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Assessing Accuracy of Livestock Market Reporters: Some Evidence on Pigs in Victoria

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This paper explores the hypothesis that livestock market reporters tend to err towards the middle of the actual range when estimating carcass weight and fat depth. Trial data for pigs support the hypothesis and indicate that reporters' estimates may be significantly biased in some extreme weight and fat classes even when the average errors taken across all classes are trivial. Significant distortions in the reported premiums or discounts between some fat and weight classes are implied by the errors in estimating fat and weight.

Introduction

Various Livestock Market Reporting Services (LMRS) throughout Australia report prices at livestock auction markets, aiming to improve pricing efficiency in the meat market by providing better market information. Prices are reported according to the characteristics of livestock that are thought to be important determinants of price. With present technology two key characteristics, fat depth and carcass weight, must be estimated subjectively by reporters. It is inevitable that reporters will make some errors when estimating these key variables by sight from a distance, resulting in errors in market reports. Perfect precision is not physically possible and, even if it were attainable, would not be a suitable objective for the LMRS. Stigler (1961, p. 224) suggests:

> Ignorance is like sub-zero weather: by a sufficient expenditure its effects on people can be kept within tolerable or even comfortable bounds, but it would be wholly uneconomic entirely to eliminate all its effects.

An ideal objective would be to improve estimates to the point where the marginal benefits of greater precision equal the marginal costs. A practicable objective for the LMRS is to report prices accurately in the sense that reporting errors are kept within tolerable bounds.

A study of the nature of reporting errors is potentially useful as a basis for assessing whether the errors are tolerable, and as an input to improving the estimating abilities of reporters, to defining characteristics that may usefully be reported (*e.g.* how many fat classes can be distinguished by the human eye), and to forming strategies to improve the quality of information produced.

There have been few formal studies to date in Australia aiming to assess the accuracy of livestock market reporters. Naughtin (1980) and Naughtin and Holland (1982) used three accuracy criteria: mean error, mean percentage error, and mean absolute error. An implicit assumption underlying the approach taken in those studies was that the probability of a reporter overestimating weight by, say, one kg or one per cent would be the same for any animal, regardless of its weight.

Preliminary data analysis and informal impressions of LMRS operatives suggest errors are related to actual weight or fat depth. Specifically it is thought that reporters tend to overestimate the weight of lighter animals, underestimate the weight of heavier animals, overestimate the fat depth of leaner animals and underestimate the fat depth of fatter animals, so that estimates of both fat depth and weight tend to be biased towards the middle of the range. Thus there might be biases in some classes, and market discounts or premiums for fat and weight of animals may not be reflected accurately in price reports, even when aggregate mean errors, across a wide range of weight and fat depth classes, are very small.

Buyers, too, may make errors in classifying animals and this could lead them to pay different premiums for fat and weight than they would intend to pay. In some situations errors

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made by buyers could compensate for errors made by reporters and in other situations they could compound. Only if both buyers and reporters made no mistakes would actual, intended, and reported prices exactly coincide. For some studies, errors by buyers would be an important consideration. In practice the LMRS aims to report the actual market prices. It is appropriate therefore to ignore buyer errors and to assess the LMRS in terms of the relationship between actual and reported prices. A first step towards such an assessment is to study reporters' errors in estimating fat depth and weight.

Market reports include price per head, price per kg liveweight, and price per kg dressed weight, reported by nine dressed weight classes and five (weight related) fat categories within each weight class. Two types of errors in market reports may arise from errors in estimating carcass weight: (a) within a weight class errors in estimating carcass weight would be reflected as errors in estimates of price per kg dressed weight for that class, and (b) errors in estimating carcass weight may result in animals being assigned to the wrong dressed weight class. Hence, if prices differ among weight classes there may be errors in estimating price per head and price per 1 kg liveweight by dressed weight class. Thus for carcass weight estimates, both the size of errors and whether they result in errors in assigning animals to weight classes are important. For fat depth, the magnitudes of errors are of interest only in so far as they lead to errors in classifying animals into fat categories within weight classes.

