Is willingness to pay (WTP) for beef quality grades affected by consumer demographics and meat consumption preferences?

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Abstract

One of the ongoing problems in beef marketing has been to market a product that is consistent and enjoyable. The Australian solution is to use a beef grading scheme called Meat Standards Australia (MSA) to define beef eating quality. Quality is defined on the basis of the consumers' eating experiences by assigning muscle or muscle portions to 4 grades comprising "unsatisfactory" (2 star), "good every day" (3 star), "better than everyday" (4 star) and "premium" (5 star) quality. One issue for marketers is how to price these newly defined quality grades. This paper evaluates the willingness to pay (WTP) by consumers for the defined levels of eating quality and interactions with consumer demographic factors and meat consumption preferences. The data comprised exit surveys from 6718 consumers who participated in taste panel sessions in Australia, the United States, Japan and Ireland conducted between 2005 and 2008. Consumers from each country scored WTP for the different grades in units of their relevant currency. These estimates were then expressed as a ratio of the price for 'good everyday quality' to allow comparison between the different currencies. The results clearly showed that consumers in all countries were willing to pay more for 4 and 5 star qualities

(P<0.0001), and less for 2 star quality, relative to 3 star. Japanese consumers showed the greatest increase in WTP estimates for quality, with 4 and 5 star samples being valued at 1.7 and 2.9 times the WTP value assigned to 3 star product. United States consumers were next with Australian and Irish consumers showing the smallest increase in WTP with increased quality. In all countries consumer age interacted with quality grade (P<0.0001) with consumers in the age range 25-35 years willing to pay more for quality, compared with older consumers. Other demographic factors and meat consumption preferences had little impact on consumers relative WTP for eating quality. This information can be used in setting prices, marketing and selecting quality for the different markets.

1. Introduction

An ongoing challenge in beef marketing is to provide a consistent and enjoyable eating experience for the consumer. In the past, variation in the production, processing and value adding steps along the supply chain has contributed to a variable eating experience for the consumer. As eating experiences can now be quantified or measured consistently, this allows marketers to develop products which meet those specifications. In pricing those products in the marketplace it is important to understand how much the consumer is willing to pay for different quality specifications.

Australia has taken an innovative role in the description of beef quality through its development of the Meat Standards Australia (MSA) beef grading scheme. This scheme predicts the eating quality of individual cuts of beef using critical control points from the production, processing and value adding sectors of the supply chain (Thompson 2002, Polkinghorne *et al.* 2008a). The scheme was implemented on a voluntary basis for the Australian domestic market in 2000 and by 2008 over 838,000 carcasses were being graded annually (Anon 2008a). The development of the MSA prediction model was underpinned by sensory testing where untrained consumers tasted samples of beef produced from a range of production and processing systems and cooked using a variety of methods. The sensory results were then used to develop empirical equations which predicted consumer palatability of each muscle or portion thereof.

Initially the sensory testing focused on consumer responses in Australia, but more recently large scale consumer taste tests have been undertaken in collaboration with researchers in a number of countries including Korea (Thompson *et al.* 2008, Hwang *et al.* 2008, Park *et al.* 2008), Japan, the United States and Ireland. At the completion of the taste tests held in Australia, Japan, the United States and Ireland, consumers were asked how much they would pay for the different quality grades in units of their own currency. These data were used to calculate the consumers' relative willingness to pay (WTP) for the different quality grades and to investigate potential interactions with their demographic profiles and meat consumption preferences.

Previous studies on WTP for beef products have examined the effect of animal feeding method (Umberger *et al.* 2002), cut type (Erikson *et al.* 1998), food safety issues (Cowan and MacCarthy 2000), tenderness (Lusk *et al.* 2001), perceived health attributes (Umberger *et al.* 2009) and country of origin labelling (Loureiro and Umberger 2003) on consumers WTP. This study focused on the relationship between eating quality grades and the consumers' relative WTP.

2. Experimental Procedures

Large scale consumer taste tests and surveys were undertaken in Australia, the United States, Japan and Ireland ultilizing a total of 2280, 1438, 1620 and 1380 consumers respectively. These taste tests were conducted between 2005 and 2008 as part of a larger study to compare consumer responses to tasting beef samples which ranged in eating quality and cooking method. Detailed protocols for the consumer taste tests have been described by Watson *et al.* (2008). Briefly, the consumer tests in each country used the same methodology whereby untrained consumers were recruited from community organizations and clubs to participate in the panels. The consumers were selected to provide a broad cross-section of demographics in the countries studied and a monetary incentive was provided to the club. In the initial screening, consumers were recruited up to 60 years of age, had a preference for beef cooked to a medium level of doneness, and consumed meat at least once every two weeks. Consumers only evaluated one cooking method.

