



Using farm assurance schemes to signal food safety to multiple food retailers in the U.K.☆

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Abstract

It is argued that privately run farm assurance schemes in the U.K. have been developed predominantly to signal the presence of desired levels of food safety (and other credence) attributes to domestic multiple food retailers. It is hypothesised that these food retailers will only buy ‘farm assured’ meat from abattoirs, therefore abattoirs must buy and process ‘farm assured’ livestock. Other factors, including abattoir size, procurement policy, level of processing and hygiene levels, are also hypothesised to affect the probability of an abattoir selling meat to large multiple retailers. The hypotheses are tested through a survey of abattoirs in the United Kingdom and a logistic regression is used to assess significance. It is found that buying farm assured livestock is a highly significant positive factor in selling meat to large multiple retailers; in addition, the procurement policy of abattoirs (affecting traceability of product) and abattoir size are also found to be significant determinants of the probability of this trade. The empirical evidence supports the hypothesis that industry-led farm assurance schemes are indeed used by large multiple food retailers as a credible signal of food safety (and other credence) attributes. © 2001 Elsevier Science Inc. All rights reserved.

1. Introduction

Food safety has come under close scrutiny in the United Kingdom through the 1980s and 1990s. Nowhere has this scrutiny been more rigorous than in the United Kingdom fresh meat supply chain. The recent bovine spongiform encephalopathy (BSE) crisis (and suggested link with new variant Creutzfeldt–Jakob disease or CJD), the *Escherichia coli* outbreak in Scotland and, more recently, Foot and Mouth Disease have led to concerns regarding the

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safety of meat and the need for the supply chain to find ways of assuring food safety to meet legislative requirements.

This paper considers quality assurance initiatives that have been introduced in response to food safety concerns regarding meat. A ‘perceived quality’ approach is taken, where ‘food safety’ is one of many ‘quality’ attributes. Credible communication of food safety attributes is considered vital for retailers to satisfy current legislative requirements, and it is argued that only private quality assurance initiatives are able to signal these attributes. Hence, it is hypothesised that large multiple retailers will insist on buying farm assured meat, which in turn will mean that abattoirs must purchase farm assured livestock if they are to supply these supermarkets. In addition, other factors hypothesised to determine trade between abattoirs and large multiple retailers are posited. The hypotheses are tested through a mail survey to abattoirs in the U.K.

1.1. The nature of food safety attributes

‘Food safety’ attributes form one sub-set of product attributes and include inter alia, pathogens and residues (Caswell, Bredahl and Hooker, 1998; Northen, 2000). It is clear that many of these food safety attributes are ‘health related’, that is, there is a health risk associated with them (Antle, 1995; Segerson, 1999). It should also be recognised that many food safety attributes will not be detected in the supply chain or during consumption. Such attributes are termed ‘credence’ attributes and must be differentiated from those attributes that may be experienced during consumption (for example, sensory attributes) which are termed ‘experience’ attributes (Darby & Karni, 1973; Steenkamp, 1989; Andersen, 1994). As credence attributes cannot, by definition, be detected, it is clear that some credible way of informing buyers in the supply chain of the safety of the food products is necessary. Northen (2000) argues that credence attributes must be signalled to buyers through quality assurance schemes in the relevant part of the food supply chain, where the credibility of the scheme label is generated from adequate scheme standards and independent inspections carried out by experts.

2. Managing food safety in the U.K.

2.1. Regulatory structure for food in U.K.

Historically, public regulation of food safety in the U.K. has relied on general target standards which imposed criminal liability on anyone rendering food intended for human consumption injurious to health (Henson & Northen, 1997). As foods became subject to greater processing, however, the need developed for more detailed specification and performance standards, where such standards run parallel with target standards. Partly as a result of the increasing complexity of vertical and horizontal regulations, a major change in U.K. government policy toward food safety was enacted with the introduction of the Food Safety Act, 1990.