Two procedures were used to assess reporter errors. First, for each pig in the trial, the errors in estimating fat depth and weight were computed. These error data were then regressed against the actual magnitudes being estimated and mean errors were computed by actual weight and fat class. The results of these measurements were used to test for reporter bias, to test whether errors were related to actual weight and fat and to indicate the nature of reporter biases. Second, contingency tables were constructed to determine the extent to which animals reported as being of a particular weight or fat class were actually drawn from other weight or fat classes. Finally, a hypothetical price schedule was imposed on the data to indicate the extent to which errors in classifying animals might lead to errors in price reports. The significant departures from previous work are to examine data by weight and fat class rather than pooling across all classes, and to indicate the effects of reporter errors on price reporting errors.

Data and Methods for the Study

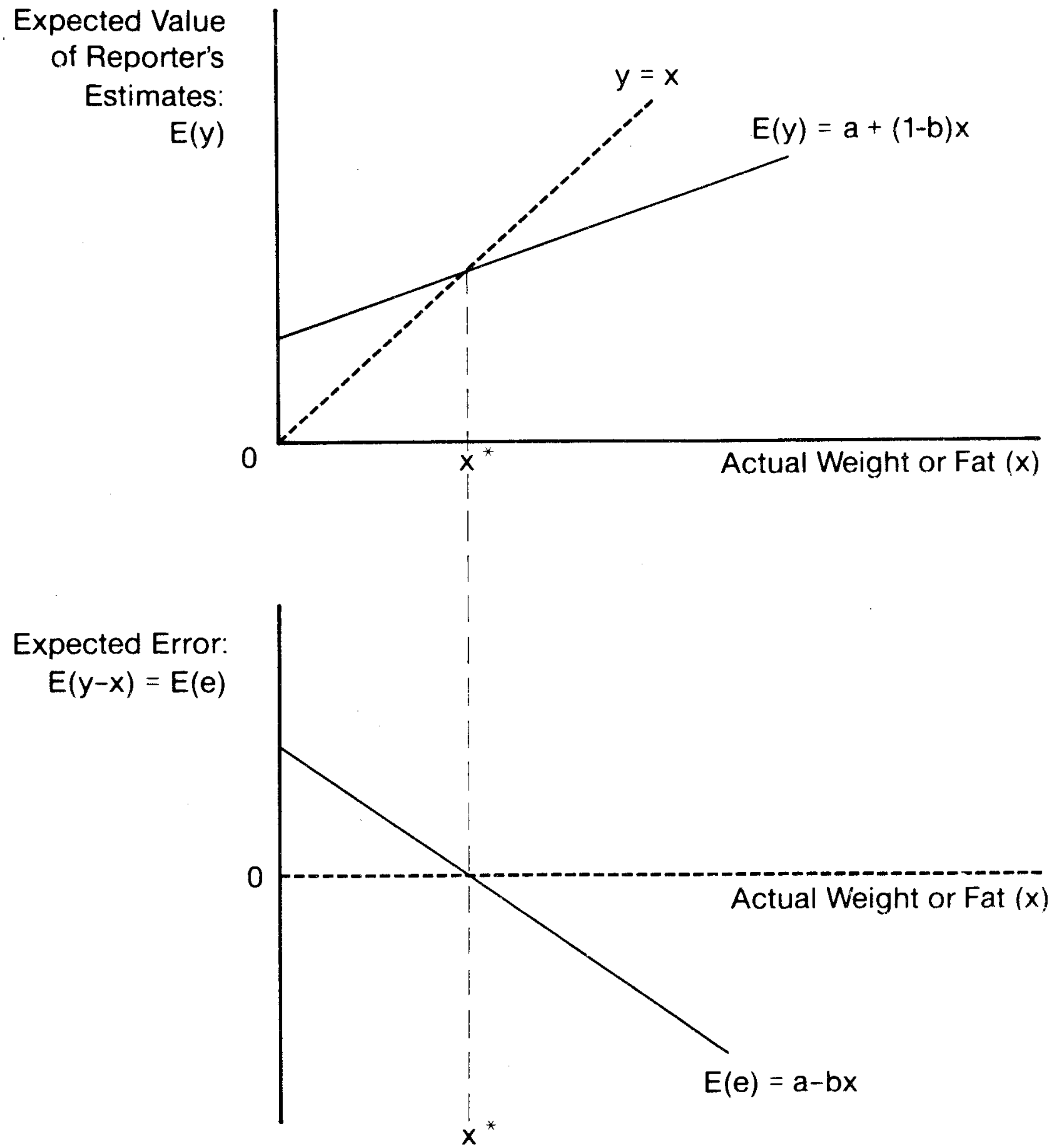
The Department of Agriculture and Rural Affairs in Victoria has recently expanded the scope of its LMRS to report the Ballarat pig auction market. As part of a pilot programme, trials were conducted at a country abattoir from February to June 1983. The two pig market reporters were required to estimate the carcass weight and fat depth of pigs immediately prior to slaughter.[1] Following slaughter, carcass weight and fat depth measurements were taken.[2] The resulting records of reporter estimates before slaughter and actual measurements after slaughter were used for this study. These data and our analysis relate to individual reporters' estimates of fat depth and carcass weight for individual pigs under trial conditions. The normal work of reporters is to assess average carcass weight and fat depth for pens of animals and one would normally expect smaller errors in assessing the average, rather than individual, figures.[3] One might also expect some cancelling of the random component of errors when individual reporters' estimates are combined into a report. Although the trial data do not correspond exactly to real world market reporting, they may be used nevertheless to indicate the likely nature of errors in the day-to-day activities of reporters.

