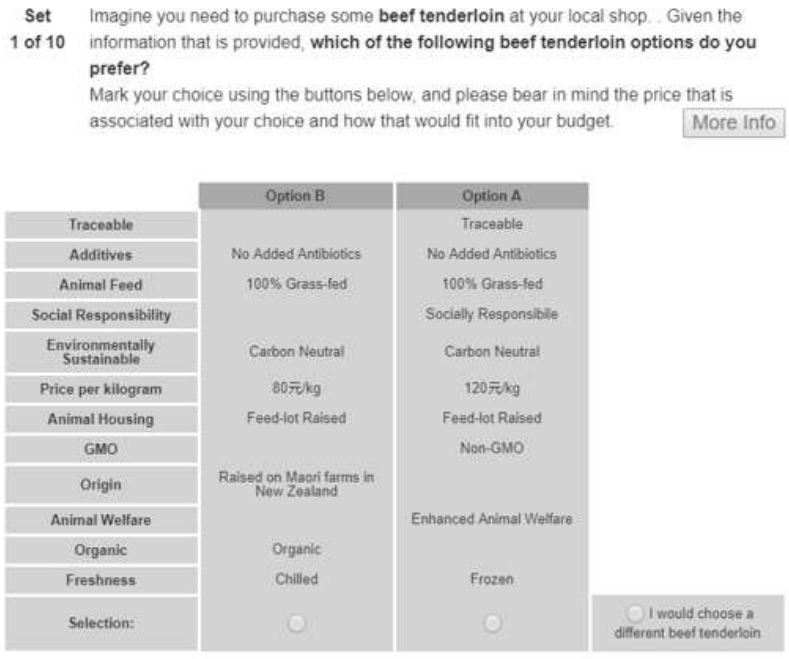


Figure 2.1 Example of a choice experiment question shown to respondents

Product choices are statistically analysed, and consumers' WTP for each attribute is estimated. A more detailed presentation of theoretical foundation and statistical procedure can be found in Appendix A.

Chapter 3
Survey Results

3.1 Sample demographic description

- The sample comprised a wide range of demographics, which is important to ensure that the sampling process broadly canvased the relevant population (Figure 3.1).
- It is important to note that we are not attempting to represent the overall Beijing population, but rather those that purchase beef tenderloin at least fortnightly.

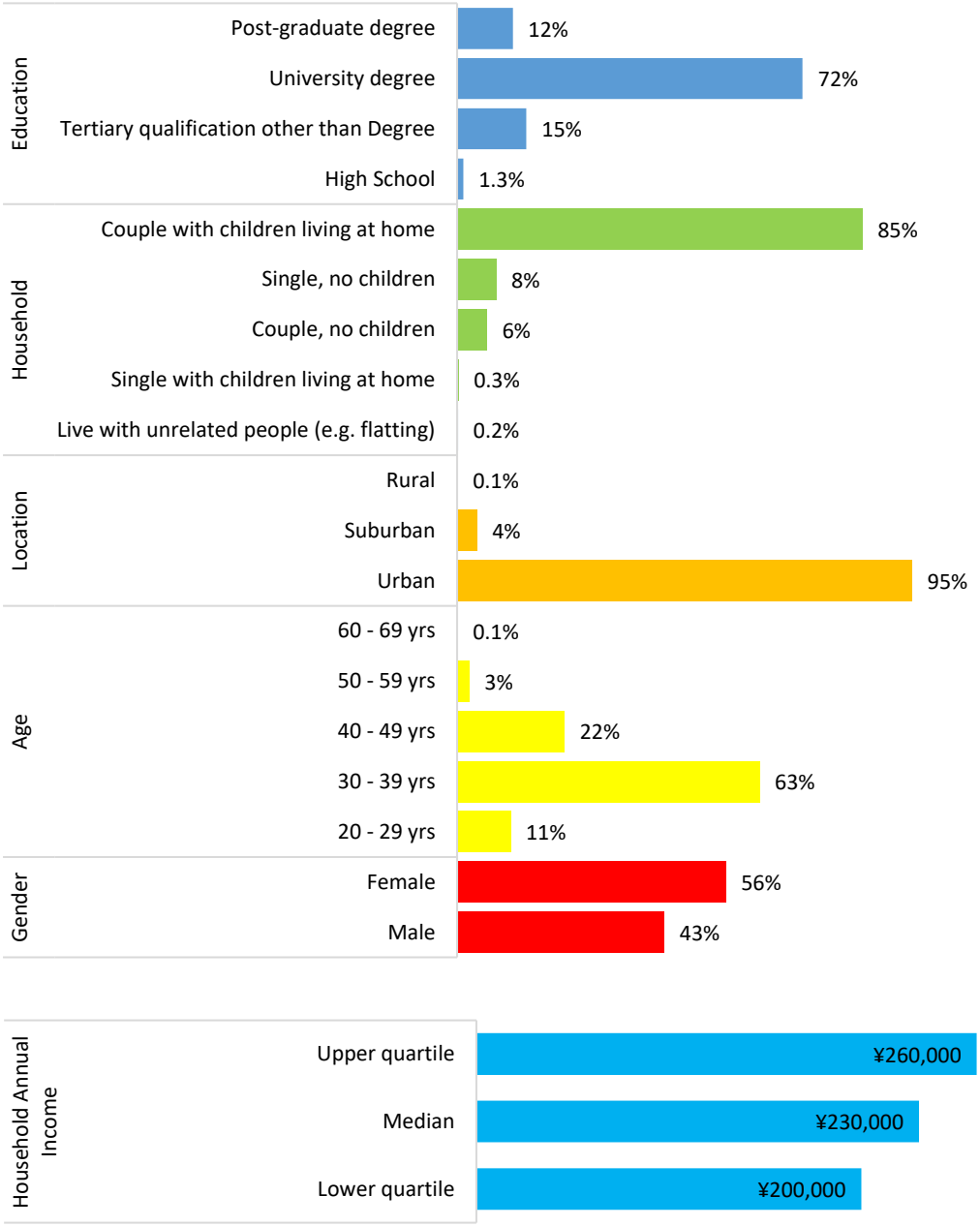


Figure 3.1 Sample demographics

3.2 Purchase and consumption behaviour

- On average, respondents usually consume between three and four meals a week that contain beef (Figure 3.2). Two meals per week is the most common frequency.

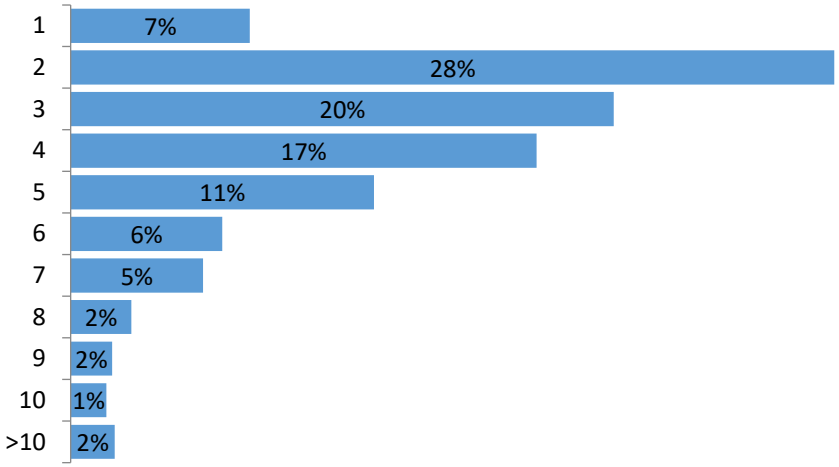


Figure 3.2 Number of meals per week containing beef

- Everyone invited to respond to the survey purchased tenderloin in the previous month (Figure 3.3).

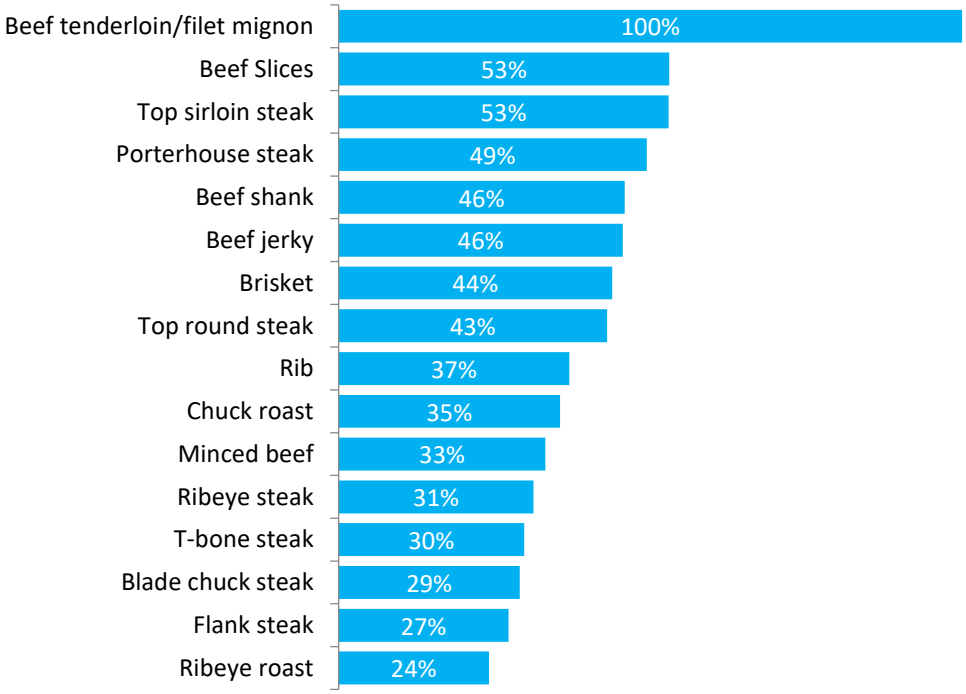


Figure 3.3 Beef product purchases in previous month

- The most common number of different beef cuts purchased in the previous month is three to four (Figure 3.4).

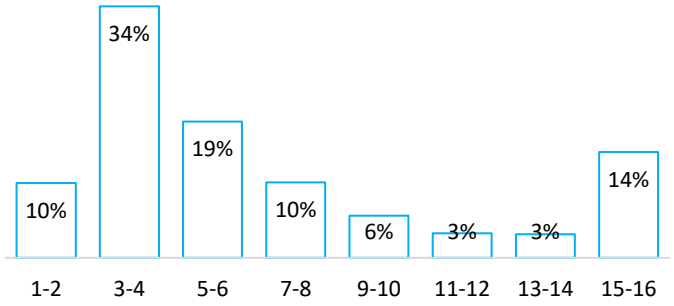


Figure 3.4 Number of different beef cuts purchased in previous month

- Average price per kilogram (kg) usually paid is highest for *top round steak* and lowest for *beef slices* (Figure 3.5).