Taste tests were administered on different nights at predetermined locations for three groups each of 20 consumers. At the start of each taste panel demographic details were recorded prior to each consumer tasting seven samples of beef over a three-quarter hour period. Details on the

questionnaire used to record demographic and meat consumption preferences were provided by Hwang *et al.* (2008). Demographic information included categories for income, age, number of adults and children in the household, occupation, gender and whether they were the main purchaser of beef in the family. Meat consumption data included the frequency they consumed beef, preferred doneness, and how they viewed the importance of meat in their diet.

There were small differences between the demographic details recorded in each country, such as the categories for income and age. This reflected the inputs from local researchers and whilst the changes were only small they made a combined analysis difficult. For example, income categories for total household income per year were recorded using the following scales. In Australia, the income levels were: (1) < $20,000, (2) $20,000-50,000 and (3) >$50,000. In Japan, the income levels were: (1) <¥2.9 million, (2) ¥3.0-3.9 million, (3) ¥4.0-4.9 million, (4) ¥5.0-5.9 million, (5) ¥6.0-6.9 million, (6) ¥7.0-7.9 million, (7) ¥8.0-8.9 million, (8) ¥9.0-9.9 million, (9) ¥10.0-11.9 million and (10) >¥12.0 million. In the United States, the income levels were: (1) <$20,000, (2) $21,000-50,000, (3) $51,000-75,000, (4) $76,000-100,000 and (5) >$101,000. In Ireland, the income levels were: (1) <€20,000, (2) €20,000-50,000 and (3) >€50,000.

Age categories also varied between countries. For Australia, age levels were: (a) <20, (b) 20-25, (c) 26-30, (d) 31-39 and (e) 40-60. For Japan, age levels were: (a) 20-25, (b) 26-30, (c) 31-39, (d) 40-50 and (e) >51. For the United States, age levels were: (a) 20-30, (b) 31-40, (c) 41-50, (d) 51-60 and (e) >61. For Ireland, age levels were: (a) 20-25, (b) 26-30, (c) 31-40, (d) 41-50 and (e) >51.

The demographics questionnaire also asked gender, the number of adults and the number of children living in the household. In all countries consumers were asked to classify their occupation using the following categories: (a) Trades, (b) Professional, (c) Technical, (d) Sales/Service, (e) Labourer, (f) Home duties, (g) Student and (h) Not employed. All questionnaires asked whether the consumer was the main purchaser of groceries in the household.

The meat consumption preferences of the consumers were described by questions on the frequency of beef consumption, their preferred degree of doneness and their attitude to meat. The frequency of beef consumption in any form was recorded on the following scale: (a) Daily, (b) 4-5 times/week, (c) 2-3 times/week, (d) Weekly, (e) Fortnightly, (f) Monthly and (g) Never eat. Although during recruitment it was requested that consumers preferred meat cooked to a medium degree of doneness they were asked to specify their preferred degree of doneness using the scale rare, medium/rare, medium, medium/well done and well done. To indicate how much consumers liked red meat they were also asked which category best described their attitude to meat: (a) "I enjoy red meat. It is an important part of my diet", (b) "I like meat well enough. It's a regular part of my diet", (c) "I do eat red meat although, truthfully it wouldn't worry me if I didn't", and (d) "I rarely/never eat red meat".

After completing the questionnaire consumers then tasted seven samples which had been allocated using a latin square design to ensure that the samples presented to any consumer covered as wide a range in eating quality as possible. Although not disclosed to the consumers the first sample was generally of average quality and was used as a reference to facilitate calibration of sensory scores. The subsequent six samples varied randomly in eating quality. At the completion of each tasting consumers were asked to score the sample for tenderness, juiciness, like flavour and overall liking using a 10 centimetre line scale, which was anchored with the words "not tender/very tender", "not juicy/very juicy", for tenderness and juiciness and "dislike extremely/like extremely" for like flavour and overall liking attributes. After each tasting, consumers were also asked to grade that sample as either "unsatisfactory", "good every day", "better than everyday" and "premium".