[1] One of the reporters was experienced at reporting sheep and cattle but neither reporter had any previous experience in pig market reporting. The aim of the trial was to monitor and improve reporter accuracy, as part of a training programme. Preliminary tests indicated no significant differences in error distributions between the first half and last half of the trial so all the data were used in the analysis.

[2] Carcass weights were hot weight/head on, kidneys and channel fats removed, in kg. Fat measurements were taken at the P2 site (65 mm from the dorsal midline at the 12th/13th rib) using an introscope with fat depth measurements expressed in mm. These measurements, particularly of fat depth, are subject to error. For a discussion and estimates of the accuracy of the introscope when used to estimate fat depth of beef carcasses, *see* Dennes *et al.* (1975).

[3] Pens usually contain six or seven pigs and are often sold in lots of two pens. Normally, at a sale, reporters have a measure of average liveweight per head for each pen of animals and to estimate carcass weight requires only estimating a dressing percentage. The information on liveweight should reduce errors in estimating dressed weight. Information on liveweights was not available to reporters in the trial.

Figure 1: The Suggested Relationship Between Expected Values of Estimates and Errors and Actual Values in the Linear Case



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Model and Hypotheses

A fairly general model of the relationship between a reporter's estimate of the value of a variable and its actual value is:

$$(1) \qquad y = f(x,z)$$

where y = a reporter's estimate of x,

x = the magnitude to be estimated,

and z = variables other than x (*e.g.*, sex, breed, conformation or fat for weight estimates) that influence the reporter's estimate.

Unless reporters are perfectly accurate (*i.e.* $f(x,z) = x$) there will be reporting errors (e) which are defined as:

$$(2) \qquad e = y - x = g(x,z)$$

The general hypothesis is that reporting errors are related to the actual values to be estimated. To focus on this hypothesis, it was postulated that errors contain a deterministic part ($h(x)$) that is a function of actuals and a random part (u) representing the effects of all other variables (z):

$$(3) \qquad e = h(x) + u$$

The specific hypothesis is that reporters tend to overestimate small magnitudes and underestimate large magnitudes but that they tend to make small errors around the middle of the actual distribution of x. Suppose the special case holds that estimates (and thus errors) are linearly related to actuals:

$$(4) \; y = a + (1+b)x + v \text{ and } e = a + bx + v$$

where v is a random component with an expected value of zero, and is unaffected by the transformation from y to e.