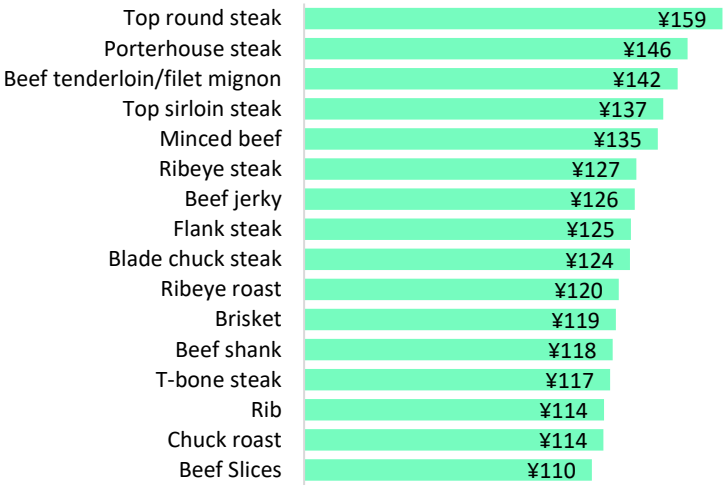


Figure 3.5 Average price per kg usually paid for beef cuts

- Half of respondents usually paid more than ¥139/kg, with a quarter paying more than ¥178/kg (Figure 3.6).

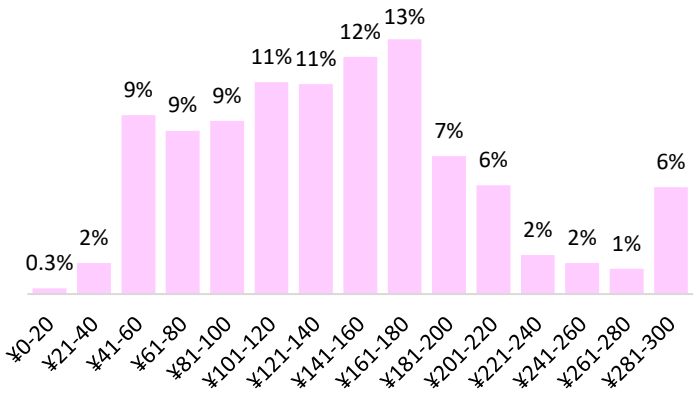


Figure 3.6 Price per kg usually paid for beef tenderloin

- NZ has the second-highest country-of-origin purchase frequency behind domestically raised beef (Figure 3.7).

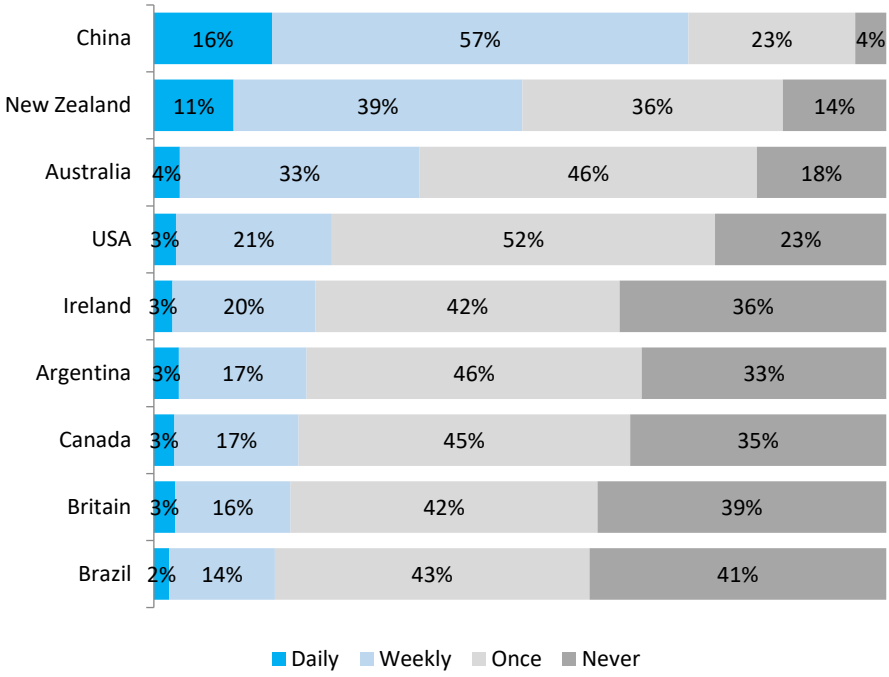


Figure 3.7 Country-of-origin purchase frequency in previous month

- Beef raised in NZ has the highest quality ranking overall when compared with the other countries considered (Figure 3.8), and is ranked highest by about a third of respondents, and in the top three by 67 per cent of respondents.

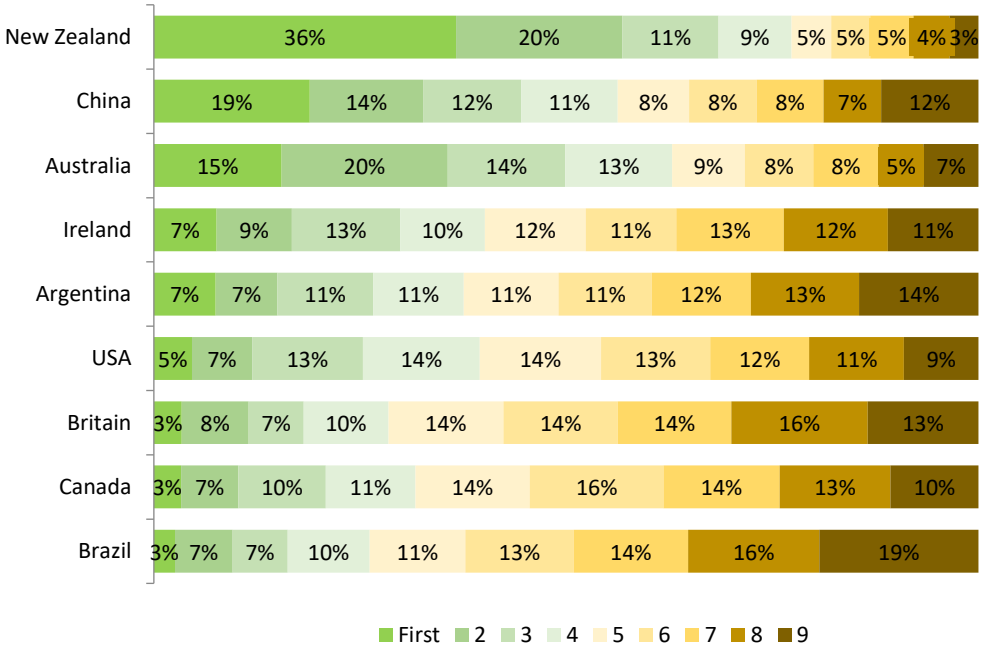


Figure 3.8 Beef country-of-origin ranking

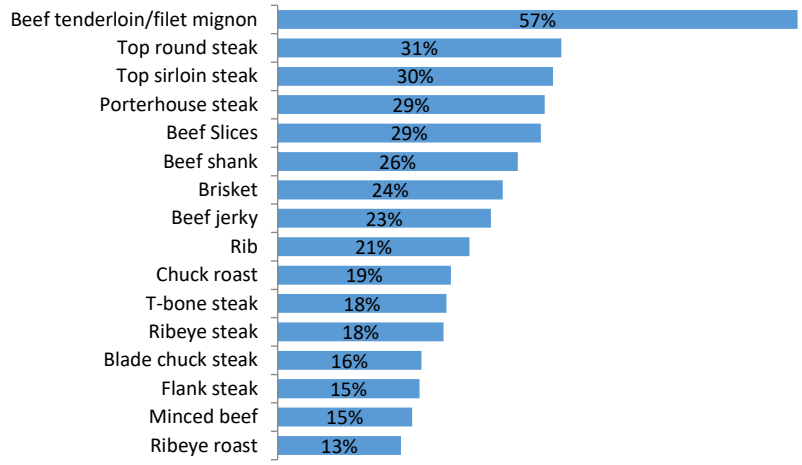


Figure 3.9 NZ beef cuts purchased in previous month

- High *food safety*, *100 per cent grass-fed*, and attributes representing an unadulterated pure product are most important for consumers purchasing NZ beef (Figure 3.10).

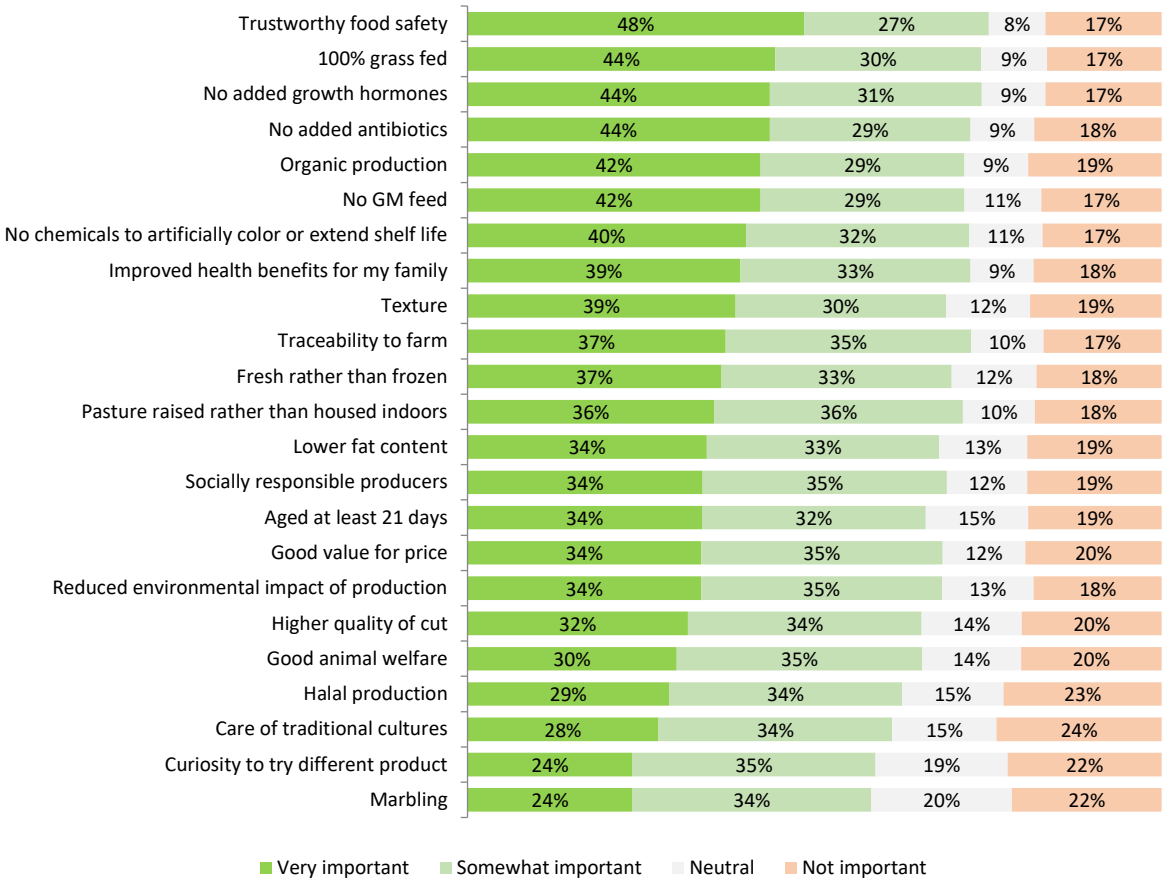


Figure 3.10 Reasons for purchasing New Zealand produced beef

- Pork has the next highest overall purchase frequency behind beef (Figure 3.11).