Prior to the Food Safety Act, food safety standards invoked a ‘warrantee’ defence whereby suppliers were required to show that food did not enter into a state that contravened

the standard while it was under their control. Food purchased by others was deemed to be ‘warranted’, meaning that the seller assumed legal liability for ensuring that the food conformed to the standard at the time of sale. As Hobbs and Kerr (1992) note, the Act provided for a major change in this legal responsibility, with the creation of the ‘due diligence’ defence. This defence requires the food industry to demonstrate that they have been proactive in ensuring that the food they handle and the food obtained from upstream suppliers is safe for human consumption. The implication for the U.K. food industry is that own-branded foods, either at the processor stage (manufacturers’ brands) or the retail stage (retailers’ brands) are subject to ‘due diligence’ requirements.

Maintenance of the due diligence defence for fresh meat is particularly important to large multiple retailers (supermarkets) as they account for 72.2% of retail meat sales (Meat and Livestock Commission, 1999a), virtually all of which is own label (Fearné & Hughes, 1999). In addition, the fresh meat sector is one in which problems of foodborne illness, animal disease and low consumer confidence require retailers to be especially careful in providing safe, high quality products (Henson and Northen, 1997). Whilst other customers of abattoirs (such as wholesalers, caterers and processors) are also liable under the Food Safety Act, it is posited that they will be less likely to demand farm assured meat. Three reasons are given: firstly, they are less ‘exposed’ as their investment in brand capital is often much less than retail chains; the supply chain is often much longer (making traceability more difficult); and they are likely to have less interest in other attributes affected by industry-led farm assurance schemes (e.g., animal welfare).

The major consequence of the change in legislation from a ‘warrantee’ to a ‘due diligence’ defence is that retailers are forced to impose standards on, and monitor, their suppliers in order to try and assure this defence. Clearly, the opportunity cost for supermarket food technologists in auditing suppliers is high.¹ This has created an incentive for the development of private standards within the supply chain to ensure that the due diligence defence is met. Third party private auditing bodies and quality assurance schemes have been created to fulfil this role on behalf of the retailers (see Henson & Northen, 1998).

It should be noted that whilst the 1990 Act has provided an opportunity for private quality assurance initiatives to flourish, several other factors have enabled the development and growth of private standards, the most important being the structure of the U.K. food-retailing sector. In addition to having a high market share of meat sales, the multiple food retail sector is dominated by a relatively small number of supermarket chains, with 10 multiple retailers accounting for over 60% of total retail grocery sales and the four largest food retailers now accounting for over 40% of retail grocery sales (Meat and Livestock Commission, 1999a). The major consequence of this is that there are relatively few alternative markets for suppliers of food. Hence, multiple retailers have market power and are able to impose their requirements for due diligence and other product specifications very effectively on the supply chain.

2.2. Types of quality assurance initiative

Quality assurance initiatives for fresh meat in the United Kingdom may be divided into public and private initiatives, either mandatory or voluntary in nature. Table 1 demonstrates the four categories of initiative and gives an example of each type.

Table 1
Types of quality initiative in United Kingdom fresh meat sector

Type	Mandatory	Voluntary
Public	Fresh Meat (Hygiene and Inspection) Regulations 1995	Beef Assurance Scheme
Private	Retailers’ standards	Industry-led farm assurance schemes

Most public initiatives are mandatory, such as the Fresh Meat (Hygiene and Inspection) Regulations, 1995, although at least one voluntary public scheme (Beef Assurance Scheme) exists. Private schemes are split between those which are genuinely voluntary and those that are de facto mandatory. It should be noted, however, that the categorisation of private schemes into the two types changes: a conclusion which may be drawn from recent sector analysis is that the majority of private initiatives starting out as voluntary are becoming, or have become, de facto mandatory (Henson and Northen, 1997).

2.3. Growth of private quality assurance schemes

Antle (1995) and Segerson (1999) argue that when faced with communicating credence attributes to buyers, the market fails and credible quality signals must be developed by public or private initiatives. The question must be asked, therefore, why private, rather than public, assurance initiatives are prevalent in the U.K. fresh meat supply chain?

