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Evaluating a Pig Carcase Classification Service Using Willingness to Pay Techniques

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Samples of pig producers and buyers operating at Blayney Abattoir were surveyed for their willingness to pay for the pig carcase classification service which has been in operation there since 1974. The survey of producers encountered few problems. The service was valued at more than twice its cost by seventy-one respondents representing about one third of producers normally supplying Blayney. The survey of buyers was less successful and little reliance was placed on its results.

1 Introduction

A pig carcase classification service has been in operation at Blayney Abattoir since 1974 on a trial basis. It is one of a number of trials of carcase classification for pigs and other species being conducted at abattoirs throughout Australia. One objective of the trials was to establish the technical feasibility of measuring the four carcase parameters — sex, age, weight and fat depth. This objective was largely achieved.

A more ambitious objective was an economic evaluation of carcase classification. Not only are the benefits of carcase classification intrinsically difficult to measure but the problem is compounded because the full benefits of classification are not realised until further marketing innovations it allows, particularly selling systems based on classification, have been tested.

Previous attempts at evaluating classification services fall into two broad categories. The first consists of those using benefit cost analysis, examples of which include studies by the BAE (1976) and Griffith (1978). These studies were, by necessity, *ex ante* in nature and the benefits of the service were estimated as anticipated cost savings and revenue gains from the service on the implicit assumption that the classification service adequately described carcasses and facilitated marketing.

The other category includes econometric studies designed to establish the relationships between carcase characteristics and carcase quality. Examples of these include those by the BAE (1976) which were *ex ante* in nature and a study

* Senior Economist, Orange. The issues and methodology which form the basis of this study were extensively discussed by the group of economists responsible for the economic evaluation of carcase classification trials conducted under the auspices of the NCCSC and the author wishes to acknowledge the contributions of this group. Jeff Davis, Jim Johnston and the referees also made valuable suggestions.

by Griffith and Giles (1977) of how well carcass parameters measured in the pig carcass classification service explained variations in wholesale and retail prices. While these studies indicated the potential usefulness of proposed classification parameters particularly as compared to existing carcass sorting procedures, they were not conducted within a benefit cost framework and generally were seen as forerunners of similar studies of larger samples with a more formalized experimental design (Griffith and Giles 1977)¹.

The benefits of a classification service could also be estimated as the sum of the changes in consumer surplus and quasi-rents to fixed resources accruing to all in the production chain including input suppliers, pig producers, "middlemen", retailers, processors and consumers, that arise from the introduction of carcass classification².

The original objective of this study was to estimate the gains in quasi-rents that pig producers, wholesalers, processors and retail butchers at one abattoir, Blayney Abattoir, are *currently* enjoying as a result of the introduction of the classification service. These gains were to be estimated as the aggregate willingness to pay (WTP) for the service by the industry at Blayney. Had this objective been met the benefits of classification would still have been underestimated to the extent that no account was taken of any change in consumer surplus or quasi-rents to input suppliers nor was any attempt made to assess the longer term benefits of marketing innovations that may eventually flow from the introduction of the service.

As will be discussed later, attempts to estimate the quasi-rents gained by pig buyers were not successful, hence most attention in this paper has been devoted to estimating the change in quasi-rents accruing to pig producers. The aggregate WTP by producers, an estimate of their gain in quasi-rents, was offset against the cost of the service to give a measure of its net benefit.

Blayney Abattoir is an appropriate place to undertake such a study. As the classification service has been in operation since 1974 its users are now familiar with it and are better able to assess its value. More importantly most pigs killed at Blayney are sold on a weight and fat depth basis, a marketing innovation allowed by carcass classification.

The classification service at Blayney is described in section 2. In sections 3 and 4 the WTP and survey methodology are discussed. The results of the survey of producers are presented and discussed in section 5.

2 The Pig Classification Service

The classification service at Blayney Abattoir involves measuring sex, weight and fat depth (P2). Strictly speaking because these parameters are only

1. These larger studies remain to be done, yet their potential contribution to establishing classes for trading and price differentials between classes is perhaps of even greater value now.

2. An alternative methodology suggested by P. Biggs (personal communication) is to estimate the demand for and supply of the classification service itself.

measured and not then put into classes, the service is a measurement or specification service. Weight and fat depth measurements are recorded both on the hock of the carcass and in the weight book while sex is recorded in the weight book only. Copies of the weight book sheet are available to the abattoir, the buyers and to those producers selling on a consignment basis. Retailers can read the weight and P2 information from the carcass. Fat depth is measured and its accuracy monitored by the New South Wales Meat Inspection Service. There is no direct charge for the service.