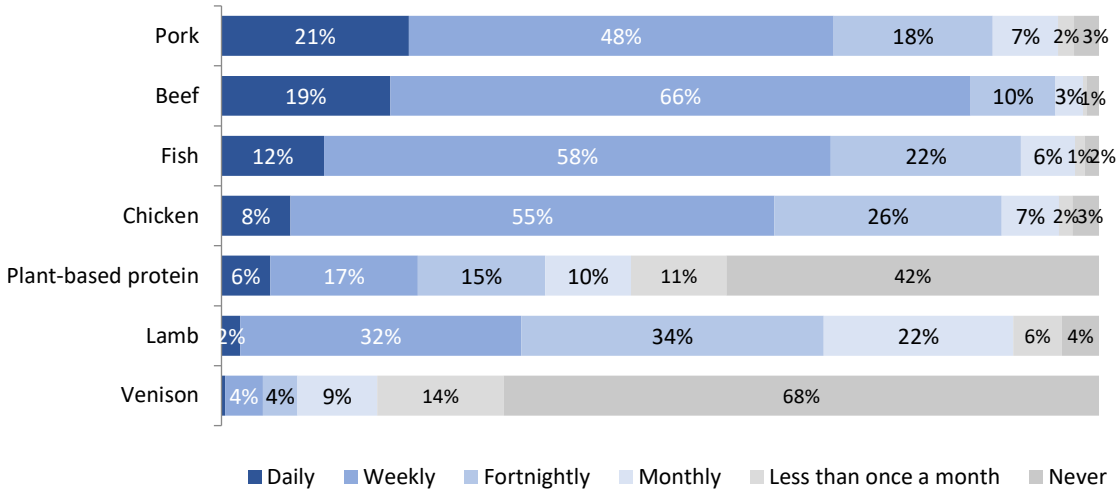


Figure 3.11 Protein type purchase frequency

- For respondents who purchased plant-based protein products at least monthly, health and environmental concerns are important reasons (Figure 3.12).

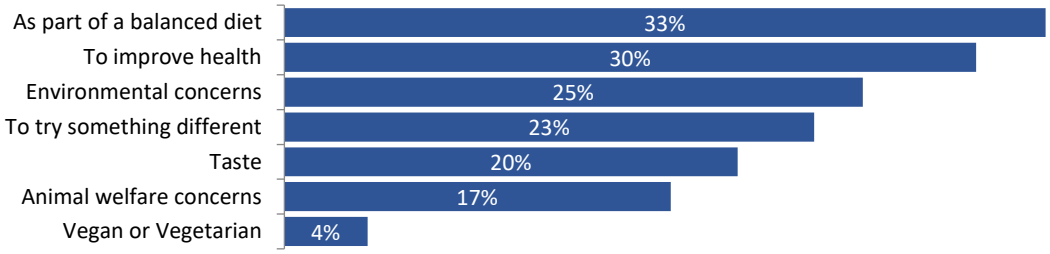


Figure 3.12 Reasons for purchasing plant-based proteins

- An overall preference for animal proteins is the main reason for not purchasing plant-based protein products (Figure 3.13).

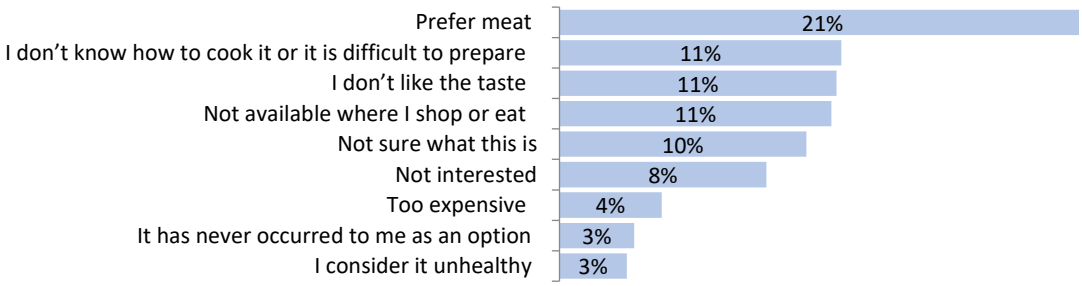


Figure 3.13 Reasons for not purchasing plant based proteins

- Most consumers pay attention to labeling and seek out information for unfamiliar products (Figure 3.14). Over three quarters think that beef is healthier than pork, and eat more beef instead of pork due to African Swine Fever concerns. A similar proportion of consumers have some concern about the long-term effects of modern beef production practices.

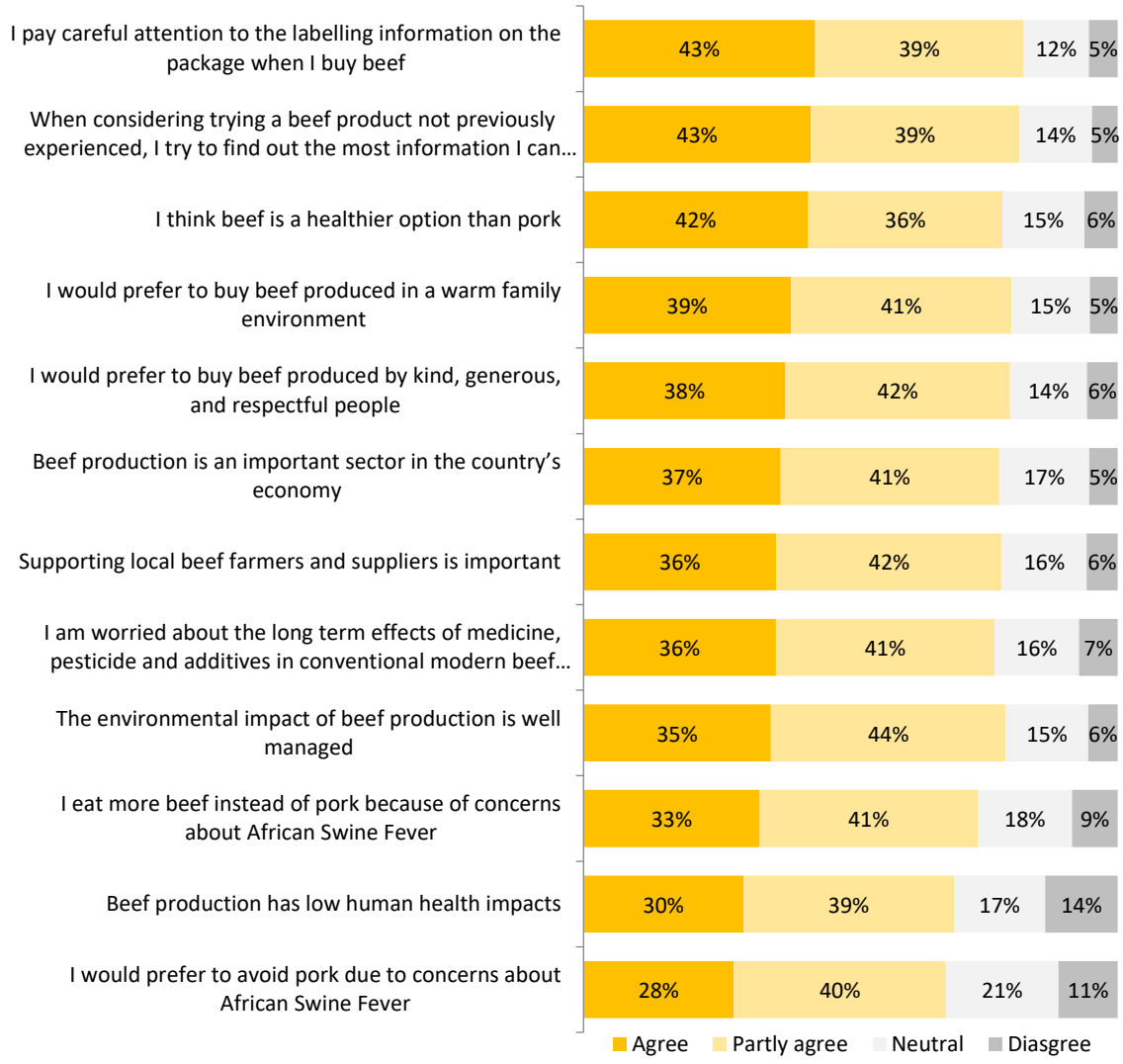


Figure 3.14 Perceptions and attitudes relating to beef production

3.3 Use of digital media and smart technologies for beef shopping

- Mobile devices such as smartphones are used more frequently to access the internet than home devices such as desktop computers (Figure 3.15).

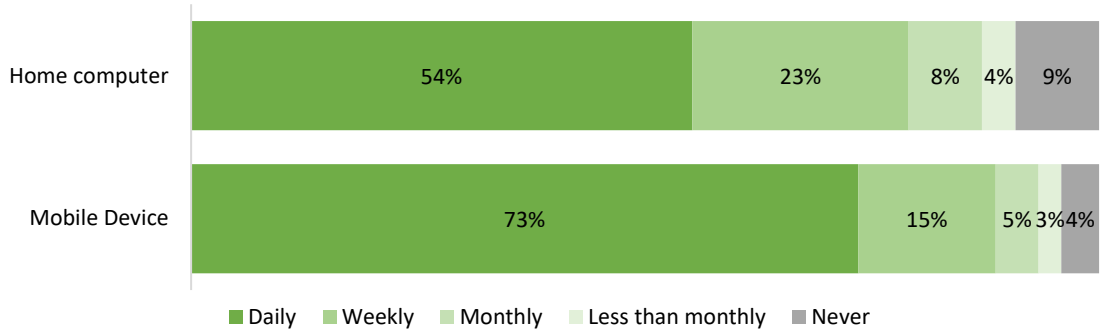


Figure 3.15 Frequency of internet access

- The types of digital media used to search for information about *how a product is produced* are generally different from those used when deciding on *which product to purchase* (Figure 3.16).