At the completion of tasting the seven samples, consumers were asked how much they would pay in local currency "based upon beef they had just consumed" for each of the four grades (i.e. 2 star which was graded "unsatisfactory", 3 star which was graded "good everyday", 4 star which was graded as "better than everyday" and 5 star which was graded "premium"). For all the consumers in the United States, Japan and Ireland taste panels the WTP estimates were scored by marking a box indicating a discrete price (Miller *et al.* 2001). In Australia approximately half the consumers used the box system, whilst the remainder marked a line to indicate their WTP on a continuous scale.

In Japan consumers were sourced from Osaka and Tokyo and in the United States they were sourced from Lubbock, Pheonix and Washington. This allowed the effect of city on WTP estimates to be tested for those consumer samples.

Each taste test utilized a single cooking method, so the responses were also used to evaluate whether there was an effect of cooking method on WTP. Grilling was common across all countries whilst the other cooking methods were generally those commonly utilized in the country, and in some cases additional cooking methods were added. For the United States samples were prepared using

grill and roast cooking methods, while in Japan grill, yakiniku and shabu-shabu were used. Ireland used grill, roast and yakiniku whilst Australia used grill, shabu-shabu and yakiniku methods. Details of the cooking methods are provided by Anon (2008b).

A small number of WTP records were excluded for the following reasons: (a) if a respondent did not provide information on all grade levels of WTP, (b) if they indicated a lower WTP for higher grade levels (e.g. a consumer indicated a higher WTP for MSA 2 star "unsatisfactory" than for MSA 3 star "good everyday" quality) suggesting that the consumers did not understand the question or were providing a random answer, and (c) consumers provided a WTP for MSA 5 star which were more than six times the MSA 3 star. Applying constraint a) for incomplete data to the Australian, Ireland, United States and Japan data sets, excluded 360, 366, 29, and 79 respondents, respectively. Applying constraints b) and c) excluded a further 41, 55, 44, and 70 respondents, respectively.

Table 1 shows the percentage population distributions for the demographic categories for the consumers from the different countries used in this study. Distributions of consumer income levels were similar with approximately 10 per cent in the sample in the lower income bracket for each country. Age distributions were skewed to the younger age brackets for Australia, Ireland and the United States, which contrasted to Japan with a much older age profile. The gender balance was similar in Australia, Ireland and the United States with a higher proportion of females among the Japanese consumers. The distributions of consumers on the number of adults and children in the households were similar between countries. The proportion of respondents that were the main grocery purchaser was highest in the Japanese sample, followed by the United States and Australia with Ireland having the lowest proportion of consumers that were the main grocery purchaser.

Table 2 shows the percentage populations for the meat eating preferences for the consumers from the different countries. Even though consumers were recruited on the basis that they ate meat at least once every two weeks there were still 5 per cent of the Irish consumers which consumed meat less frequently than this. Australian and United States consumers ate meat more frequently than Irish consumers, with the lowest frequency of eating meat in Japanese consumers. Also, even though the consumers were recruited on the basis that they liked their meat cooked to medium there was still a distribution in their preferred degree of doneness. Japanese and Australian consumers liked their beef cooked to a higher degree of doneness than Irish or United States consumers. A greater proportion of consumers from Australia and the United States enjoyed red meat and considered it an important part of their diet, compared with Irish and Japanese consumers.

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Table 1. Percentage distribution of demographic factors by consumer group

Consumer group	Category/Percentage distribution by category									
	Annual Income									
	<20	20-50	>50							
Australian ('000 $AUD pa)	9	25	66							
	<2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	7.0-7.9	8.0-8.9	9.0-9.9	10.0-11.9	>12.0
Japanese (mill ¥ pa)	10	11	13	14	12	10	7	8	9	6
	<20	20-51	50-75	76-100	>101					
United States ('000 US$ pa)	12	29	24	16	19					
	<20K	20-50K	>50K							
Irish ('000 € pa)	10	41	49							
	Consumer Age									
	<20	20-25	26-30	31-39	40-60					
Australian	27	5	14	39	14					
		20-25	26-30	31-39	40-50	>51				
Japanese		9	9	23	21	39				
		20-30	31-40	41-50	51-60	>61				
United States		35	21	27	16	2				
		20-25	26-30	31-40	41-50	>51				
Irish		22	14	19	25	20				
	Gender									
	Male	Female								
Australian	46	54								
Japanese	34	66								
United States	50	50								
Irish	53	47								
	Number of adults in the house									
	1	2	3	4	5	6	7	8		
Australian	5	50	23	13	5	1	<1	3		
Japanese	6	47	22	17	5	1	<1	<1		
United States	17	58	17	5	1	<1	0	1		
Irish	7	45	22	17	7	1	<1	<1		