The service is also a complete one in that at present all pigs and all parameters are measured. As a result the fixed costs of the service, mainly labour, are high relative to the service's marginal cost. Because the service is provided free of charge and is essentially an information service and because of the nature of its cost structure there has been some debate about whether the service is a public or private good. As it is attached to particular carcasses and can be rival and exclusive in consumption there seem to be strong grounds to treat the service as a private good³.

The most contentious area in estimating the cost of classification is the treatment of labour costs. As mentioned, the trial was established so as to enable all carcasses to be classified. In effect this meant that labour was a fixed resource and did not vary with the number of carcasses classified. Even in situations where slaughter floor routine can be altered so that the amount of labour employed bears some relationship to throughput, the labour costs attributable to classification would be most difficult to estimate. In this study labour has been treated as a fixed cost. Other fixed costs include training staff, supervising the trial, monitoring the accuracy of the service and the depreciation of and interest on funds invested in introsopes. Detailed cost information can be found in Mullen (1981). Total fixed costs amounted to \$64.42 per day of which the labour cost was \$56.54. The variable costs of classification included repairs and maintenance to the introscope and tickets. They amounted to two cents per carcass and hence were much lower than the average cost of classification.

3 The Willingness to Pay Approach

At least conceptually the changes in consumer surplus and quasi-rents to fixed resources arising from the introduction of a classification service could be identified and measured using an approach similar to that used by Freebairn, Davis and Edwards (1982) in their study of how the impact of a change in costs at one stage of a production chain (extending from the non-farm input sector through to the final consumer) is distributed throughout the whole chain⁴. Not

3. Freebairn (1980) pointed out stronger arguments for public intervention in other aspects of a classification service and these include the initial research and development of the service, the consumption of the benefits of which is unlikely to be exclusive, and also in the monitoring of the accuracy of the service because of the presumed integrity of government monitoring services.

4. A corollary of this is that charges imposed initially on one sector, to cover the cost of a classification service for example, are distributed throughout the production chain in the same manner as benefits. A further implication of this is that if marginal cost pricing of the service is not possible because high fixed costs mean that marginal cost is less than average cost then average cost pricing may be an acceptable second best solution having the advantage that "the user pays".

only were they able to demonstrate graphically the distribution of benefits but, assuming competitive price behaviour, they were also able to derive formulae enabling the changes in surpluses to be estimated providing supply and demand parameters are known. The difficulty that does arise however in the context of this study, is that whereas Freebairn, Davis and Edwards traced through the impact of a single change in the supply curve of one sector in the production chain on the other sectors, a carcass classification service is expected to alter supply and demand curves of several (if not all) sectors simultaneously. Some idea of the pervasive impact of a classification service can be obtained by listing the four categories of benefits of such a service as perceived by Freebairn (1980, p. 5) — “greater operational efficiency of marketing activities, as a precondition for or facilitator of other marketing innovations, superior decision making by individuals and greater allocative efficiency”.

Partial equilibrium analysis could be used to identify for each of these four categories the changes that occur in consumer surplus and quasi-rent. If the relevant demand and supply parameters were known then the changes could be estimated and aggregated for comparison with the cost of the service.

In the present context of evaluating a carcass classification service where the relevant demand and supply parameters are unknown and the service is not charged for, then WTP techniques may provide an alternative means of estimating changes in consumer surplus and quasi-rents⁵. Obviously WTP must be expressed not just on a per carcass basis but must be related to the quantity of the service demanded as this will allow aggregate WTP to be estimated. The aggregate WTP of all those affected by the introduction of a classification service should capture the changes in consumer surplus and producers' quasi-rents to fixed resources and reflect the demand for the classification service⁶.

As mentioned in the Introduction the approach in this study has been to estimate the quasi-rents gained by pig producers at Blayney as the WTP for the classification service. Following Freebairn, Davis and Edwards but restricting our attention to demand and supply at the farm level, the graphical analysis of Figure 1 illustrates the nature of the changes in producer quasi-rents that is being estimated. In theory, the introduction of a classification service could shift both the demand and supply curves at the farm level to the right. While recognising that some producers may not experience one or both these shifts and may in fact experience shifts to the left, the analysis below concentrates on the “ideal” situation described above. Obviously the analysis could be extended to other situations.