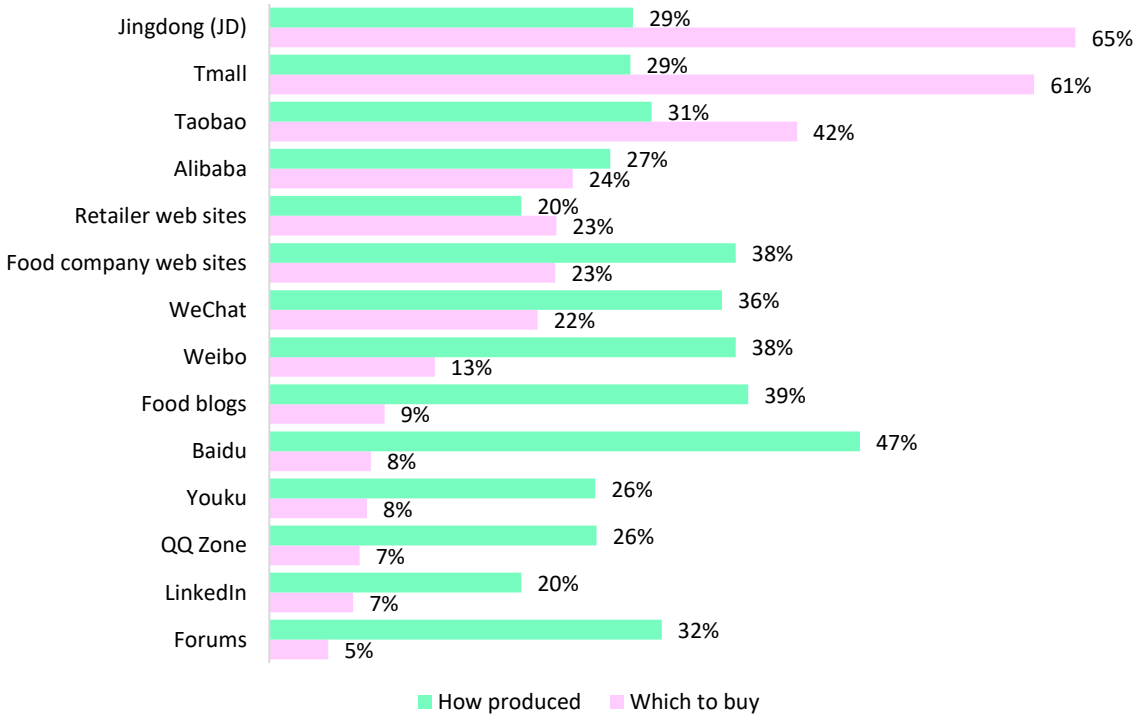


Figure 3.16 Use of digital media for information searching and product purchasing

- Barcodes are used more for information searching about a product, while QR codes are used more for product purchasing (Figure 3.17).

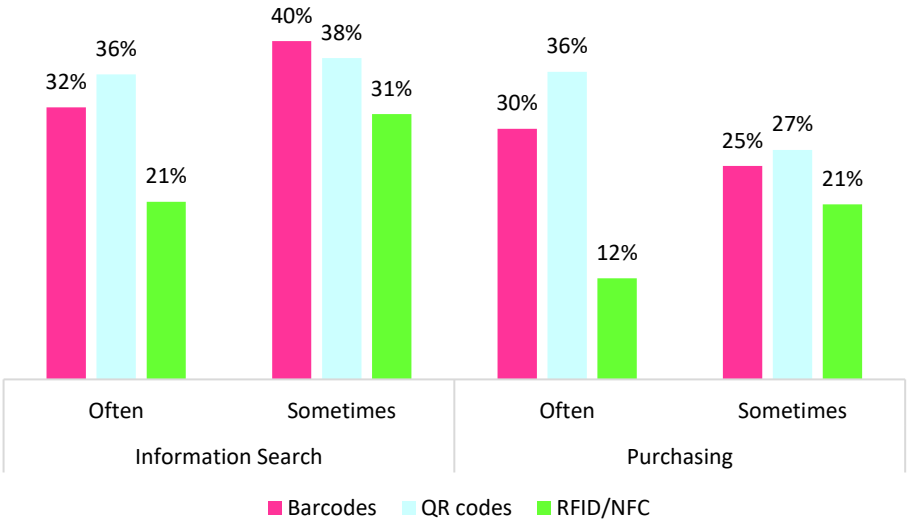


Figure 3.17 Use of smart technologies for information searching and purchasing

- While a third of respondents currently use mobile applications to search for environmental information about a product, half of respondents are interested in using mobile applications for this purpose (Figure 3.18).

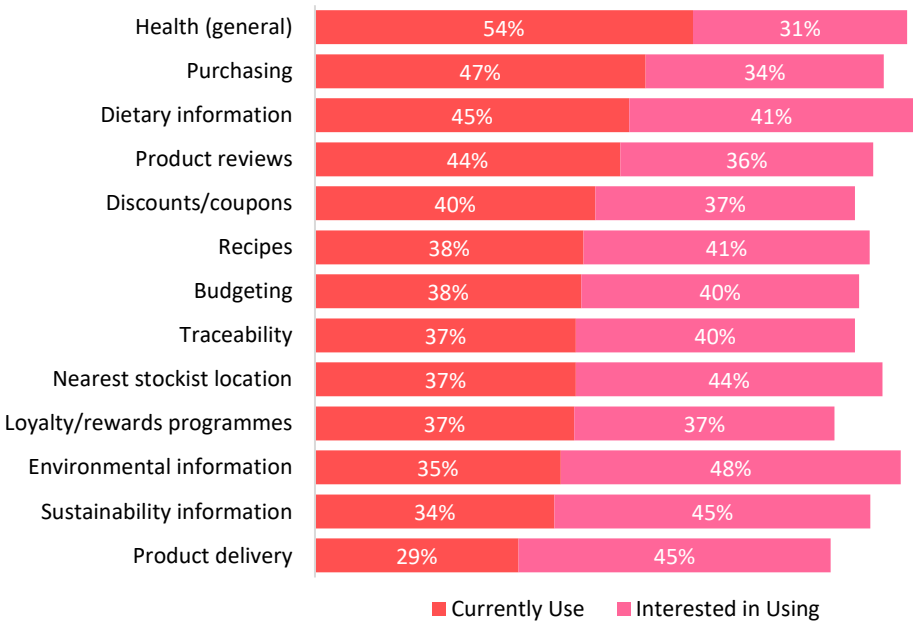


Figure 3.18 Current and potential uses of mobile applications

- Online purchasing channels are important for respondents' beef purchasing, with respondents spending, on average, 23 per cent of beef expenditure online from domestic sources (Figure 3.19).

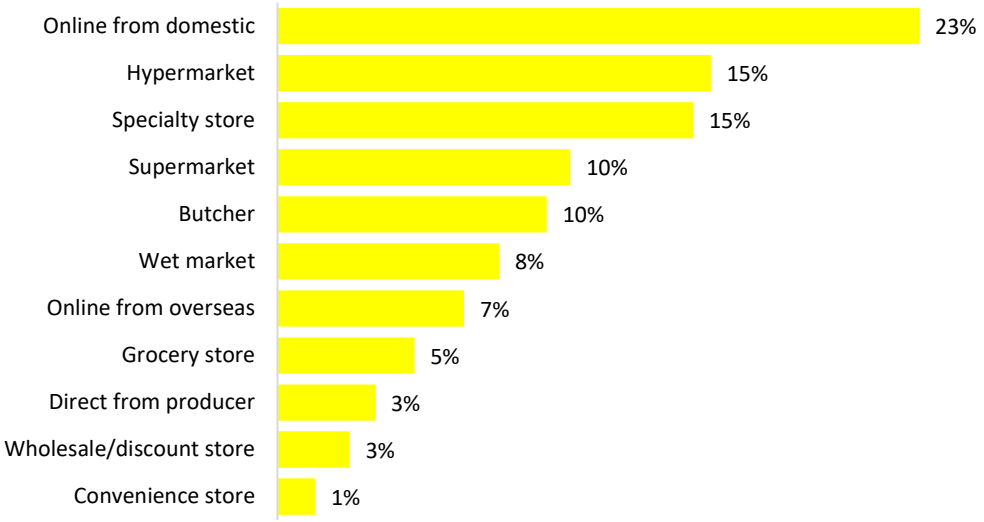


Figure 3.19 Percentage of beef expenditure by retail channel

- About eight out of ten respondents buy beef online domestically, while about four out of ten respondents spent more than 20 per cent of their beef expenditure online (Figure 3.20).

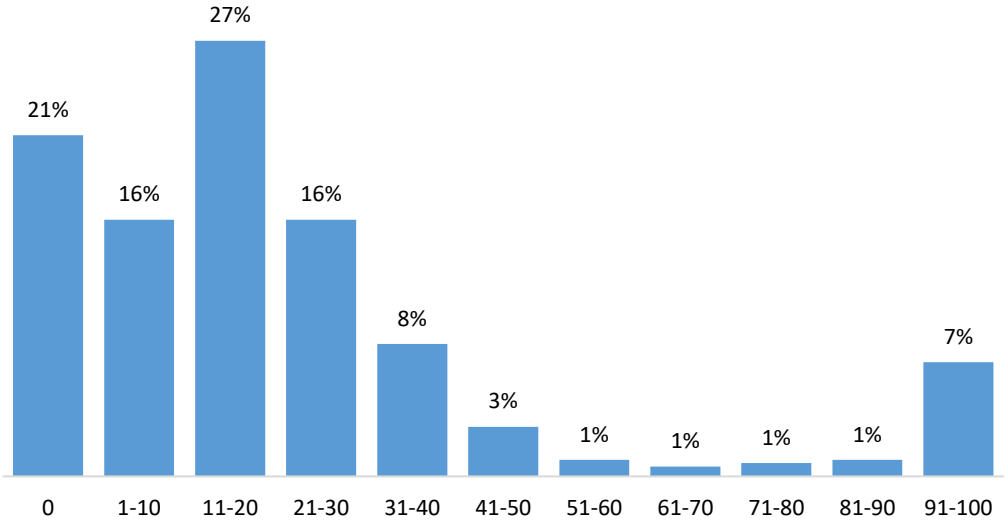


Figure 3.20 Per cent of online beef expenditure domestically

- Access to products not available locally, and greater variety are the most important reasons for those choosing to shop online (Figure 3.21).

Figure 3.21 Main reason for shopping online for beef

- Supermarkets, TMall and Jingdong are the main online retail channels used by those purchasing beef online (Figure 3.22).