In this linear model the specific hypothesis implies the slope parameter b is between 0 and -1.0 with a positive intercept a such that for some magnitude of x in the middle of the range (say x^*) the expected error would be zero: *i.e.* $a = -bx^*$. This type of relationship is represented graphically in Figure 1.

Unbiasedness is, intuitively, a desirable property for reporters' estimates. This would require that observations of actuals and estimates should be scattered at random around the 45 degree line in Figure 1a and that errors be scattered at random around the zero line in Figure 1b. In terms of the parameters of the model this requires both $a = 0$ and $b = 0$. If errors were unrelated to actuals ($b = 0$) there may still be some bias ($a \neq 0$). The other desirable property is that the estimates fall closely around the 45 degree line (the errors fall closely around the zero line). In practice there may be an optimal trade-off between bias and dispersion. Here this trade-off is not of specific concern and the nature of the biases is of major interest.

Tests for Reporter Biases

Errors (e) were computed by subtracting the actual value of fat depth or carcass weight (x) from each reporter's estimate (y) for each pig in the trial: $e = y - x$. The two reporters were treated as independent samples.[4]

For the first piece of empirical work, the following linear model, corresponding to equation (4), was estimated by regression.

$$(5) \qquad e = a + bx + v$$

Initially it was assumed that the residuals (v) would have the usual OLS properties, but the OLS results indicated significant autocorrelation and heteroscedasticity.[5] The autocorrelation was virtually eliminated by sorting (arbitrarily) according to the size of actual weight or fat depth. Then, weighted least squares (allowing different variances for different weight or fat classes) was used to correct for heteroscedasticity. The results are reported in Table 1.

The null hypothesis is that reporter errors are independent of actuals and have a mean of zero. This was tested by testing the restriction on parameters: $a = 0$ and $b = 0$. The regressions indicate a strong correlation between errors and actuals and the null hypothesis is firmly rejected for both fat depth and weight estimates for each reporter separately and for the two reporters combined.

[4] The "actual" data of weight and fat depth were obtained by "objective" measurement but nevertheless are subject to error (see footnote 2). Thus we are not really studying "errors" but rather differences between two alternative sets of estimates. The objective measures of weight and fat depth are thought to be unbiased and in the analysis we treat them as if they were exact.

[5] Significant first-order autocorrelation was indicated by Durbin-Watson (d) statistics. Heteroscedasticity was indicated initially by plots of residuals and was confirmed using a Goldfeld-Quandt test (Pindyck and Rubinfeld 1981).

Although the parameter estimates were very similar for the two reporters for both fat depth and weight, an F-test suggests pooling weight errors across reporters is inappropriate for this regression. The parameter estimates indicate that reporters tended to underestimate larger magnitudes and overestimate smaller ones, as depicted in Figure 1.

The regressions indicate a significant relationship between errors and actuals. Further analysis is required to obtain more detailed information about the nature of the relationship. One approach would be to construct prediction intervals around the regression, but this is difficult using the results from weighted least squares; and the true relationship may not be linear. Instead, to obtain more information about the form of the relationship, as well as the extent of the biases, mean errors and mean percentage errors were computed directly by actual weight and fat class of animal. Table 2 contains mean weight errors by actual carcass weight class.

When all the data was pooled across all weight classes of pigs, the mean errors were trivial and not statistically significant. The mean percentage error was statistically significant, suggesting an average upwards bias of 1.3 per cent, but is tolerable. This result is comparable to Naughtin's (1980) for cattle and would indicate that the weight estimates are very accurate. However, as anticipated, when the data were separated into three arbitrary weight classes some more important biases were revealed. For lighter (under 40 kg) pigs, the weight estimates were biased up on average by three kg (nine per cent). For pigs in the middle of the weight range (41–55 kg) the weight estimates were unbiased. For heaver pigs (over 56 kg) the reporters tended to underestimate weights—but, although the mean percentage error of −1.8 per cent is statistically significant, it is probably not economically important.