A shift to the right of the farm supply from S to S' could arise from either lower costs associated with selling systems based on carcass classification or from lower production costs where classification information is used to aid production

5. The appropriateness of WTP techniques is discussed in Willig (1976) and Mishan (1968) with respect to consumer surplus and producers' quasi-rent respectively. Methodologies for valuing unpriced goods have largely been developed in the context of valuing recreational and environmental resources and have been extensively reviewed by Sinden and Worrell (1979).

6. An attempt was made to elicit the WTP of the users of beef classification in the evaluation of trials in both Queensland and Western Australia (Western Australian Department of Agriculture 1981). In neither case was WTP correlated with quantity demanded.

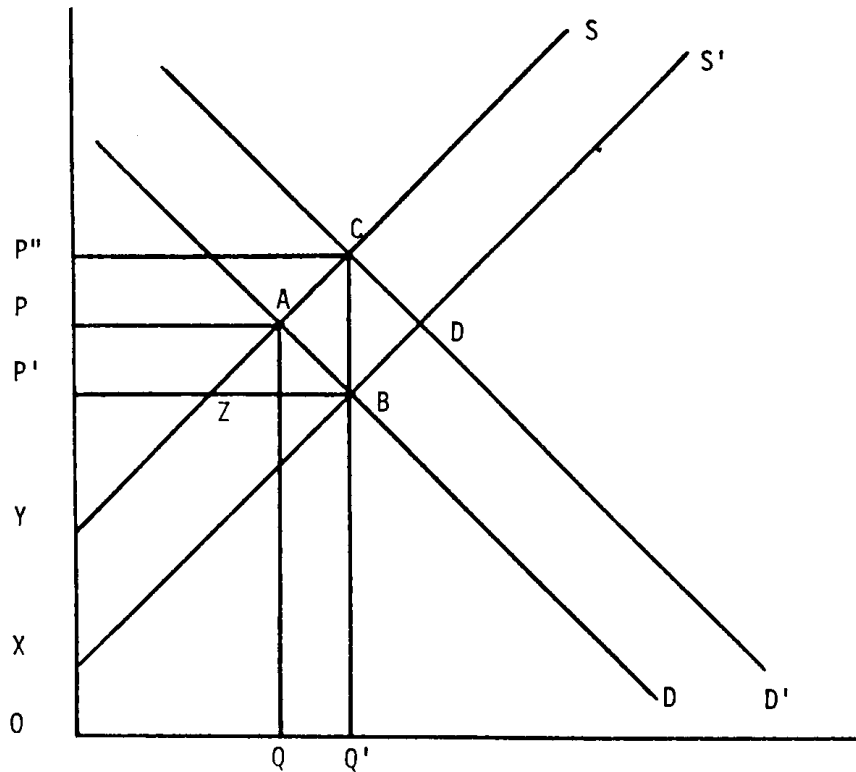


Figure 1: Demand and Supply of Pigs at Farm Gate

decisions. Such a shift results in quantity rising from Q to Q' and farm price falling from P to P' . The change in producer quasi-rent is the area $XYZB$ less the area $P'PAZ$.

A shift to the right of demand at the farm level from D to D' could arise either from an increased demand by buyers, including final consumers, for the classified product or from lower buying costs experienced by "middlemen". Such a shift results in quantity demanded rising from Q to Q' and farm price rising from P to P'' . The change in producer quasi-rent is the area $PP'CA$.

The total value of the classification service to a producer who experiences the shifts in demand and supply described above is the sum of the changes in quasi-rent⁷. The WTP by a producer for the service is his assessment of the total change in quasi-rent he experiences.

4 The Survey

4.1 The Sampling Procedure

The WTP data were derived from a sample survey of the pig industry at Blayney. The target populations of producers and buyers were difficult to define

7. In the unlikely event that the changes in demand and supply are such that the equilibrium price remains at P but quantity demanded increases then the total change in quasi-rents to producers is given by the area $XYAD$.

as they varied throughout the year. Some indication of the number of producers involved was obtained both from the organizers of the two large producer groups whose pigs are regularly killed at Blayney and from the abattoir management. The groups have approximately 80 to 110 regular suppliers respectively and the abattoir management suggest that an additional 45 producers regularly supply pigs giving a total population of approximately 235 producers.

The buying side is dominated by a large processor who accounts for sixty to seventy per cent of the normal kill. Other regular operators at Blayney include a large supermarket chain, a small number of local butchers and six wholesalers who supply local and Sydney retail outlets.