It was argued earlier that the change in legal liability (from ‘warrantee’ to ‘due diligence’ defence) has been a major factor encouraging the growth of private quality initiatives in the United Kingdom. This would seem to fit with a major conclusion of Segerson (1999) that government intervention (as noted above) “does not necessarily imply that mandatory regulations must be imposed [rather] firms may still choose to invest voluntarily if induced to do so by a ‘carrot’ or a ‘stick’ ” (p. 68). In the case of the U.K., the ‘stick’ is the threat of costly fines and damaged reputations if food safety attributes are not provided (through the Food Safety Act, 1990 and ‘due diligence’ requirement). Coupled with this, the nature of the U.K. supply chain (high concentration of large multiple food retailers, coupled with relatively high levels of own-label food sales) makes investment in brand capital an important strategy and implies that the costs of product failure can be extremely high (Henson and Northen, 1998). So that buyers in the chain can be assured of purchasing food products with the necessary safety attributes (and so help maintain/defend brand capital), private assurance initiatives have been set up to signal credibly such credence attributes.

It must be stressed again that food safety attributes are only one type of many ‘quality’ attributes. As there is a health risk associated with the under provision of food safety attributes it is not surprising that government will intervene when such attributes are credence in nature to consumers (as argued by Antle, 1995; Segerson, 1999). However, attributes such as ‘high animal welfare’ and ‘origin’ are not generally associated with health risks; therefore, even though they are credence in nature there is not the same need for government intervention.² Clearly, if these attributes are demanded by final consumers (and, therefore, buyers in the chain) then private initiatives are needed to signal their presence and allow the buyers to reduce their transaction costs of quality discovery.

A further explanation for the growth in private quality initiatives in the 1980s and 1990s is the failure of public controls to provide credible signals. Clearly, consumer and supply chain concerns regarding food safety attributes in the fresh meat supply chain have not been helped by the U.K. Government's handling of the BSE crisis³ or the outbreaks of *E. coli* and *Salmonella* foodborne illness. As stressed earlier, standards and inspections to those standards are crucial in generating credible quality signals to buyers.

Unsatisfactory levels of food safety inspection, added to the lack of credibility of the U.K. government regarding management of food safety has led to the demand for private schemes. Food retailers (and others in the supply chain) demand that these schemes conduct more frequent and rigorous inspections than public enforcement bodies are able to attain, and that scheme standards have sufficient coverage and depth. It is argued here that private schemes for managing credence attributes (including food safety attributes) allow for more credible quality signals, and hence allow food retailers to be more sure of their due diligence defence.

2.4. *Farm assurance schemes*

Private safety assurance schemes exist at many levels of the meat supply chain, including the farm and processor sectors. This paper does not, however, consider processor level schemes. Rather, the paper considers schemes operating at the farm level (farm assurance schemes) and indicates how these schemes can be used by multiple food retail chains as signals of various credence attributes, thus helping to assure their due diligence defence.

Two types of farm assurance scheme operate in the U.K. fresh meat sector. The first type of scheme is the industry-led 'generic' farm assurance scheme, operating within a particular region, for a particular species, to which any producer meeting the necessary standards and inspections can join. The second type of scheme is operated by multiple food retailers, and uses membership of industry-led farm assurance schemes as only one of many entry requirements. Membership of this scheme is open only to producers who supply the particular retailer. These latter schemes also tend to have standards in place that affect sensory attributes (such as type of feed, breed, weight at slaughter, etc.). This paper considers the former type of (industry-led) scheme.

Industry-led farm assurance schemes in the U.K. meat industry have been in place since the early 1990s. All farm assurance schemes have as their basis written standards, commonly developed by interested parties in the industry. The coverage of these standards will depend on the aims of the scheme and the expertise of those writing them. Potential members of the scheme are required to attain and maintain these standards. Fearne (1998a) notes that all industry-led farm assurance schemes in the U.K. livestock sector cover the same critical standards:

- Traceability
- Feeding
- Animal health
- Animal welfare
- Transport and handling.

By definition, the standards in farm assurance schemes must be process standards; no standards exist in any of the schemes that directly affect meat quality. Northen (2000) demonstrates that these schemes affect mainly food safety, welfare and traceability attributes (attributes which are credence in nature) and not experience attributes or intrinsic cues.

Farm assurance schemes exist for particular species (for example, cattle, sheep or pigs) and are national in scope (for example, England and/or Wales and/or Scotland). They are run by the meat industry,⁴ with standards being set by expert technical committees to meet the requirements of scheme customers (processors/retailers). All schemes are now independently audited and many are attempting to improve perceptions of their independence through certification by relevant overseeing bodies.