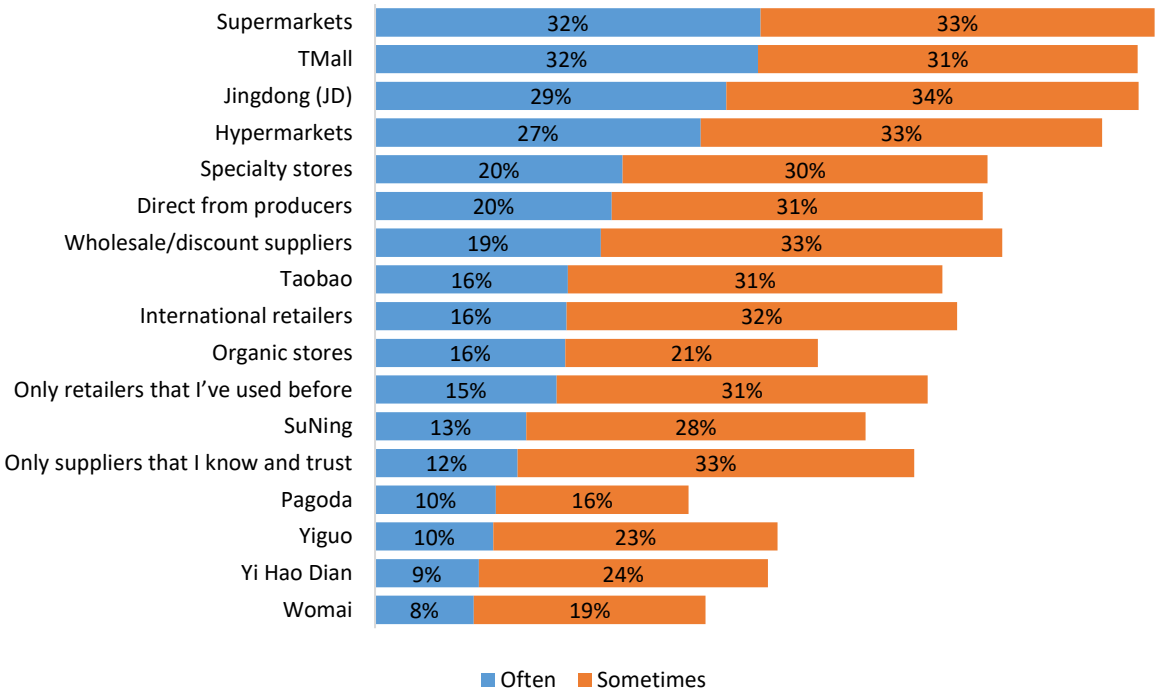


Figure 3.22 Use of online retail channels

3.4 Choice Experiment analysis of beef tenderloin choices

In this section, we present the findings of the Choice Experiment. Our aim is to identify which beef attributes drive product choices, by how much, and by who. We do this by segmenting the sample of consumers into groups based on which product offerings they preferred (Appendix B). Choice Experiments can be somewhat more difficult to answer compared with the usual question formats that people have typically seen before, so it is important to check whether respondents have been able to complete the exercise reliably. Overall, task and attribute understanding was high, and most respondents felt certain that their responses reflected real-world choices if these beef products were available (Figure 3.23).

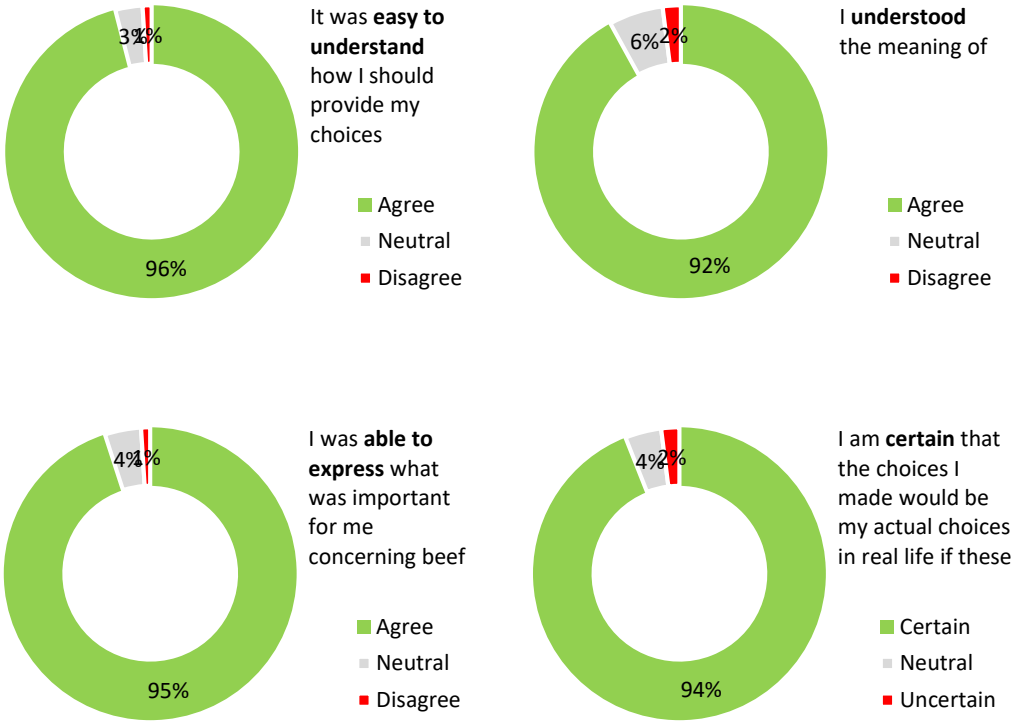


Figure 3.23 Choice experiment debriefing questions: task understanding, attribute understanding, ability to express preferences, certainty of choices made

Therefore, the results present the Willingness to Pay by attribute for the three consumer groups. The WTP tell us how much more the average consumer is willing to pay per kg of beef tenderloin with a particular attribute, over tenderloin that does not have this attribute (Table 3.1, Figure 3.24). For example, members of Group Three are willing to pay, on average, ¥48.4/kg more for tenderloin that is produced *organically* over beef that is not. There is some uncertainty in WTP estimates, and the Confidence Intervals reported in Table 3.1 indicate that we can be 95 per cent sure that the true WTP falls within this interval.

In regard to country of origin group three are the most willing to pay for tenderloin sourced from New Zealand farms and also that raised on Māori farms, at just under double the average price. Group two have a higher WTP for beef raised in Australia at 135 per cent and is also willing to pay a premium of 74 per cent for feedlot raised beef, 70 per cent for carbon neutral beef and 42 per cent for water quality protection. Group one is willing to pay the highest premium for 100 per cent grass fed tenderloin, prefers China as the country of Origin but also willing to pay for feedlot raised beef.

In Table 3.1, this is reported under each group's column heading. We can see that three distinct consumer groups have been identified, the first group has an estimated size of 71 per cent, the second group's size is 17 per cent and the third is 12 per cent. These group sizes tell us the probability that a randomly selected Beijing beef tenderloin purchaser belongs to that consumer group.

Table 3.1 Beef tenderloin attribute willingness-to-pay by consumer group

Beef tenderloin Attribute	Group One 71%	Group Two 17%	Group Three 12%
Organic	¥21.6 (14, 29)		¥48.4 (3, 100)
Enhanced Animal Welfare	¥10.8 (3, 19)		
GMO-free	¥27.3 (19, 36)		
Carbon Neutral	¥30.1 (9, 52)	¥90.8 (5, 177)	
Biodiversity Enhancement	¥34.3 (13, 56)		
Water Quality Protection		¥54.9 (26, 84)	
Feedlot Raised	¥134.8 (6, 264)	¥96.3 (17, 175)	
100% Pasture Raised	¥23.8 (17, 31)	¥48.2 (14, 82)	
No added antibiotics			
No added hormones	¥22.3 (16, 29)	¥10.7 (-1, 21)	¥32.7 (3, 28)
Social responsibility		¥38.5 (15, 61)	
Traceability		¥16.6 (-5, 38)	¥32.9 (6, 72)
100% Grass-fed	¥158.6 (4, 313)		¥12.9 (4, 40)
Grain-fed	¥10.8 (3, 19)		
Chilled	¥12.5 (4,21)	¥71.7 (29, 114)	
Fresh	¥18.5 (7, 29)	¥62.5 (21, 104)	
Raised in China	¥80.2 (53, 107)		
Raised in Australia	¥59.6 (30, 90)	¥176 (-6, 358)	
Raised in USA	¥61.2 (35, 87)		
Raised in Argentina	¥47.8 (27, 67)		¥84.9 (5, 175)
Raised in NZ	¥74.8 (42, 107)		¥160.1 (9, 329)
Raised on Māori farms in NZ	¥31.9 (16, 47)	¥59 (19, 99)	¥157.8 (1, 314)

Average WTP per kg beef tenderloin (95 per cent Confidence Interval)

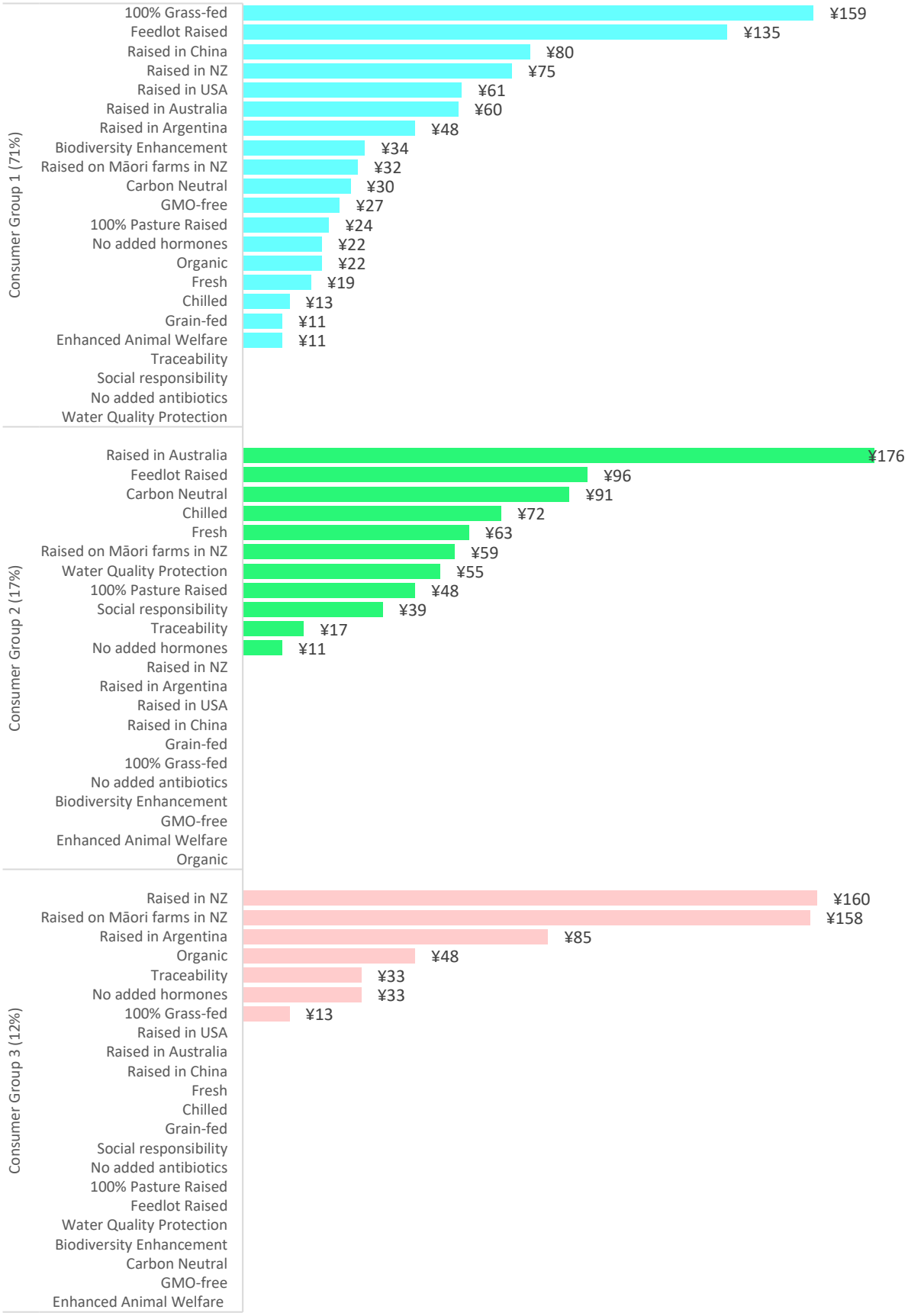


Figure 3.24 Beef tenderloin attribute willingness-to-pay by consumer group

Country-of-origin preferences are significantly varied across consumer groups.