The lower part of Table 2 includes the mean errors by ten weight classes, including the nine actual weight classes used in market reports and a less than 30 kg class. Weights were significantly overestimated for the three lightest weight classes. The average bias decreased as weight class increased and there were no statistically significant biases except in the first three weight classes. However, both reporters tended to underestimate weights for heavier pigs, with the size of the underestimate tending to increase with actual weight. The mean percentage errors were very large and positive for the lightest pigs decreasing to trivial in the middle of the range and increasingly large and negative in the heavier classes.

Table 1: Regressions of Weight Errors Against Actual Weight and Fat Errors Against Actual Fat

	Reporter	Intercept	Slope	SSE	R^2	N
Weight Errors	A	6.751** (0.974)	−0.1212** (0.021)	223.1	.25	226
	B	8.198** (1.021)	−0.1599** (0.022)	214.2	.26	206
	Both	7.466** (0.728)	−0.1389** (0.016)	451.7	.22	432
Fat Errors	A	4.510** (0.793)	−0.294** (0.055)	221.3	.13	226
	B	4.448** (0.812)	−0.318** (0.054)	209.5	.15	206
	Both	4.508** (0.572)	−0.308** (0.039)	437.6	.13	432

Notes: Figures in parentheses are standard errors of estimates.

** Denotes significantly different from zero at one per cent level.

Estimates used weighted least squares after sorting the data by actual weight for weights and actual fat for fat.

Table 3 contains mean fat errors by five actual fat depth classes and across all pigs sampled. Across all fat categories (0–38mm) the average fat errors for each reporter and both reporters together were trivial but the overall percentage error (two percent) was statistically significant. However when the data were organized into five fat categories, corresponding roughly to those used in market reports, there were more significant biases.[6] Both reporters tended to overestimate fat depth for leaner pigs (0–9 mm and 10–15 mm fat) and to underestimate fat depth for fatter pigs. Fat depth estimates were biased towards the middle of the actual range, and the average percentage errors were quite large in the extreme fat categories.

For both fat and weight estimates the two reporters both tended to err towards the middle

Table 2: Mean Weight Errors by Actual Weight Class

Weight Class (kg)	Mean Errors (kg) Reporter		Both Reporters: Mean Errors (kg)	Both Reporters: Mean Percentage Errors (%)	Number of Observations by Reporter		
	A	B			A	B	Both
All Pigs	0.43 (0.33)	−0.07 (0.38)	0.19 (0.25)	1.3** (0.5)	226	206	432
0–40	2.98** (0.44)	2.98** (0.40)	2.98** (0.29)	8.8** (0.9)	49	49	98
41–55	0.42 (0.39)	0.07 (0.49)	0.25 (0.31)	0.5 (0.6)	76	72	148
56 +	−0.81 (0.6)	−1.95** (0.73)	−1.33** (0.47)	−1.8** (0.7)	101	85	186
0–30	5.57** (1.02)	5.71** (0.99)	5.64** (0.68)	19.8** (2.3)	7	7	14
31–35	2.62** (0.55)	3.08** (0.83)	2.85** (0.49)	8.4** (1.5)	13	13	26
36–40	2.52** (0.61)	2.28** (0.43)	2.40** (0.37)	6.3** (1.0)	29	29	58
41–45	0.39 (0.72)	0.26 (0.54)	0.33 (0.45)	0.8 (1.0)	23	23	46
46–50	0.70 (0.64)	−0.03 (0.94)	0.34 (0.56)	0.7 (1.2)	30	29	59
51–55	0.09 (0.68)	0.00 (0.96)	0.05 (0.57)	0.1 (1.1)	23	20	43
56–60	−1.18 (0.79)	−0.90 (1.26)	−1.06 (0.63)	−1.8 (1.1)	40	30	70
61–70	−0.38 (0.86)	−1.35 (1.04)	−0.82 (0.66)	−1.2 (1.0)	37	31	68
71–80	−0.83 (1.99)	−3.11 (1.52)	−1.72 (1.26)	−2.1 (1.7)	18	18	36
81 +	−2.5 (3.79)	−6.83 (5.64)	−4.68 (3.31)	−5.3 (3.3)	6	6	12

Notes: Figures in parentheses are standard errors of estimates; ** and * denote significantly different from zero at the one and five per cent level, respectively.