The majority of these schemes were implemented in response to consumer, retailer and industry concerns regarding animal husbandry and food safety, leading Baines and Davies (1999) to coin the term ‘confidence-building’ assurance schemes. These concerns were due, in part, to the change to a ‘due diligence’ defence. Fearn (1998a), Fearn and Hughes (1999) and Spriggs, Hobbs and Fearn (1999) argue that the uncertainty raised in retailers’ minds as to what constitutes a ‘due diligence’ defence encouraged them to take steps to ensure the safety of products supplied to them. This, in turn, has meant that up-stream firms have needed to monitor their food product handling. In effect, it is argued that ‘risk management’ has replaced ‘added value’ as the driver for greater co-ordination in the meat supply chain. Capstick (1993) concurs in recognising that the rate of development of quality assurance schemes was accelerated by the arrival of the Food Safety Act, 1990. This author agrees in arguing that quality assurance schemes have been used as quality signals and co-ordinating mechanisms to help secure a due diligence defence for retailers.

Whilst Fearn and Kuznesof (1994) recognise that the aims of such schemes “include the reinforcement of customer confidence in the quality and welfare issues which affect consumer purchasing decisions” (p. 504) and the schemes define their role as providing a service to the industry and provide consumer confidence,⁵ it is evident that the schemes themselves are often not communicated to the final consumer. That is, whilst a significant proportion of fresh meat, particularly in multiple food retailers, carries a ‘farm assured’ label, there is often no reference to the actual scheme. One reason for this, supported by Walley, Parsons and Bland (1999), is that there is consumer confusion as to what different scheme labels represent, and the desire of retail chains not to dilute their own brand capital.

In summary, it would seem that industry-led farm assurance schemes have as a major function the provision of credible quality signals which allows the strengthening of the due diligence defence for firms in the meat supply chain, rather than acting as an explicit signal to end consumers. The combination of the change from a warrantee defence to a due diligence defence and the power of U.K. multiple food retailers has created a scenario where these retailers can impose their requirements throughout the food supply chain. The failure of market mechanisms and government policy to signal credence quality attributes (including food safety) has created the need for private quality management (through the use of farm assurance schemes) to communicate these quality attributes (and allow buyers in the supply chain to reduce their costs of discovering quality).

3. Application

Given the change in food law and the associated need for retailers to impose standards on the supply chain it is argued that large multiple retailers have encouraged the development of private farm level and processor level assurance schemes. In turn, it is posited that these schemes have helped the retailers assure their due diligence defence through the purchase of farm assured meat.

It is hypothesised, therefore, that abattoirs buying farm assured livestock (selling farm assured meat) will be more likely to sell meat to large multiple retailers.

Hypothesis 1. Buying farm assured livestock will positively affect the probability of an abattoir selling meat to multiple food retail customers.

Whilst the major aim of the application is to test the proposition that buying farm assured stock is a significant determinant of trade with multiple food retailers, it is also recognised that other factors are likely to determine this trade. The application also tests what are likely to be other important determinants: in all, four other factors were considered as contributing to an abattoir selling meat to multiple food retailers. The hypotheses for each are outlined as follows.

First, given past problems with hygiene practices of abattoirs in the U.K. (Meat and Livestock Commission, 1999b; Mintel, 1999), and the need for retailers to demonstrate that their suppliers' premises meet acceptable hygiene standards (as part of their due diligence defence) (Hobbs and Kerr, 1992; Henson and Northen, 1998) a way of determining the hygienic conditions in abattoirs is necessary. The Hygiene Assessment System (HAS) score,⁶ developed by the Meat Hygiene Service (MHS) in the U.K. is used as such a measure. Given the need for retailers to ensure their due diligence defence, it is hypothesised that:

Hypothesis 2. The lower the abattoir's HAS score, the less probable it is that the abattoir will supply multiple food retailers with meat.