- Consumers in Group One have the highest WTP for grass-fed beef of the three groups and rank this the highest of the attributes considered.
- They are the only consumer group to value enhanced animal welfare, GMO-free, and biodiversity enhancement.

- Consumers in Group Two have the highest WTP for Australian beef of the three groups and rank this highest of the attributes considered.
- Consumer Group Two are the only group WTP for water quality protection, and social responsibility
- They have the highest WTP for Carbon Neutral production of the three groups

- Consumers in Group Three value NZ and Māori raised beef similarly and rank these highest of the attributes considered.
- These consumers have the smallest set of attributes found as significant in their beef choices.
- They have the highest WTP for Organic beef of the three groups.

3.5 Consumer group descriptions

This section describes each of the three consumer groups identified in the statistical analysis, using the same questions presented above. The objective is to highlight the differences and similarities between groups that can be useful in identifying the types of consumers who are willing-to-pay for attributes relevant to an organisation's objectives. For example, an organisation interested in developing into the Carbon Neutral space will be able to use the information below to describe the members of Consumer Group Two, who are the group willing-to-pay the most for this attribute. As we go through the comparisons, the small bar charts on the right hand side will highlight the group with the largest values with a green bar.

- Consumers in Group Three are more likely to be male, with a university degree and have lower incomes relative to the other groups. While Group Two consumers have the highest average consumption (Table 3.2).

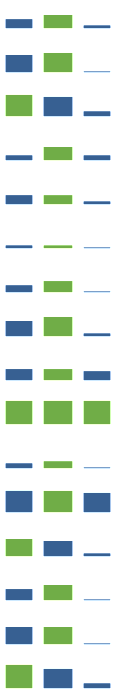
Table 3.2 Describing consumer groups: Demographics

Demographics	Group One	Group Two	Group Three
Female	58%	57%	40%
< 44 years old	94%	91%	94%
> 65 years old	0%	1%	0%
Suburban	4%	7%	3%
Have children	86%	84%	85%
University degree	84%	85%	89%
> ¥240,000	37%	37%	15%
Average meals containing beef per week	3.8	4.0	3.3

- Group Two and Three consumers have a similar range of beef cut purchases, and are greater overall compared with Group Three (Table 3.3).

Table 3.3 Describing consumer groups: Beef Product Purchases

Purchase **in last month**	Group One	Group Two	Group Three
Minced beef	33%	39%	23%
Beef shank	48%	50%	22%
Porterhouse steak	53%	50%	26%
Blade chuck steak	28%	39%	26%
Ribeye steak	32%	33%	25%
Ribeye roast	25%	25%	22%
T-bone steak	30%	36%	18%
Brisket	45%	50%	23%
Rib	37%	38%	33%
Tenderloin/filet mignon	100%	100%	100%
Flank steak	28%	30%	19%
Top sirloin steak	53%	55%	50%
Top round steak	46%	43%	25%
Chuck roast	36%	43%	21%
Beef jerky	48%	48%	22%
Beef Slices	57%	52%	27%



- Group Three consumers pay higher prices overall than both other groups (Table 3.4).

Table 3.4 Describing consumer groups: Beef Product Prices Usually Paid

Average price/kg	Group One	Group Two	Group Three
Minced beef	¥131	¥141	¥165
Beef shank	¥117	¥114	¥141
Porterhouse steak	¥147	¥136	¥182
Blade chuck steak	¥121	¥127	¥154
Ribeye steak	¥126	¥132	¥132
Ribeye roast	¥120	¥121	¥130
T-bone steak	¥116	¥121	¥122
Brisket	¥117	¥114	¥158
Rib	¥115	¥116	¥104
Tenderloin/filet mignon	¥143	¥130	¥161
Flank steak	¥124	¥123	¥138
Top sirloin steak	¥142	¥133	¥108
Top round steak	¥160	¥152	¥181
Chuck roast	¥116	¥104	¥133
Beef jerky	¥124	¥122	¥183
Beef Slices	¥110	¥105	¥125

- Group Two consumers are more likely to purchase NZ beef weekly and to rank NZ beef quality higher (Table 3.5). Porterhouse and Top Round steaks are the next most often purchased NZ beef cut (beside tenderloin) for all groups.

Table 3.5 Describing consumer groups: New Zealand Beef Purchasing

	Group One	Group Two	Group Three
Buy NZ beef at least weekly	48%	61%	55%
NZ produces the best beef	36%	39%	35%
Rank NZ in top three best beef producers	66%	74%	69%
NZ beef products purchased			
Minced beef	15%	18%	9%
Beef shank	27%	30%	11%
Porterhouse steak	30%	31%	17%
Blade chuck steak	16%	20%	6%
Ribeye steak	18%	24%	14%
Ribeye roast	14%	13%	11%
T-bone steak	19%	20%	11%
Brisket	26%	29%	9%
Rib	20%	22%	24%
Tenderloin/filet mignon	57%	56%	53%
Flank steak	16%	17%	14%
Top sirloin steak	29%	35%	29%
Top round steak	31%	39%	17%
Chuck roast	20%	23%	6%
Beef jerky	24%	25%	13%
Beef Slices	30%	31%	14%
Important reasons for purchasing NZ beef			
Good animal welfare	67%	69%	51%
Good value for price	70%	77%	43%
Curiosity to try different product	62%	67%	20%
Reduced environmental impact of production	70%	71%	52%
Trustworthy food safety	76%	82%	58%
Socially responsible producers	71%	73%	52%
Lower fat content	69%	75%	47%
Higher quality of cut	67%	71%	46%
No added antibiotics	74%	80%	48%
No GM feed	74%	76%	48%
No added growth hormones	76%	80%	51%
Traceability to farm	75%	79%	47%
Texture	70%	75%	52%
Pasture raised rather than housed indoors	73%	78%	52%
Fresh rather than frozen	72%	73%	47%
Organic production	73%	80%	48%
No chemicals to color or extend shelf life	74%	76%	55%
Halal production	65%	66%	39%
Aged at least 21 days	68%	71%	45%
Care of traditional cultures	64%	63%	39%
Improved health benefits for my family	74%	77%	54%
Marbling	61%	64%	29%

Grass fed	74%	73%	55%	

- Group Three consumers have the lowest purchase frequency for substitute animal meat proteins and the highest for plant-based protein compared to both other groups (Table 3.6). A balanced diet and health improvements are the main reasons for Group Three consumers to purchase plant-based proteins.

Table 3.6 Describing consumer groups: Alternative Proteins Purchase Frequency

At least weekly	Group One	Group Two	Group Three
Lamb	37%	34%	15%
Chicken	65%	64%	45%
Alternative plant-based protein	20%	21%	40%
Venison	5%	8%	0%
Fish	72%	62%	63%
Pork	74%	74%	29%
Beef	88%	88%	65%
Why do you eat pant-based proteins			
Animal welfare concerns	17%	17%	11%
Environmental concerns	26%	22%	25%
Taste	20%	22%	15%
As part of a balanced diet	33%	33%	36%
To try something different	23%	22%	26%
To improve health	30%	34%	29%
Vegan or Vegetarian	3%	3%	7%
Why **don't** you eat plant-based proteins			
Not sure what this is	11%	10%	5%
Not available where I shop or eat	11%	11%	13%
I don't know how to cook it or	11%	10%	15%
Prefer meat	21%	22%	21%
I don't like the taste	11%	9%	15%
Too expensive	3%	3%	13%
Not interested	9%	5%	11%
I consider it unhealthy	2%	2%	8%
It has never occurred to me as an option	2%	3%	10%

- Members of Group Three are less likely to consider beef production as important to the economy, or to want to support local farmers. They are also significantly less likely to think that environmental impacts are well managed or that health impacts are low (Table 3.7).

Table 3.7 Describing consumer groups: Attitudes towards health, environment and beef production

Important Factors	Group One	Group Two	Group Three
Beef production is an important sector in the country's economy	80%	79%	61%
Supporting local beef farmers and suppliers is important	81%	80%	59%
The environmental impact of beef production is well managed	81%	80%	64%
Beef production has low human health impacts	73%	69%	40%
I am worried about the long term effects of medicine, pesticide and additives in conventional modern beef production	81%	76%	48%
When considering trying a beef product not previously experienced, I try to find out the most information I can about the product before I try it	82%	85%	73%
I pay careful attention to the labelling information on the package when I buy beef	84%	87%	61%
I would prefer to buy beef produced in a warm family environment	83%	81%	59%
I think beef is a healthier option than pork	81%	78%	61%
I would prefer to avoid pork due to concerns about African Swine Fever	72%	71%	34%
I eat more beef instead of pork because of concerns about African Swine Fever	78%	73%	43%
I would prefer to buy beef produced by kind, generous, and respectful people	83%	79%	58%

- Use of home computers is significantly less than for mobile devices for all groups. Group Two has higher daily internet access compared to the other groups (Table 3.8).

Table 3.8 Describing consumer groups: Frequency of internet access

Daily Access	Group One	Group Two	Group Three
Mobile device e.g. smartphone	73%	80%	70%
Home computer e.g. desktop	54%	65%	43%

- There is substantial variation in the use of digital media when looking for information to inform decisions on which products to purchase between consumer groups (Table 3.9).