	Number of children in the house									
	0	1	2	3	4	5	6			
Australian	39	16	27	12	3	<1	<1			
Japanese	58	16	19	6	1					
United States	57	17	14	7	4	1	1			
Irish	41	24	17	12	3	2				
	Occupation[1]									
	a)	b)	c)	d)	e)	f)	g)	h)	i)	
Australian	12	23	21	6	8	1	10	2	17	
Japanese	4	4	17	7	19	8	30	6	4	
United States	8	34	18	8	7	3	7	4	12	
Irish	7	32	15	16	5	1	11	2	11	
	Main Purchaser									
	Yes	No								
Australian	60	40								
Japanese	83	17								
United States	71	29								
Irish	45	55								
	Questionnaire Format									
Australian	Box	Line								
	40	60								

The definitions for the levels for "Occupation" are provided in the materials and methods section.

Table 2. Percentage distribution of meat consumption habits by consumer group

Consumer	Category/Percentage Distribution by Category						
	Frequency of eating meat (times per week)						
	7	4-5	2-3	1	0.50	0.25	Never
Australian	5	28	51	14	2		
Japanese	0	4	38	39	19		
United States	12	27	37	16	6	2	
Irish	3	15	48	24	5	4	1
	Preferred Degree of Doneness						
	Rare	Medium/Rare	Medium	Medium/Well	Well Done		
Australian			34	27	39		
Japanese			25	52	23		
United States	27	29	3	31	10		
Irish	13	9	26	24	28		
	Attitude to meat[1]						
	a)	b)	c)	d)			
Australian	55	37	7				
Japanese	20	55	26				
United States	47	38	13	3			
Irish	38	42	18	2			

The definitions for the levels for "Attitude to meat" are provided in the materials and methods section.

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3. The Statistical Model

In this study, WTP was the dependent variable which was affected by the MSA grade and the consumers' demographic factors and meat eating preferences. Given that consumers each gave WTP estimates in their local currency, the ratio approach also allowed comparison of effects across the different countries. Essentially this approach controlled for the effect of the general price level both over time and also across countries on WTP and indicated the amount relative to a base level that a consumer was willing to pay for different levels of quality.

This functional form for WTP within each country was:

$$Ratio_{ij} = \beta_j MSA_j + \alpha_{1i}(demographics)_i + \alpha_{2i}(meat\ consumption\ habits)_i + \gamma Z_i + \varepsilon_{ij}$$

where Ratio was the grade divided by the base grade, according to the formula:

$$Ratio_{ij} = \frac{MSA_{ij}}{MSA_{i3}}$$

where MSA referred to the MSA quality level, demographics factors and meat consumption preferences referred to the stated preferences for the ith consumer respondent and the jth MSA quality level such that j = 2, 3, 4, 5, and Z was the known matrix of random effects. Independent variables in the model were fixed effects for MSA quality grade and demographic factors including total household income, age, gender, number of children and number of adults in the household, occupation, main grocery purchaser along with cooking method, city and questionnaire format. The questionnaire format variable refers to whether a box or line measurement score was used in the Australian sample. Meat consumption preferences included frequency of beef consumption, preferred degree of doneness and attitude to meat. Levels for the independent variables are defined in the materials and methods section. This model was estimated using a random effect for respondent nested within cooking method and/or city as appropriate. All first order interactions between MSA quality grade and other fixed effects were tested and non-significant interactions (P>0.05) excluded from the final model.

4. Results and Discussion

Means, variance and range for WTP estimates for the different nationalities are presented in Table 3. The WTP estimates were expressed both in the currency of the country and as a ratio of the WTP for 3 star beef, with the latter allowing comparisons between countries. Consumers in all countries valued 2 star or "unsatisfactory" eating quality samples at approximately half the value assigned to the 3 star or "good everyday" eating quality samples, although there were small differences between countries. Japanese consumers showed the greatest increase in WTP estimates for quality, with 4 and 5 star samples being valued at 1.7 and 2.9 times the WTP value assigned to 3 star product. United States consumers were next with Australian and Irish consumers showing the smallest increase in WTP estimates for quality with 4 and 5 star samples being valued 1.6 and 2.0 times the value assigned to 3 star samples, respectively.