Table 3: Mean Fat Errors by Actual Fat Class

Fat Class (mm)	Mean Errors (mm) Reporter		Both Reporters		Number of Observations by Reporter		
	A	B	Mean Errors	Mean Percentage Errors	A	B	Both
All Pigs	0.20 (0.22)	−0.07 (0.38)	0.02 (0.23)	2.0* (1.1)	226	206	432
0.9	2.07** (0.79)	1.43 (0.98)	1.75** (0.62)	19.9** (7.0)	14	14	28
10–15	0.67** (0.26)	0.42 (0.26)	0.55** (0.18)	4.8** (1.4)	128	118	246
16–21	−0.62 (0.38)	−1.02** (0.37)	−0.80** (0.27)	−4.5** (1.5)	71	61	132
22–27	0.10 (1.21)	−1.20 (1.50)	−0.55 (1.31)	−2.2 (4.1)	10	10	20
28 +	−8.67** (1.77)	−14.0** (2.31)	−11.34** (1.86)	−34.4** (4.8)	3	3	6

Notes: Figures in parentheses are standard errors of estimates; ** and * denote significantly different from zero at the one and five per cent level, respectively.

of the actual range for the variable being estimated. In the classes at the extremes of the ranges the average biases were statistically significant, large as a percentage of actuals, and of magnitudes that may be economically important. This is particularly so for the lightest, leanest, and fattest classes of pigs.

The Extent to which Pigs were Classified Incorrectly

Next, the data for both reporters are pooled and arranged categorically in contingency tables. These tables indicate the frequencies with which animals were reported in incorrect weight or fat classes. Table 4 contains data on weights. In each column in Table 4 is shown, of the number of animals that were reported in a particular weight class, the percentages that correctly belong in that weight class and the percentages that belong in other weight classes.

Slightly over half of the animals were assigned correctly to weight classes (on the diagonal) and more than nine-tenths of animals were from one weight class either side of their reported class. As one would expect from the results in Table 2, the greatest errors occurred in the lower weight classes with significant fractions of pigs being assigned to higher weight classes than they should have been. Consequently, 39 per cent of pigs that were reported as being in the 31–35 kg class were from the less than 30 kg class; 29 per cent of pigs reported as being in the 36–40 kg class were from the 31–35 kg class; and 35 per cent of pigs reported as being in the 41–45 kg class were from the 36–40 kg class. But most of the pigs reported as being from a particular weight class were either from that weight class or one weight class either side.

The results for fat depth (Table 5) are similar. Well over half of the animals were assigned along the diagonal to correct fat classes. At the ends of the distribution significant fractions were assigned incorrectly. Thus, for example, of animals reported as having 1–9 mm of fat, 69 per cent had 10–15 mm and of those reported as being in the

[6] Fat depth is strongly related to weight with heavier pigs tending to be fatter. There are five fat "scores" for each weight class but the fat depth for each score is greater for heavier pigs in market reports. Due to data limitations a single set of five fat classes was used for all pigs sampled.

Table 4: Percentages (by Reported Weight Class) of Pigs from Actual Weight Classes

Actual Class (kg)	Actual Total (No.)	Classes Assigned By Reporters (kg)									
		0–30	31–35	36–40	41–45	46–50	51–55	56–60	61–70	71–80	80+
		%	%	%	%	%	%	%	%	%	%
0–30	14	66.7	39.1	4.2	1.4						
31–35	26	33.3	39.1	29.1	2.8						
36–40	58		21.7	54.1	35.2	3.1					
41–45	46			10.4	43.7	15.3					
46–50	59			2.1	16.9	52.3	14.8	6.5	1.2		
51–55	43					13.8	40.7	23.9	1.2		
56–60	70					15.3	33.3	54.3	20.0		
61–70	68						11.1	15.2	57.6	20.8	7.7
71–80	36								18.8	66.7	30.8
80+	12								1.1	12.5	61.5
		100	100	100	100	100	100	100	100	100	100
Total Reported	432	3	23	47	71	65	54	46	85	24	13

Note: Numbers underlined represent the proportion of pigs reported in a class that were actually from that class.