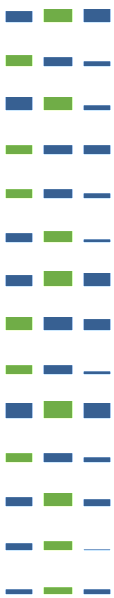
Table 3.9 Describing consumer groups: Use of digital media for product purchasing

Which to buy	Group One	Group Two	Group Three
Weibo	13%	18%	8%
Taobao	44%	49%	24%
WeChat	22%	27%	13%
Alibaba	26%	27%	11%
Jingdong	68%	67%	35%
TMall	64%	61%	44%
Food company sites	22%	22%	34%
Food blogs	8%	9%	21%
QQ Zone	7%	8%	10%
Baidu	8%	8%	7%
Youku	7%	11%	9%
Forums	4%	4%	9%
LinkedIn	7%	9%	1%
Retailer websites	21%	25%	40%

- Similarly, there is significant variation in digital media use for information on how products are made. However, Group Two appears to have overall greater use, while Group Three has relatively lower overall use (Table 3.10).

Table 3.10 Describing consumer groups: Use of digital media for information on how a product is produced

How a product is produced	Group One	Group Two	Group Three
Weibo	37%	40%	39%
Taobao	33%	26%	17%
WeChat	38%	39%	19%
Alibaba	27%	27%	27%
Jingdong	31%	30%	15%
TMall	31%	32%	9%
Food company sites	36%	44%	39%
Food blogs	40%	38%	32%
QQ Zone	29%	27%	10%
Baidu	47%	54%	45%
Youku	28%	27%	17%
Forums	31%	40%	24%
LinkedIn	21%	27%	8%
Retailer websites	20%	25%	15%



- Use of smartphone technologies for either information searching or product purchasing is similar across all groups (Table 3.11).

Table 3.11 Describing consumer groups: Use of smart technologies for information searching and purchase

Use Often	Group One	Group Two	Group Three
Information Searching			
Barcodes	33%	33%	25%
QR Codes	36%	39%	32%
RFID/NFC	22%	19%	19%
Product Purchasing			
Barcodes	30%	35%	22%
QR Codes	36%	38%	42%
RFID/NFC	11%	13%	16%

- Accessing health information is the highest use of apps on smart phones across all groups. Group Three consumers have lower overall use of phone apps (Table 3.12).

Table 3.12 Describing consumer groups: Use of phone applications

Currently use	Group One	Group Two	Group Three
Health (general)	57%	51%	33%
Dietary information	48%	43%	23%
Sustainability information	36%	33%	22%
Environmental information	37%	32%	26%
Budgeting	41%	36%	19%
Purchasing	50%	48%	25%
Nearest stockist location	39%	41%	17%
Product reviews	45%	47%	27%
Traceability	39%	40%	20%
Recipes	41%	42%	16%
Loyalty/rewards programmes	39%	42%	16%
Discounts/coupons	41%	46%	23%
Product delivery	31%	32%	17%

- Group One consumers spend the most online domestically or from hypermarkets, while Group Three consumers spend the most online from overseas of the three groups (Table 3.13).

Table 3.13 Describing consumer groups: Percentage of beef expenditure by retail channel

Average percent	Group One	Group Two	Group Three
Grocery store	5%	5%	4%
Specialty store	15%	15%	13%
Online from domestic	24%	22%	14%
Online from overseas	6%	8%	10%
Hypermarket	16%	13%	12%
Wet market	8%	9%	6%
Butcher	9%	9%	12%
Wholesale/discount store	2%	3%	6%
Direct from producer	3%	3%	9%
Supermarket	10%	11%	13%
Convenience store	1%	1%	1%

- For those shopping online for beef, the main reason differs across the three groups with greater variety important for Group One consumers, and availability mainly important for Group Two (Table 3.14).

Table 3.14 Describing consumer groups: Main reason for shopping online for beef

	Group One	Group Two	Group Three
I like being able to order products that are better or not available locally	19%	25%	22%
There is a greater variety of products	20%	21%	7%
Products are generally higher quality	13%	8%	21%
I like the convenience of having products delivered to my home	12%	8%	10%
I have access to special offers and promotions	9%	13%	14%
I like being able to avoid having to go into the store.	4%	7%	3%
Prices are generally lower	3%	3%	4%

- For those shopping online, TMall is the most often used online retailer for Group One consumers, while supermarkets are most often used by Group Two and Three consumers (Table 3.15).

Table 3.15 Describing consumer groups: Use of online retail channels

Use Often	Group One	Group Two	Group Three
Wholesale/discount suppliers	19%	22%	14%
International retailers	14%	17%	29%
Direct from producers	19%	24%	19%
Supermarkets	30%	38%	39%
Hypermarkets	28%	34%	15%
Yiguo	11%	11%	1%
Specialty stores	21%	26%	9%
Jingdong (JD)	30%	31%	16%
SuNing	13%	18%	5%
Yi Hao Dian	9%	13%	4%
Pagoda	10%	12%	3%
Womai	8%	11%	4%
Organic stores	15%	22%	10%
Taobao	16%	24%	5%
TMall	35%	33%	9%
Only suppliers that I know and trust	11%	17%	6%
Only retailers that I've used before	15%	19%	6%

Chapter 4
Conclusions

This report presents the results of a survey of beef tenderloin consumption in Beijing China. The survey was of just over 1,000 respondents who were selected as purchasing beef at least once a month.

The survey assessed purchase behaviour and the reasons for purchasing beef by country of Origin. New Zealand beef tenderloin was the second most purchased by country of origin after China followed by Australian sourced beef. New Zealand was ranked the highest of the countries included for quality. These qualities included safe, 100 per cent grass fed, no added antibiotics, no GM feed, no hormones and organic.

Respondents were asked series of question re their use of digital media and purchasing decisions. Twenty three per cent of respondents shopped on line domestically for their beef. Fifteen per cent use hypermarkets and the same number specialty stores. Seven per cent shopped on line from overseas outlets.

The survey included a choice experiment to assess the Willingness to Pay by consumers for different attributes associated with beef mince. The consumers were then segmented, using a latent class model, into 3 classes each with different characteristics and preferences.

The results showed that consumer group three (the smallest group at 12 per cent of the sample) were willing to pay the most for beef tenderloin from New Zealand, with a premium of nearly per cent, and similar for New Zealand beef raised on Māori farms.

Group two have a higher WTP for beef raised in Australia at 135 per cent and is also willing to pay a premium of 74 per cent for feedlot raised beef, 70 per cent for carbon neutral beef and 42 per cent for water quality protection. Group one is willing to pay the highest premium for 100 per cent grass fed tenderloin, prefers China as the country of Origin but also willing to pay for feedlot raised beef.

Appendix A
Statistical Method

This appendix provides technical details of statistical analysis of choice data. The appendix includes a brief description of the theoretical foundations of choice analysis followed by statistical probability estimation approaches, focusing on contemporary models applied in this report. Lastly, the method used in generating monetary estimates is described.

A.1 Conceptual Framework

In Choice Experiments (CEs), researchers are interested of what influences, on average, the survey respondents' decisions to choose one alternative over others. These influences are driven by people's preferences towards the attributes but also the individual circumstances such as their demographics or perceptions of the choice task (e.g., the level of difficulty or understanding) (Hensher et al. 2015).

Each alternative in a choice set is described by attributes that differ in their levels, both across the alternatives and across the choice sets. The levels can be measured either qualitatively (e.g., poor and good) or quantitatively (e.g., kilometres). This concept is based on the characteristics theory of value (Lancaster 1966) stating that these attributes, when combined, provide people a level of utility[1] *U* hence providing a starting point for measuring preferences in CE (Hanley et al. 2013; Hensher et al. 2015). The alternative chosen, by assumption, is the one that maximises people's utility[2] providing the behavioural rule underlying choice analysis:

$$U_j > U_i \tag{0.1}$$

where the individual *n* chooses the alternative *j* if this provides higher utility than alternative *i*. A cornerstone of this framework is Random Utility Theory, dated back to early research on choice making (e.g., Thurstone 1927) and related probability estimation. This theory postulates that utility can be decomposed into systematic (explainable or observed) utility *V* and a stochastic (unobserved) utility ε (Hensher et al. 2015; Lancsar and Savage 2004).

$$U_{nj} = V_{nj} + \varepsilon_{nj} \tag{0.2}$$

where *j* belongs to a set of J alternatives. The importance of this decomposition is the concept of utility only partly being observable to the researcher, and remaining unobserved sources of utility can be treated as random (Hensher et al. 2015). The observed component includes information of the attributes as a linear function of them and their preference weights (coefficient estimates).

$$V_{nsj} = \sum_{k=1}^{K} \beta_k x_{nsjk} \tag{0.3}$$

with *k* attributes in vector x for a choice set s. Essentially, the estimated parameter β shows "the effect on utility of a change in the level of each attribute" (Hanley et al. 2013, p. 65). This change can be specified as linear across the attribute levels, or as non-linear using either dummy coding or effect coding

[1] Related terminology used in psychology discipline is *the level of satisfaction* (Hensher et al. 2015).
[2] In choice analysis, utility is considered as *ordinal utility* where the relative values of utility are measured (Hensher et al. 2015).

approaches. The latter coding approach has a benefit of not confounding with an alternative specific constant (ASC) when included in the model (Hensher et al. 2015).

A.2 Statistical Modelling of Choice Probabilities

The statistical analysis aims to explain as much as possible of the observed utility using the data obtained from the CE and other relevant survey data. In order to do so, the behavioural rule (eq. 1.1) and the utility function (eq. 1.2) are combined (Hensher et al. 2015; Lancsar and Savage 2004) to estimate the probability of selecting an alternative *j*:

$$\Pr_{nsj} = \Pr\left(U_{nsj} > U_{nsi}\right) = \Pr\left(V_{nsj} + \varepsilon_{nsj} > V_{nsi} + \varepsilon_{nsi}\right) = \Pr\left(\varepsilon_{nsi} - \varepsilon_{nsj} < V_{nsj} - V_{nsi}\right) \forall j \neq i \quad (0.4)$$

where the probability of selecting alternative *j* states that differences in the random part of utility are smaller than differences in the observed part. A standard approach to estimate this probability is a conditional logit, or multinomial logit (MNL) model (McFadden 1974). This model can be derived from the above equations (1.2 and 1.3) by assuming that the unobserved component is independently and identically distributed (IID) following the Extreme Value type 1 distribution (see e.g. Hensher et al. 2015; Train, 2003). Although the MNL model provides a "workhorse" approach in CE, it includes a range of major limitations (see e.g. Fiebig et al. 2010; Greene and Hensher 2007; Hensher et al. 2015):

- Restrictive assumption of the IID error components
- Systematic, or homogenous, preferences allowing no heterogeneity across the sample
- Restrictive substitution patterns, namely the existence of independence of irrelevant alternatives property where introduction (or reduction) of a new alternative would not impact on the relativity of the other alternatives
- The fixed scale parameter obscures potential source of variation

Some or all of these assumptions are often not realised in collected data. These restrictive limitations can be relaxed in contemporary choice models. In particular, the random parameter logit (RPL) model (aka, the mixed logit model) has emerged in empirical application allowing preference estimates to vary across respondents (Fiebig, et al. 2010; Hensher et al. 2015; Revelt and Train, 1998). This is done by specifying a known distribution of variation to be parameter means. The RPL model probability of choosing alternative *j* can be written as:

$$\Pr_{nsj} = \frac{\exp(\beta_n' x_{nsj})}{\sum_J \exp(\beta_n' x_{nsj})} \quad (0.5)$$

where, in the basic specification, $\beta_n = \beta + \eta_n$ with η being a specific variation around the mean for *k* attributes in vector *x* (Fiebig, et al. 2010; Hensher et al. 2015). Typical distributional assumptions for the random parameters include normal, triangular and lognormal distributions, amongst others. The normal distribution captures both positive and negative preferences (i.e., *utility* and *disutility*) (Revelt and Train, 1998). The lognormal function can be used in cases where the researcher wants to ensure the parameter has a certain sign (positive or negative), a disadvantage is the resultant long tail of estimate distributions (Hensher et al. 2015). The triangular distribution provides an alternative functional form, where the spread can be constrained (i.e., the mean parameter is free whereas spread is fixed equal to mean) to ensure behaviourally plausible signs in estimation (Hensher et al. 2015). Further specifications used in modelling include parameters associated with individual specific characteristics (e.g, income)

that can influence the heterogeneity around the mean, or allowing correlation across the random parameters. The heterogeneity in mean, for example, captures whether individual specific characteristics influence the location of an observation on the random distribution (Hensher et al. 2015). In this study, the frequency of visits to rivers, streams and lakes was used to explain such variance.