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Table 3. Means, variance and range for willingness to pay (WTP) estimates for Australian, Japanese, the United States and Irish consumers for beef which they scored as 2 star (unsatisfactory), 3 star (everyday quality), 4 star (better than everyday) and 5 star (premium) expressed in units of their local currency and as a ratio of the 3 star value

MSA grade	WTP in local currency			WTP expressed as a ratio of 3 star		
	Mean	Stdev	Range	Mean	Stdev	Range
	Australian Consumers			(n=2116 respondents)		
	$AUD/kg			Ratio of 3 star		
2 star	5.36	3.61	0-24	0.57	0.23	-1 - 0
3 star	12.11	4.40	1-34	1		
4 star	17.66	5.67	2-50	1.51	0.32	0 – 3
5 star	24.04	7.51	2-50	2.10	0.61	0 – 5
2 star	5.36	3.61	0-24	0.57	0.23	-1 - 0
	Japanese consumers			(n= 1471 respondents)		
	¥/100gm			Ratio of 3 star		
2 star	251	154	100-1800	0.48	0.16	-0.9-0
3 star	474	241	100-3500	1		
4 star	777	396	200-4500	1.69	0.38	0- 3.5
5 star	1295	742	200-6000	2.86	1.00	0 – 5
	United States consumers			(n=1338 respondents)		
	$US/lb			Ratio of 3 star		
2 star	2.30	1.73	1 – 11	0.56	0.20	-1 - 0
3 star	5.00	2.34	1 – 15	1		

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4 star	7.86	3.16	1 – 20		1.64	0.44	0 – 2.8
5 star	11.09	4.18	1 – 20		2.37	0.80	0 – 4.67
	Irish Consumers				(n= 960 respondents)		
	€/kg				Ratio of 3 star		
2 star	2.82	1.46	1-12		0.49	0.21	-1 – 0
3 star	5.63	1.99	2-14		1		
4 star	7.92	2.20	2-15		1.46	0.31	0 – 2.25
5 star	10.41	2.58	3-15		1.97	0.55	0 – 5

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Table 4. F ratios for the effect of MSA grade, demographic and meat consumption effects and relevant interactions on willingness to pay (WTP) expressed as a ratio of the 3 star grade for Australian, Japanese, the United States and Irish consumersates and Irish consumers

Variable	Australian NDF, DDF	F ratio	Pr > F	Japanese NDF, DDF	F ratio	Pr > F	United States NDF, DDF	F ratio	Pr > F	Irish NDF, DDF	F Value	Pr > F
MSA grade	3, 6315	5,959.80	<.0001	3, 4397	4,813.96	<.0001	3, 3988	1,772.57	<.0001	3, 2864	3,626.86	<.0001
Demographics												
Income	2, 6315	0.04	0.957	9, 4397	0.97	0.460	4, 3988	1.46	0.213	2, 2864	0.47	0.624
Consumer Age	4, 6315	8.35	<.0001	4, 4397	4.93	0.001	4, 3988	4.06	<.0001	4, 2864	4.74	0.001
No of adults in the house	7, 6315	0.47	0.858	7, 4397	1.44	0.184	6, 3988	2.27	0.034	7, 2864	1.07	0.379
No of children in the house	6, 6315	0.60	0.730	4, 4397	4.08	0.003	6, 3988	0.56	0.761	5, 2864	1.30	0.263
Occupation	8, 6315	1.23	0.275	8, 4397	1.15	0.329	8, 3988	1.56	0.132	8, 2864	1.12	0.346
Gender	1, 6315	0.29	0.589	1, 4397	0.79	0.375	1, 3988	0.65	0.421	1, 2864	2.27	0.132
Main grocery purchaser	1, 6315	1.22	0.269	1, 4397	0.77	0.379	1, 3988	3.06	0.081	1, 2864	0.06	0.812
Questionnaire Format	1, 6315	11.40	0.001									
Cooking method	2, 2084	1.10	0.332	2, 1427	0.18	0.834	1, 1302	0.23	0.636	2, 928	2.36	0.095
City				1, 1427	2.95	0.086	2, 1302	1.18	0.309			
Meat consumption habits												
Frequency eating beef	4, 6315	0.71	0.582	3, 4397	1.91	0.125	5, 3988	0.93	0.458	6, 2864	1.10	0.360
Preferred degree of doneness	2, 6315	1.98	0.138	2, 4397	0.10	0.906	5, 3988	0.11	0.990	4, 2864	1.54	0.187
Attitude to meat	2, 6315	2.86	0.057	2, 4397	0.05	0.950	3, 3988	0.29	0.836	3, 2864	1.06	0.365
Interactions												
MSA grade *Age	12, 6315	14.32	<.0001	12, 4397	15.34	<.0001	12, 3988	4.23	<.0001	12, 2864	5.94	<.0001
MSA grade * Preferred degree of doneness	6, 6315	2.18	0.042							12, 2864	2.55	0.002
MSA grade*Questionnaire Format	3, 6315	54.09	<.0001									