Second, larger abattoirs are hypothesised to be more likely to sell meat to multiple food retailers. There are three major reasons for this: (i) larger abattoirs are more likely to have the necessary processing facilities which enable the retailer to deal with one company only; (ii) a larger abattoir is more able to deal with the large retailer's varying needs regarding quantity and variety of meat cuts; and (iii) many of the largest food retailers have reduced the number of meat suppliers they deal with to enable them to develop longer-term relationships with larger meat suppliers (Fearne, 1998a):

Hypothesis 3. The larger the throughput of the abattoir, the more likely it is to sell meat to multiple food retailers.

Third, in order to maintain the highest levels of traceability, and hence help with their due diligence defence, retailers will opt for the most direct procurement of livestock (i.e., direct from the farm); in addition, several authors have highlighted problems with traceability through live-ring auction markets (Ritchie & Leat, 1995; Hobbs, 1995; Meat and Livestock Commission, 1998). With the growth of retailer/abattoir operated producer groups, the largest retailers are also able to influence the husbandry practices of group farmers in order

to provide livestock to the slaughterer which will give superior eating quality and functional characteristics, and to ensure that the livestock have been produced to high standards of safety.⁷ In addition, buying directly enables abattoirs (and ultimately retailers) to have a greater control on the price paid to producers. It is hypothesised, therefore, that:

Hypothesis 4. The greater the percentage of livestock procured by abattoirs through live-ring auction markets, the less probable it is that they sell meat to large multiple food retailers.

Finally, it is hypothesised that abattoirs which process the meat into retail packs are more likely to supply multiple retailer customers than those that do not. Whilst a growing number of these large retail chains have their own in-house butchers, the majority of meat on retail shelves in the U.K. comes pre-packed from integrated abattoir/processors.

Hypothesis 5. Abattoirs which process meat into retail packs are more likely to supply multiple retailer customers than those which do not.

By testing the hypotheses developed above, the significant factors determining whether an abattoir sells meat to a supermarket can be found. A binary dependent variable was chosen, with a ‘zero’ if an abattoir sells no meat to supermarkets and a ‘one’ if it sells some or all meat to supermarkets. This decision was taken on the basis that supermarkets must assure themselves that their suppliers meet certain crucial safety and other criteria before any trading commences—that is, if suppliers do not meet the necessary criteria, they will not supply any meat to these retailers. The set of variables thought to affect the probability of an abattoir selling meat to large multiple retailers is included in the logit model shown in Table 2.

Table 2
Initial set of variables in model

Variable	Type of variable	Description
Dependent		
Supply multiple food retailers	Dummy	1 = Abattoir sells >0% meat to multiple food retailers 0 = Abattoir sells 0% meat to multiple food retailers
Independent		
Hygiene	Limited	Percentage hygiene assessment system score
Live-ring mart	Limited	Percentage of livestock bought by abattoir from live-ring markets
Retail packs	Dummy	1 = Abattoir sells retail packs of meat 0 = Abattoir does not sell retail packs of meat
Abattoir size	Continuous	Abattoir throughput (no. of cattle units ^a)
Farm assured livestock	Dummy	1 = Abattoir buys >0% farm assured livestock 0 = Abattoir buys 0% farm assured livestock

^a The definition of one cattle unit follows the EC definition of one cattle beast, three pigs or seven sheep (Meat and Livestock Commission, 1994).

3.1. Survey

Having developed the hypotheses it is necessary to consider the survey process. As the hypotheses relate to abattoirs, it was necessary to survey the population of abattoirs in the U.K. A mail survey was sent to all 439 operational abattoirs in the U.K. in the summer of 1998, using a three wave mailing process (Dillman, 1978). One hundred and sixty usable responses were received, giving a response rate of 36.4%. This response rate is comparable with other recent mail surveys of abattoirs in the U.K. (Hobbs, 1995). Non-response bias was tested and found to be absent, and the distribution of the respondents (in terms of HAS scores and throughput) was found to be similar to the population of abattoirs, indicating a representative sample was received.

4. Results

The results of the logistic regression are presented in Table 3. Before accepting and analysing the results of the model, however, it is necessary to consider whether the model fits the data sufficiently well to be considered credible. Both the statistical significance of the model and the overall model fit are assessed in the following sections.