16–21 mm range, 40 per cent were from leaner classes, but comparatively small numbers were involved in the extreme classes. Almost half of the pigs were reported in the 10–15 mm class and 75 per cent of these were correctly reported in that class.

Implications for Accuracy of Market Reports

If some aggregate measure of average error were used, as by Naughtin (1980) and Naughtin and Holland (1982), one would conclude that pig market reports are likely to be extremely accurate. However our results, based on this trial data, indicate that market reporter's estimates of fat depth and weight still may be biased for some classes of pigs. The biases in the trial data were greatest at the extremes of the fat depth and weight ranges and may be important for the extreme classes, but only a fraction of the pigs sold at auction and used in the trial belong in the classes where serious errors were made. Nevertheless, the reporting errors led to significant fractions of animals being assigned to incorrect weight and fat depth categories and this is a potential source of inaccuracy in the reported prices for all classes of pigs.

As suggested earlier, when prices vary according to actual weight, assigning animals to wrong classes may lead to biased estimates of price per kg liveweight, per kg carcass weight or per head by weight class. Market premiums or discounts for weight may not be reflected accurately in reports. Similarly market premiums or discounts for fat may not be reported accurately. To determine the seriousness of these distortions would require information on actual premiums and discounts for fat and weight.

In the absence of actual price data, hypothetical price data based on confidential "over-the-hooks" price schedules were used to compute the biases in reported prices implied by the biases in fat and weight estimates. The schedules of "over-the-hooks" prices were in the form of a price per kg dressed weight for each of five fat scores within each of eleven weight classes.[7] The fat scores refer to different actual fat depths for different weight classes. The differences in price per kg between adjacent fat scores within a weight class were large (up to 18 cents per kg) relative to the differences in price per kg between adjacent weight classes for a given fat score (in many cases zero). Consequently, errors in estimating fat depth are likely to be economically more important than errors in estimating weight.

Pigs were assigned "actual" prices from the price schedule according to their actual weight and fat scores, assuming that buyers

Table 5: Percentages (by Reported Fat Class) of Pigs From Actual Fat Classes

Actual Class (mm)	Actual Total (No.)	Classes Assigned by Reporters (mm)				
		1–9	10–15	16–21	22–27	28–38
		%	%	%	%	%
1–9	28	<u>28.2</u>	6.6	2.0		
10–15	246	69.2	<u>75.6</u>	37.5	4.3	
16–21	132	2.6	16.9	<u>56.6</u>	26.1	60.0
22–27	20		0.5	3.3	<u>52.21</u>	40.0
28–38	6		0.5	0.6	17.4	
		100	100	100	100	100
Total Reported	432	39	213	152	23	5

Note: Numbers underlined represent the proportion of pigs reported in a class that were actually from that class.

would not make any estimation errors and that the auction market prices would be equal to the "over-the-hooks" prices. Then the hypothetical reported price for each class was computed as the average of the "actual" prices assigned to the pigs that were reported—correctly or not—as belonging in that class. Figure 2 shows the errors in the hypothetical reported prices by five fat classes within eleven weight classes of pigs. These estimates suggest that market reports might contain serious errors, particularly in reported discounts for fat, especially at the extremes of the weight range. This results because there are substantial discounts for fat and there can be significant errors in assigning animals among fat classes. Again this result should be tempered by the knowledge that the majority of pigs sold do not belong in the extreme weight classes for which the absolute and percentage errors in prices were greatest. In the middle of the weight range there were some significant distortions in the prices for the fattest pigs but very few very fat pigs are sold in those weight classes.