Significance of the fixed effects on WTP expressed as a ratio of 3 star values are presented in Table 4. As expected, MSA grade was the most significant variable category in all countries ($P<0.0001$). Consumer age and the interaction between consumer age and MSA grade was also significant in all countries ($P<0.001$). While there are several other significant fixed effects, these were not consistent between countries, and the F ratios were generally low suggesting that with the exception of consumer age by MSA grade interaction and to a lesser extent the preferred degree of doneness by MSA interaction, the other demographic factors and beef preference characteristics had insignificant and small effects upon the relative WTP estimates for eating quality.

It was surprising given some earlier results that most demographic and meat preference variables had little or no effect on WTP estimates. For example, in an Irish study on consumers WTP for "safe" beef, Cowan and MacCarthy (2000) found that occupation, higher income and frequency of purchasing beef affected consumers WTP. However, in agreement with our results, Umberger *et al.* (2002) found no significant income and meat consumption effects upon WTP for animal feeding method.

The Effect of MSA Quality Grade

MSA quality grade was clearly the most significant variable which affected consumers WTP (Table 4) in each of the four countries. The relationships between WTP and MSA beef quality grade are shown in Figure 1. Using a variety of methodologies other workers have also concluded that consumers were willing to pay more for higher quality (Lusk *et al.* 2001, Feuz *et al.* 2004).

Figure 1. Willingness to pay (expressed as a ratio to 3 star grade) for Australian, Japanese, the United States and Irish consumers, adjusted for demographic and meat consumption preferences
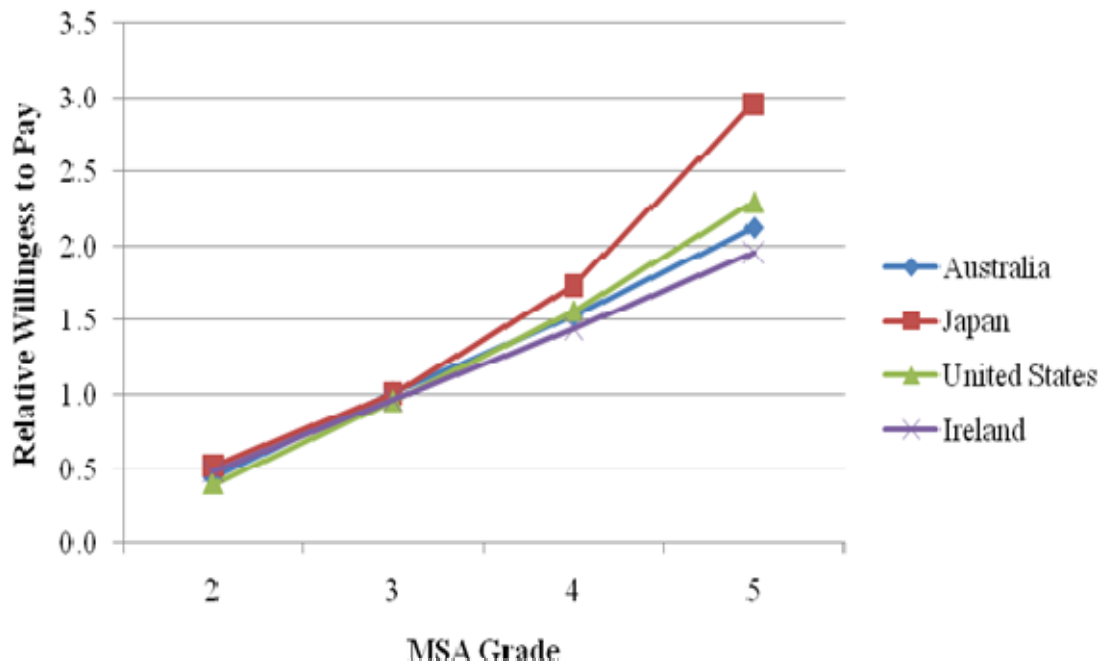
Figure 1 clearly shows an increasing curvilinear relationship relationship between WTP and MSA quality grade was preferred for the Japanese consumers, whilst a linear function best described the relationships for the Australian, United States and Irish consumers. This inferred that Japanese consumers were prepared to pay an increasing premium for higher quality categories, whereas the consumers in the other countries were willing to pay similar increments for the increases in quality grade. Whilst there were only small differences between most countries in consumers WTP at the

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lower quality levels there were substantial differences at the higher quality grades with Japanese prepared to pay the highest premium, followed by the United States, Australian and Irish consumers.