4.1. Statistical significance of model

Table 4 presents the test results for the estimated model. The χ^2 -test result demonstrates that there is a highly significant difference in $-2LL$ between the null model and the model presented. In addition, the Hosmer and Lemeshow result shows no statistically significant

Table 3
Results of logit model

Variable	Coefficient	SE	Wald	Significance
Constant	-8.025	4.282	3.513	0.061*
Hygiene	0.453	0.052	0.755	0.385
Abattoir size	7.84E-05	1.515E-05	26.807	0.000***
Farm assured livestock	2.540	1.294	3.851	0.049**
Live-ring mart	-0.023	0.012	3.735	0.053*
Retail packs	-0.073	0.754	0.009	0.923

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

Table 4
Test results for statistical significance of model

Test	χ^2 -value	df	Significance
χ^2 for change in $-2LL$	134.661	5	0.000
Hosmer and Lemeshow	3.882	8	0.868

Table 5
Overall model fit for model

Fit measures	Value
$-2LL_{\text{model}}$	61.53
Goodness-of-fit	122.99
R^2_{logit}	0.69
Cox & Snell R^2	0.60
Nagelkerke R^2	0.82

difference between observed and predicted classifications. These results provide support for the acceptance of the model as a significant logistic regression model.

4.2. Overall model fit

Table 5 presents overall fit measures. Whilst it is difficult to judge objectively the model fit from the $-2LL_{\text{model}}$ or the ‘goodness-of-fit’ figure, the three R^2 values all indicate good model fit.

As a final test of goodness-of-fit, the classification matrix between observed and predicted values for the model is presented in Table 6. From the table, the probability of correctly predicting a ‘0’ is 0.954 and a ‘1’ is 0.879. The overall predictive power of the model is 0.925 (92.5% accurate). This indicates the strong predictive power of the model and lends additional support for the model.

From the above, it may be concluded that the logistic model in Table 3 is statistically significant and is a good fit to the data; the results of the model can, therefore, be interpreted with confidence.

4.3. Interpretation of model results

Three factors have been found which explain if an abattoir sells any meat to multiple retail chains. The first significant determinant ($p < 0.05$) of the probability of an abattoir selling meat to multiple retailers is whether the abattoir buys farm assured livestock. The positive sign of the coefficient indicates that if the abattoir buys farm assured livestock there is a greater predicted probability that the abattoir supplies multiple food retailers; thus, hypothesis (Hypothesis 1) is supported. This association supports the argument that farm assurance schemes are used by food retailers as signals of food safety attributes.

Table 6
Classification table for model: predicted group membership

Observed (no.)	Predicted (no.)		Probability of correct prediction
	Supply 0% to supermarkets	Supply >0% to supermarkets	
Supply 0% to supermarkets	84	4	0.954
Supply >0% to supermarkets	7	51	0.879

A second significant coefficient is 'Live-ring Mart' ($p < 0.1$). In contrast to the other significant variables, the sign of 'Mart' is negative indicating that the higher the percentage of livestock bought by abattoirs through live-ring auctions, the lower the predicted probability that the abattoir supplies supermarkets. This result supports the hypothesis (Hypothesis 4).

A final significant factor is the size of throughput in the abattoir (Abattoir Size) which is a highly significant determinant ($p < 0.01$) of the probability of an abattoir selling meat to large retailers. The sign of the coefficient indicates that the larger the abattoir the greater the predicted probability that the abattoir supplies large retailers, which supports the hypothesis (Hypothesis 3).

Two factors were found to be insignificant. Hygiene assessment system scores (Hygiene) are not a significant determinant of the probability of abattoirs selling meat to large multiple retailers, hence Hypothesis 2 must be rejected. Likewise, 'Retail Packs' is found to be an insignificant determinant of selling meat to multiple food retailers, hence Hypothesis 5 must be rejected.

5. Conclusions

The results of the logistic regression have shown that buying farm assured livestock (and hence selling farm assured meat) is positively related to trading with supermarkets in the U.K. Given retailers' desires for high levels of traceability and food safety in order to strengthen their due diligence defence, using 'farm assured' livestock and meat is a way for them to demonstrate the presence of these credence attributes. This result supports the argument that such schemes are used by retailers as signals of food safety attributes.