Another difficulty in identifying the target populations was that of tracing the final buyers, presumably retailers, of pig carcasses traded by the six wholesalers. Because of the difficulty of tracing the buyers of the particular pigs classified during the survey period, the target population was restricted to the six wholesalers, the processor, the supermarket and the local butchers. This group is referred to below as the first buyers of the pig carcasses. The drawback of this approach is that the value of the classification service to the retail butchers who purchased pigs from wholesalers was ignored⁸.

The choice of a sample population was influenced by the need for sufficient respondents so that the survey results would be representative of the industry at Blayney and by the need to conduct the survey over a short time period. A short time period was necessary for two reasons. First, it reduced recall problems and enabled respondents to associate their valuation of the service with the specific number of pigs they traded during the survey week. A second reason, was the possibility that the value of the service may vary with pig prices. The influence of pig prices is discussed in more detail below.

The sample population was finally defined as all pig producers and first buyers who traded pigs through Blayney Abattoir in the week of 23rd October to 29th October, 1980. It was possible to conduct a census of this population by mail. To improve the response rate an attempt was made to re-contact by telephone as many as possible of those who did not initially respond to the mail survey. Unfortunately those who conduct surveys have little control over when potential respondents reply. In this case replies either by mail or by telephone were being received until December. Greater efforts were made to ensure a response from the larger producers.

4.2 How Representative is the Sample

During the survey week 1 495 pigs were killed. This level of kill was above the weekly average of 1 365 for the twelve month period ending that week (range 136 to 1 941) but this was expected because of the proximity to Christmas and it is unlikely to influence the results of the survey. The pig chain operated for

8. Another reason for limiting the target population to first carcase buyers was the fear that wholesalers might reflect in their valuation the value of the service to retailers hence giving rise to a double counting problem. In practice, the problem did not arise. Furthermore at least theoretically, it would seem that the problem should not arise providing the questionnaire is well designed and well answered, fairly heroic assumptions admittedly.

five days during the week and the total cost of classifying the 1 495 pigs was \$352 or 23.5 cents per pig.

The buyers and producers of the 1 495 pigs were identified from the abattoir's weight book with the exception of the producers of sixteen pigs who remained unidentified. The pigs were supplied by seventy-nine producers, eight of who had a total of sixteen pigs for their personal consumption and were not surveyed, partly because they were expected to have little value for the service for these pigs and partly because of the expected effort required to get a response from such a small group. Of the remaining seventy one producers, fifty-two replied giving a response rate of seventy three per cent. These producers accounted for eighty six per cent of the pigs killed during the week. The seventy one producers surveyed also represent thirty per cent of the estimated total population of 235 producers and hence there is good reason to expect that their views are representative of producers who normally trade at Blayney.

The 1 495 pigs (with the exception of the sixteen pigs killed on private account and eleven of the unidentified pigs) were purchased by thirteen buyers who were all surveyed. Despite the fact that the thirteen buyers surveyed included all who normally traded at Blayney and that more than half of them, accounting for over eighty per cent of the pigs, responded, little reliance has been placed on this part of the survey. There are several reasons for this approach. First, the small sample size together with the structure of the buying sector meant that the influence of some individual responses was large and respondents could be readily identified. It is difficult to see a solution to this problem since the industry at most abattoirs has a similar structure to Blayney — a small number of buyers with a few of these accounting for most production. Perhaps a survey of buyers at a number of abattoirs or budgeting techniques will prove more reliable than the methodology used here. A second difficulty was that the large corporate structure of the processor and the supermarket created uncertainty about whom to direct the questionnaire to and reduced the chance of a reply.

Because of its expected influence on the value placed on the classification service the level of pig prices during the survey week is also of interest when assessing how representative the survey results are. The graph point for 50–60 kg pigs issued for the weekly Homebush pig sale by the New South Wales Livestock Market Reporting Service provides a guide to price trends at the time. The average prices in the year 1979–80 and 1980–81 were \$1.48 per kg and \$1.57 per kg respectively. In 1980–81 prices ranged from \$1.29 to \$1.86. The quoted price for the survey week was \$1.64 per kg. Hence while pig prices in the survey week were above average it seems unlikely that they were so divergent as to greatly influence the value placed on the classification service.

4.3 The Questionnaire

The questionnaire sought information on the number of pigs handled during the week; whether the respondent received the classification information; the method by which the pigs were traded; the perceived advantages and disadvantages of the service and finally the respondents were asked how much the service was worth to them personally. This last question was asked in such a way that

respondents had the opportunity to enter against a range of values the number of pigs, from the total number they handled during the week, for which they would demand the classification service⁹.