The strong relationships between WTP and MSA grades provided clear evidence that consumers were willing to pay more for improved beef quality. The MSA scheme in Australia, which has been operating nationally since 2000, operates in the main by simply discriminating between graded (3 star or better) or ungraded beef (Polkinghorne *et al.* 2008b, Griffith *et al.* 2009). Based on levels of current usage, Griffith *et al.* (2009) calculated substantial economic benefits accumulating at retail from this scheme, but made the point that the benefits would be much larger if retailers utilized the full potential of the MSA grading scheme and charged a premium for the 4 and 5 star graded beef products. The results from our study clearly showed that consumers were willing to pay more for the higher grades of beef and provided initial estimates as to the differentials that consumers were willing to pay for the different grades.

The Effect of Age

The interactions between age and MSA grade are shown in Table 5 for Australian, Japanese, United States and Irish consumers. For these interactions a similar pattern was evident whereby as the age category increased from less than 20 years up to 35 years the WTP estimates at the higher MSA quality grades were higher than for older age categories. This was a significant and substantial effect that was consistent across countries, indicating key age groups differed in their WTP for the higher quality grades. This could be utilized in targeted advertising or other methods to attract customers. While earlier literature reported a negative effect on WTP as age increased (Lusk *et al.* 2001, Fuez *et al.* 2004), the presence of the interaction between age and quality grade, whereby there was a pattern of increasing WTP up to a certain age and then declining for older ages, has not been reported previously in the literature.

Table 5. Predicted means for willingness to pay (WTP) expressed as a ratio of 3 star for the MSA grade by age interaction for Australian, Japanese, the United States and Irish consumers

MSA Grade		Age Categories				
Australian	<20 yrs	20-25 yrs	26-30 yrs	31-39 yrs	40-60 yrs	
2 star	0.46	0.40	0.44	0.46	0.46	
3 star	1.01	1.02	1.02	1.02	1.02	
4 star	1.57	1.59	1.54	1.49	1.47	
5 star	2.24	2.25	2.15	2.02	1.95	
Japanese		20-25 yrs	26-30 yrs	31-39 yrs	40-50 yrs	>51 yrs
2 star		0.53	0.51	0.47	0.51	0.60
3 star		1.03	1.01	0.98	0.98	1.04
4 star		1.80	1.80	1.74	1.71	1.64
5 star		3.09	3.08	3.04	2.90	2.66
United States		20-30 yrs	31-40 yrs	41-50 yrs	51-60 yrs	>61 yrs
2 star		0.39	0.39	0.41	0.40	0.41
3 star		0.96	0.97	0.94	0.95	0.97
4 star		1.59	1.64	1.62	1.50	1.46
5 star		2.38	2.39	2.34	2.12	2.26
Irish		20-25 yrs	26-30 yrs	31-40 yrs	41-50 yrs	>51 yrs
2 star		0.50	0.48	0.46	0.45	0.51
3 star		0.97	0.97	0.97	0.95	0.96
4 star		1.43	1.52	1.45	1.41	1.37
5 star		1.98	2.08	2.00	1.92	1.79

The maximum standard errors for the Australian, Japanese, the United States and Irish consumers were 0.04, 0.07, 0.11 and 0.05, respectively.

MSA Quality Grade by Doneness Interaction

Degree of doneness is a trait which affects consumer appreciation of beef (Cox *et al.* 1997). In the present study there were significant interactions between preferred degree of doneness and MSA grade for the Australian and Irish consumers (Table 6). In Ireland there was a trend for the medium and medium/well done categories to have lower WTP estimates at the higher MSA quality grades, although this trend was not apparent in the well done category. In Australia, WTP estimates for the medium and medium/well done categories were similar, although the well done category showed a trend for WTP estimates to be lower for the higher MSA quality grades. Lusk *et al.* (2001) also reported an effect of doneness on WTP estimates for beef where consumers who preferred steaks cooked to a higher degree of doneness were less likely to prefer or value tender steaks.