It should be recognised that industry-led farm assurance schemes do not just lay down specifications affecting food safety; but also specifications regarding levels of other credence attributes, such as animal welfare (an attribute retailers are keen to demonstrate). Of the three credence attributes mainly affected by industry-led farm assurance schemes (traceability, food safety and animal welfare), it is arguable that only animal welfare gives retailers any competitive advantage. In order to derive such valuable advantage from farm assurance, many retailers now run their own 'proprietary' farm assurance schemes. These schemes differ from industry-led schemes in that many standards are aimed at improving experience attributes rather than just credence attributes. For example, types of feed are specified, specific breeds/sex are required and specific weight ranges sought. Such specifications are calculated to affect taste and tenderness, in addition to visual cues such as colour, marbling and leanness. Hence, it can be argued that whilst the 'output' of industry-led farm assurance schemes is not targeted toward final consumers, the 'output' of retailers' own farm assurance schemes is targeted at their consumers. It is therefore important to recognise the difference between the two types.

Whilst it is clear that selling farm assured fresh meat is a crucial determinant of trade with supermarkets, it is also clear that other factors will affect trade with such customers. The study also explored some of these. The percentage of livestock bought at live-ring auction marts was found to be negatively related to the probability of supplying supermarkets. Given

the questions surrounding traceability of livestock sourced through live-ring auctions, the issue of buying ‘lemons’ and the desire of large retailers to have greater control on the supply chain and price paid, this result is expected. In addition, abattoir size (as measured by throughput of livestock) is a significant factor in supplying this type of customer. Given the close asset-specific relationships between relatively few integrated abattoir-processors and large retail customers and the retailers’ demands for large and consistent levels of supply, this is also to be expected.

The fact that HAS scores were not found to be significant should not suggest that hygiene is considered unimportant by supermarkets; rather, it suggests that abattoirs not selling to these retailers do not necessarily have lower hygiene assessment scores than those which do sell meat. Likewise, the ‘packaging’ result indicates that abattoirs not selling meat to multiple food retailers are as likely to process meat into retail packs as those selling meat to this type of customer.

In summary, this paper has considered the use of industry-led farm assurance schemes as a way of signalling food safety (and other credence) attributes to supermarkets in the U.K. It was suggested that if such schemes were used as signals of credence quality attributes, then selling farm assured meat (and buying farm assured livestock) would positively affect the probability of an abattoir selling meat to multiple food retail customers. This was found to be the case. Secondly, it was recognised that there would be other determinants of trade between an abattoir and multiple food retailer. Some of these factors were explored and it was found that types of livestock procurement channel and size of abattoir would also affect probability of trade with these large food retail customers.

A final issue that has not been considered in this paper, but deserves greater attention, is the relationship between the credibility of quality signals and reductions in buyers’ quality discovery (transaction) costs. It could be argued that the greater the perceived credibility of the quality signal (which will be based on perceptions of scheme standards and inspections to those standards) the greater will be the reduction in the buyers’ quality discovery costs.

Notes

1. Activities such as *co-operative* New Product Development (NPD) are value-adding alternatives to conducting ‘floors/walls/ceilings’ inspections to maintain a due diligence defense.
2. It is accepted that non-health risk attributes such as animal welfare may still warrant public intervention, but from an ethical, rather than safety, standpoint.
3. Fearne (1998b) considers that the BSE crisis “exposed a Government who chose to gamble with public health and failed”.
4. Including farmers’ unions, processor trade associations/federations and meat industry bodies.
5. The “Farm Assured British Beef and Lamb” farm assurance scheme mission statement aims “to provide a nationwide farm assurance scheme giving retailers and consumers confidence in British livestock husbandry and welfare standards” (FABBL, 1997).

6. The HAS is a risk based method of assessing hygiene standards arising from slaughtered stock, people working in the plant, the premises themselves and any other relevant sources. Premises are assessed against performance criteria covering all significant aspects of production, each weighted against relevant risk. Scores are awarded by Meat Hygiene Service inspectors on a scale from 0 to 100, where higher score indicate better hygiene practices.
7. There have been additional suggestions in the U.K, farming press that, by not accepting livestock from live-ring auctions, the supermarkets hope to be able to influence livestock prices to a greater degree.

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