The question about the value of the service was deliberately phrased in terms of how much the service was worth to the respondent rather than in terms of how much they were willing to pay for the service. The main reason for this was the concern that questions about willingness to pay may have raised fears in the minds of respondents that the survey was a forerunner to a charging system and hence may have influenced their response. Comments on questionnaires and telephone discussions with respondents clearly indicated that the wording of the question was still not subtle enough to disguise its real intent.

The questioning technique used in the WTP section was that of a single direct question. The reason for this was that a mail survey did not permit the use of more sophisticated questioning techniques such as converging questions and trade-off games¹⁰.

5 Producers' WTP for the Classification Service

Of the fifty-two producer respondents, forty-five had received the weight and fat depth information. Thirty-six producers sold pigs on a weight and grade basis where the grade was based on classification measurements, seventeen sold on a consignment basis where carcass value was determined by weight with only informal agreements about carcass quality and two producers sold their pigs at auction¹¹.

The WTP data in the form of a demand schedule for the service on the part of producers are found in Table 1. In preparing this schedule, non-respondents,

Table 1: Producers Demand Schedule for Classification Service

No. of growers	No. of carcasses classified	Unit value of service (\$)	Aggregate value of service (\$)
9	148	2.00	296.00
4	94	1.50	141.00
10	194	1.00	194.00
3	43	.60	25.80
13	282	.50	141.00
3	65	.30	19.50
4	86	.20	17.20
4	67	.10	6.70
3	81	.05	4.05
7	230	.00	..
60	1 290		\$845.25

9. The exact wording of the question can be found in an accompanying appendix. The complete questionnaire can be found in Mullen (1981).

10. The techniques are reviewed in Sinden and Worrell (1979).

11. The total of fifty-five producers is explained by the fact that three producers used two methods to market their pigs and hence have been counted twice.

the owners of untraced pigs and those producers who had pigs killed for their own consumption have been ignored and this may be a source of underestimation of the value of the service.

The aggregate WTP of producers was \$845.25 which was an average of 65.5 cents per pig (over 1 290 pigs) and considerably greater than the cost of the service¹². The WTP of individual producers ranged from zero for seven producers to two dollars for nine producers. Four producers of seven pigs valued the service at zero for their "backfatters". Three other respondents, accounting for 223 pigs, also placed a zero value on the service. One grower of 201 pigs did not value the service because he could not individually identify pigs. This problem was not mentioned by any other producer. In fact some producers were using simple techniques to identify pigs through to carcass form. The reasons given by the other growers were unclear.

Five producers who claimed they did not receive the classification information placed a value on the service ranging from five cents to one dollar per pig. These producers supplied seventy-eight pigs and valued the service in aggregate at \$32.55. This anomaly is perhaps explained by the producers receiving the classification information on some informal and/or irregular basis from the operator who purchased their pigs. It may also be evidence that some producers at least, did attribute a "good for the industry" value to the service which is contrary to the intentions of the survey.

The survey of producers was deficient in two respects. First, growers were not given the opportunity to value the service at more than two dollars per carcass because of the way in which the question was structured. Nine producers of 148 pigs valued the service at two dollars.

Second, growers were not asked to differentiate between types of pigs hence implying an assumption that the service had the same value for each. The survey indicated that such an assumption may not be valid. Clearly some growers valued the service differently for "backfatters". In addition, one producer indicated that he sold both pork and bacon type pigs and valued the service at one dollar per pig and sixty cents per pig for bacon and pork types respectively. To get a further indication of whether the value of the service depended in part on the type of pig being produced, respondents were separated into two groups — those who sold to the processor and those who sold to other operators. It can reasonably be assumed that *most* pigs going to the processor are bacon type pigs and that *most* of those going to other operators are pork type pigs. The bacon group valued the service at a weighted (by number of pigs) average of sixty-nine cents per pig whereas the pork group valued the service at thirty-four cents per pig. These different valuations of the service may reflect the marketing systems available to the two groups of producers. Those pigs sold to the processor are sold on a weight and fat depth basis whereas the price of those sold to other operators was

12. Griffith (1978) suggested that the gross benefits of the service, comprising a more rapid increase in carcass quality and cost savings by retailers and wholesalers, ranged from about \$0.50 per carcass to \$4.60 per carcass. The size of the benefits depended on the discount rate used and on how early the service was introduced as this influenced the level of improvement in carcass quality that could be attained. Because the service has been in operation for so long at Blayney then presumably Griffith would have argued that the expected benefits of the service at Blayney were towards the top end of the scale.

not formally linked to P2. Hence it seems reasonable that producers selling to the processor would value the classification service more highly. This question needs to be explored more rigorously in a future study.