Table 6. Predicted means for willingness to pay (WTP) expressed as a ratio of the 3 star grade for the MSA grade by preferred degree of doneness interaction for Australian and Irish consumers

MSA			Degree of Doneness		
Grade	Rare	Medium/Rare	Medium	Medium/Well Done	Well Done
Australian					
2 star			0.44	0.44	0.44
3 star			1.02	1.02	1.01
4 star			1.52	1.55	1.52
5 star			2.14	2.15	2.08
Irish					
2 star	0.44	0.51	0.49	0.48	0.46
3 star	0.97	0.95	0.96	0.97	0.97
4 star	1.48	1.44	1.41	1.42	1.44
5 star	2.01	2.00	1.88	1.90	1.98

The maximum standard error for the Australian and Ireland were 0.03 and 0.05, respectively.

The importance of these interactions needs to be placed into context with the sample of consumers which was biased due to the initial screening for consumers who preferred their meat served medium. It is therefore not surprising that there was a limited range of only three doneness preference for the Australian consumers. For the Irish consumers the rare and medium/rare categories comprised less than 25 per cent of the total sample. It is not apparent how preferred doneness could easily be used in marketing.

The MSA quality grade by Format interaction

In Australia, the questionnaire format variable significantly interacted with the MSA variable, suggesting that consumers WTP for eating quality was significantly determined by how consumers recorded their WTP estimates. From Table 7, it is evident that if consumers scored their WTP estimate using a box it gave a reduced range in WTP, both at the lower and higher MSA quality grades. The significance of the questionnaire format by MSA grade interaction suggests that by which WTP was scored influenced how consumers interpreted the value of quality. This indicates the importance of selecting the most effective and accurate way for consumers to record WTP.

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Table 7. Predicted means for willingness to pay (WTP) expressed as a ratio of the 3 star grade for the MSA grade by Questionnaire format interaction for Australian consumers

MSA Grade	Box	Line	
2 star	0.49	0.39	
3 star	1.02	1.01	
4 star	1.49	1.58	
5 star	2.05	2.20	
The maximum standard error was 0.03.			

5. Conclusion

This study examined the effects of different MSA eating quality grades and demographic factors on consumer WTP relative to the base grade of "good everyday" quality across four countries. The functional form of the dependent variable allowed comparison between countries on a currency neutral basis.

Not surprisingly since consumers were asked to put a value on the different grades the most significant variable that influenced relative WTP was MSA quality grade. This provided clear evidence that consumers from all countries were willing to pay more for beef of higher quality. The amount consumers were willing to pay for higher quality varied substantially between countries.

There are several potential ways that the WTP results from this study could be used. On an initial level, this information could be used to price product of varying quality into the markets studied. Japanese consumers were willing to pay more for the top quality followed by the United States, Australian and Irish consumers. This would suggest to marketers that other factors being equal Japan would be a preferred destination for high quality beef to earn the greatest return, depending on the size of these markets.

The value of the WTP results can also be viewed as one measure of the value or potential value of meat that achieves a certain level of consumer satisfaction. As such, it can be used to value beef cuts within a beef carcass and indeed the value of the entire beef carcass could be assessed in this way. Polkinghorne (2006) and Polkinghorne *et al.* (2008b) described a system to value the carcass using set values for 3, 4 and 5 star product in the carcass and provide payment to the wholesaling and production sectors based on set proportions of retail value. This has the potential for each sector in the supply chain to improve the quality of beef as they receive a proportion of the increased price at retail. This information would be useful to quantify the effect of different quality controls on value, such as, varying genetics or using post-harvest handling techniques.

Another use of the results from this study is to better understand the effect of consumer demographics and meat consumption preferences upon relative WTP. Overall demographic factors and meat consumption preferences had little effect on WTP estimates. The exception was age of the consumer group which also interacted with MSA quality grade. Consumers tended to be willing to pay relatively less for quality as they got older. The age categories from less than 25 to 35 years appeared to be willing to pay the highest premium for eating quality. Given the consistency of results across countries this is an interesting and relevant result for marketers.

In this study, the information consumers had about the quality of the product focused exclusively upon palatability. It is known that consumers' WTP for beef is influenced by other factors including cut appearance, location of production, smell, labelling, organic certification and other effects. Exclusively focusing on the effect of eating quality across the reasonable range of potentially available taste specifications permits an understanding of the potential value from varying eating quality. One important caveat about the data in that it is based upon survey data of expressed WTP rather than actual consumer or purchase behaviour. For a newly developed product, such as a new quality grade, of course this is the best that is available to serve as a guide of price and value to consumers. The separate and quite important issue of how to label or communicate this value to consumers is left to further research.

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6. Acknowledgments

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