Another way to write this probability function (in eq. 1.4) (Hensher et al. 2015) involves an integral of the estimated likelihood over the population:

$$L_{njs} = \int_{\beta} \Pr_{nsj}(\beta) f(\beta|\theta) d\beta \tag{0.6}$$

In this specification, the parameter θ is now the probability density function conditional to the distributional assumption of β. As this integral has no closed form solution, the approximation of the probabilities requires a simulation process (Hensher et al. 2015; Train, 2003). In this process for data *X*, *R* number of draws are taken from the random distributions (i.e. the assumption made by the researcher) followed by averaging probabilities from these draws; furthermore these simulated draws are used to compute the expected likelihood functions:

$$L_{nsj} = E(\Pr_{nsj}) \approx \frac{1}{R} \sum_{R} f(\beta^{(r)}|X) \tag{0.7}$$

where the $E(\Pr_{nsj})$ is maximised through Maximum Likelihood Estimation. This specification (in eq. 1.6) can be found in Hensher et al. (2015). In practice, a popular simulation method is the Halton sequence which is considered a systematic method to draw parameters from distributions compared to for example, pseudo-random type approaches (Hensher et al. 2015).

A.3 Econometric Extensions

Common variations of the RPL model include specification of an additional error component (EC) in the unobserved part of the model. This EC extension captures the unobserved variance that is alternative-specific (Greene and Hensher 2007) hence relating to substitution patterns between the alternatives (Hensher et al. 2015). Empirically, one way to explain significant EC in a model is SQ-bias depicted in the stochastic part of utility if the EC is defined to capture correlation between the non-SQ alternatives (Scarpa et al., 2005).

Another extension which has gained increasing attention in recent CE literature, is the Generalized Mixed Logit (GMXL) model (Czajkowski et al. 2014; Hensher et al. 2015; Juutinen et al. 2012; Kragt 2013; Phillips 2014). This model aims to capture remaining unobserved components in utility as a source of choice variability by allowing estimation of the scale heterogeneity alongside the preference heterogeneity (Fiebig et al. 2010; Hensher et al. 2015). This scale parameter is (inversely) related to the error variance, and in convenient applications such as MNL or RPL, this is normalised to one to allow identification (Fiebig et al. 2010; Louviere and Eagle 2006). However, it is possible that the level of error variance differs between or within individuals, due to reasons such as behavioural outcomes, individual characteristics or contextual factors (Louviere and Eagle 2006).

Recent GMXL application builds on model specifications presented in Fiebig et al. (2010), stating that β_n (in eq. 1.4) becomes:

$$\beta_n = \sigma_n \beta + \gamma \eta_n + (1-\gamma)\sigma_n \eta_n \tag{0.8}$$

where σ is the scale factor (typically = 1) and $\gamma \in \{0,1\}$ is a weighting parameter indicating variance in the residual component. In the case the scale factor equals 1, this reduces to the RPL model. The importance of the weighting parameter is the impact on the scaling effect on the overall utility function (population means) versus the individual preference weights (individual means): when *γ* parameter approaches zero the scale heterogeneity affects both means, whereas when this approaches one the scale heterogeneity affects only the population means (Hensher et al. 2015; Juutinen et al. 2015). Interpretation of these parameters includes

- If *γ* is close to zero, and statistically significant, this supports the model specification with the variance of residual taste heterogeneity increases with scale (Juutinen et al. 2012); and
- If *γ* is not statistically significant from one, this suggests that the unobserved residual taste heterogeneity is independent of the scale effect, that is the individual-level parameter estimates differ in means but not variances around the mean (Kragt, 2013)

The scale factor specification (eq. 1.7) can also be extended to respondent specific characteristics associated with the unobserved scale heterogeneity (Hensher et al. 2015; Juutinen et al. 2015):

$$\sigma_n = \exp\{\bar{\sigma} + \tau\omega_n\} \tag{0.9}$$

where $\bar{\sigma}$ *is* the mean parameter in the error variance; and ω is unobserved scale heterogeneity (normally distributed) captured with coefficient *τ* (Hensher et al. 2015; Juutinen et al. 2015; Kragt, 2013). Juutinen et al. (2012), for example, in context of natural park management found that respondents' education level and the time spent in the park explained the scale heterogeneity ($\tau > 0$, p-value < 0.01). In this study, the respondents indicated levels of choice task understanding and difficulty were used to explain scale heterogeneity.

A.4 Estimation of Monetary Values

Typically the final step of interest in the CE application is the estimation of monetary values of respondent preferences for the attributes considered in utility functions. These are commonly referred to as marginal willingness-to-pay (WTP). WTP estimation is based on the marginal rate of substitution expressed in dollar terms providing a trade-off between some attribute k and the cost involved (Hensher et al. 2015) and is calculated using the ratio of an attribute parameter and the cost parameter. WTP can take into account interaction effects, if statistically significant, such as with the respondent demographics. WTP of attribute *j* by respondent *i* is calculated as the ratio of the estimated model parameters accommodating the influence of the random component (Cicia et al. 2013) as:

$$WTP_i^j = -\left(\frac{\beta_j + \varepsilon_{ij}}{\beta_{price} + \varepsilon_{ip}}\right) \tag{0.10}$$

The estimated mode parameters can also be used to estimate compensating surplus (CS) as a result of policy or quality change in a combination of attributes, using (Hanemann, 1984):

$$\mathbf{CS} = \frac{-1}{\beta cost}\left[\ln\sum_{j=1}^{J}\exp\left\{V_j^0\right\} - \ln\sum_{j=1}^{J}\exp\left\{V_j^1\right\}\right] \tag{0.11}$$

which calculates the difference in utilities before the policy or quality change (V_0) and after the policy or quality change (V_1) (Hanley et al. 2013; Lancsar and Savage 2004). Similar to WTP, the monetary

estimation of this change is possible by using the estimate for the monetary attribute $\beta_{cost.}$. Lastly, there are some challenges associated with the empirical estimation of the WTP in the RPL based models. One approach is to use a fixed cost, which simplifies the WTP estimation (Daly et al. 2012) but which may not be as behaviourally a plausible consideration as allowing heterogeneous preferences towards the cost attribute (Bliemer and Rose, 2013; Daziano and Achtnicht, 2014). Conceptually, the estimated cost parameter is a proxy for the marginal utility of income for respondents and economic theory suggests individuals will respondent differently to varying income levels. The use of a random cost parameter however, presents complications in deriving population distribution moments from the ratio of two random parameters.

Appendix B
Latent Class Model of Beef Tenderloin Choices

Table B.1 Beijing Beef tenderloin choice Latent Class model

Utility parameters[1]	Class 1	Class 2	Class 3
Organic	0.36***(0.04)	-1.83***(0.39)	0.28***(0.09)
Enhanced Animal Welfare	0.18***(0.06)	-0.31 (0.30)	0.18 (0.11)
GMO-free	0.46***(0.05)	0.05 (0.19)	0.01 (0.10)
Carbon Neutral	0.50***(0.18)	3.24** (1.32)	- 0.30 (0.24)
Biodiversity Enhancement	0.57***(0.17)	-1.11 (1.06)	-0.07 (0.25)
Water Quality Protection	0.02 (0.06)	1.96***(0.40)	- 0.03 (0.11)
Feedlot Raised	2.57** (1.08)	3.44** (1.41)	- 0.09 (0.09)
100% Pasture Raised	0.40***(0.04)	1.72***(0.47)	0.04 (0.10)
No added antibiotics	1.69 (1.57)	- 1.83 (1.28)	- 0.18 (0.24)
No added hormones	0.37***(0.04)	0.38** (0.18)	0.19* (0.10)
Social responsibility	-0.00 (0.04)	1.38***(0.29)	0.07 (0.10)
Traceability	-0.00 (0.05)	0.59* (0.31)	0.19** (0.09)
100% Grass-fed	2.65** (1.29)	2.15* (1.27)	0.38* (0.22)
Grain-fed	0.18***(0.06)	-1.01* (0.52)	0.08 (0.12)
Chilled	0.20***(0.07)	2.56** (0.57)	- 0.02 (0.17)
Fresh	0.31***(0.09)	2.23***(0.63)	- 0.50 (0.13)
Raised in China	1.34***(0.15)	-2.24** (0.91)	0.39 (0.25)
Raised in Australia	0.99***(0.23)	6.28** (2.86)	0.15 (0.25)
Raised in USA	1.02***(0.18)	1.63 (1.01)	0.08 (0.27)
Raised in Argentina	0.80***(0.12)	- 0.43 (0.50)	0.49** (0.21)
Raised in NZ	1.25***(0.18)	2.22 (2.03)	0.93***(0.29)
Raised on Māori farms in NZ	0.53***(0.10)	2.11***(0.57)	0.92***(0.18)
Price /kg tenderloin	- 0.02***(0.00)	- 0.04***(0.00)	- 0.01***(0.00)
Average class probability	0.71	0.17	0.12
Model Fit Statistics			
Log Likelihood function	- 7,538		
Log Likelihood chi^2 stat (43 d.f.)	6,917***		
McFadden Pseudo R^2	0.31		
Number of observations	10,010		
Number of respondents	1,001		

***, **,* denote statistical significance at the 1%, 5% and 10% levels respectively for the null hypothesis that a parameter estimate is not significantly different from zero.

Standard errors in brackets.

[1] Parameter mean estimates indicates the estimated average value in the model for each different parameter