The classification service is an input in the production process, demand for it being derived from the demand for differentiated pig products. Hence the value placed on the service by producers is expected to be influenced by the price of the product and by the price of other inputs such as feed. As a generalization it might be expected that the value of the service will vary directly with the profitability of pig production. While the trend in prices at the time of the survey was briefly discussed above no attempt was made in this study to relate the value of the classification service to either product prices or to other factors that may be of influence. Perhaps these issues could be taken up in future studies.

A final discussion point is the likelihood of biased valuations resulting from strategic behaviour by respondents. In this specific situation the inducement for respondents to undervalue the service is the fear of a charging system being introduced. A zero response may indicate dissatisfaction with the survey techniques although this did not appear to be a problem in this study. The inducement to overvalue the service may be the desire on the part of many producers for widespread implementation of the classification service.

Obviously the extent of bias is difficult to determine. The issue is discussed in Brookshire, Ives and Schulze (1976) who suggested that valuations should be distributed normally. In this case, while the most quoted valuation of the service, on both numbers of growers and numbers of pigs bases, is fifty cents, the concentration of valuations at both zero and two dollars seems higher than desirable.

The heavy concentration of zero values results partly from the fact that the service is not relevant to "backfatters" but more importantly because of the producer of 201 pigs who valued the service at zero because he could not identify individual pigs. The only comment that can be made about the two dollar valuations is that those contacted by telephone appeared genuine in the importance they placed on the service to their operation. Even when these high values are omitted the aggregate WTP exceeds the cost of the service.

It may be profitable in future studies to use more sophisticated questioning techniques than the single direct question approach adopted here as these approaches may assist respondents in arriving at a value for the service that more accurately reflects its impact on them personally and overcome the problem that arose in this study of arbitrary extreme values.

As mentioned above, many producers supply the processor through two producer groups. The organisers of both groups claimed that the classification service had a value to the groups over and above its value to individual members. They claimed to be in a better bargaining position with the processor if they could promise large lines of even quality pigs and the service assisted them in maintaining such a standard. One organiser valued the service for this purpose at twenty cents per pig. The value of the service to the groups has not been included in the aggregate WTP largely again because of the small sample size but also to avoid the possibility of double counting benefits.

6 Concluding Comments

In this study an attempt was made to estimate, using WTP techniques, the quasi-rents gained by pig producers and buyers at Blayney Abattoirs as a result of the introduction of a classification service. The survey of producers appeared to be most successful. The seventy-one respondents represent about thirty per cent of producers supplying Blayney. They valued the service at about two and one half times its cost. Their views are certainly representative of the views of producers supplying Blayney. They also seem likely to represent the views of producers in general as Blayney only seems atypical of the industry in the length of time the service has been in operation and hence it is reasonable to expect that most producers, particularly those selling on a classification basis, will come to value the service highly. Future studies of this type could profit by distinguishing between final products, in this case between pork and bacon production, by examining more closely the relationship between the value of the service and product and input prices, and by using more sophisticated questioning techniques which may assist respondents in assessing more accurately the value of the service to them. The survey of first carcase buyers was less successful. This can largely be attributed to the structure of the sector and of firms within the sector which resulted in such a small sample. Little can be done about this problem as it is typical of the industry. It does, however, raise doubts about how appropriate the WTP methodology is in such situations.

Appendix: The Question Concerning the Value of the Service

Finally, we would like you to put a value in money terms, on how much the service is worth to you. Below is a list of the possible values in cents per pig of the service to you. Alongside this list is space for you to enter the number of pigs for which the service has the particular value. For example, if you had 20 pigs killed during the week and if you felt the service was worth \$1 per pig, then you would enter 20 next to \$1. If you valued the service differently for different pigs, then for example, you may value the service at \$1 for 10 pigs and \$0.50 for the remaining 10.

NOTE—The total number of pigs entered in this schedule must be the same as the number of pigs killed during the week (Question 2).

\$2.00	\$0.50
\$1.50	\$0.40
\$1.00	\$0.30
\$0.90	\$0.20
\$0.80	\$0.10
\$0.70	\$0.05
\$0.60	\$0.00

If you value the service differently for different pigs, could you briefly note why.

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