Conclusion

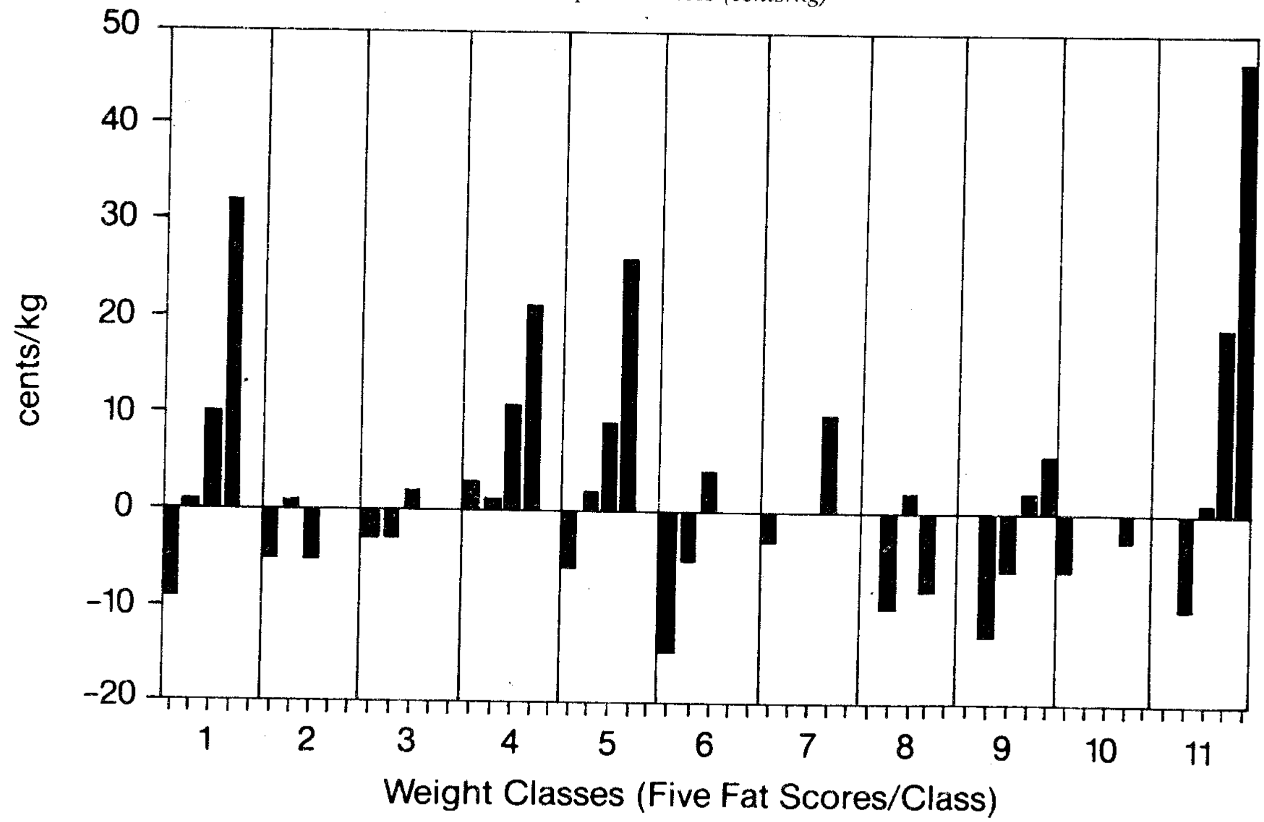
Previous assessments of the accuracy of market reporters have used some aggregate accuracy criteria. In this study the proposition that reporter errors are related to actual fat depth or weight has been tested. The analysis has used trial data collected under conditions that are quite different, and perhaps less favourable, than those under which reporters normally operate in the pig market. In the trial data, reporter errors were significantly related to actual weight or fat depth and reporters tended to err towards the middle of the range. It may be inferred that reporters would tend to make similar errors in their day-to-day pig

[7] The categories of animals were:

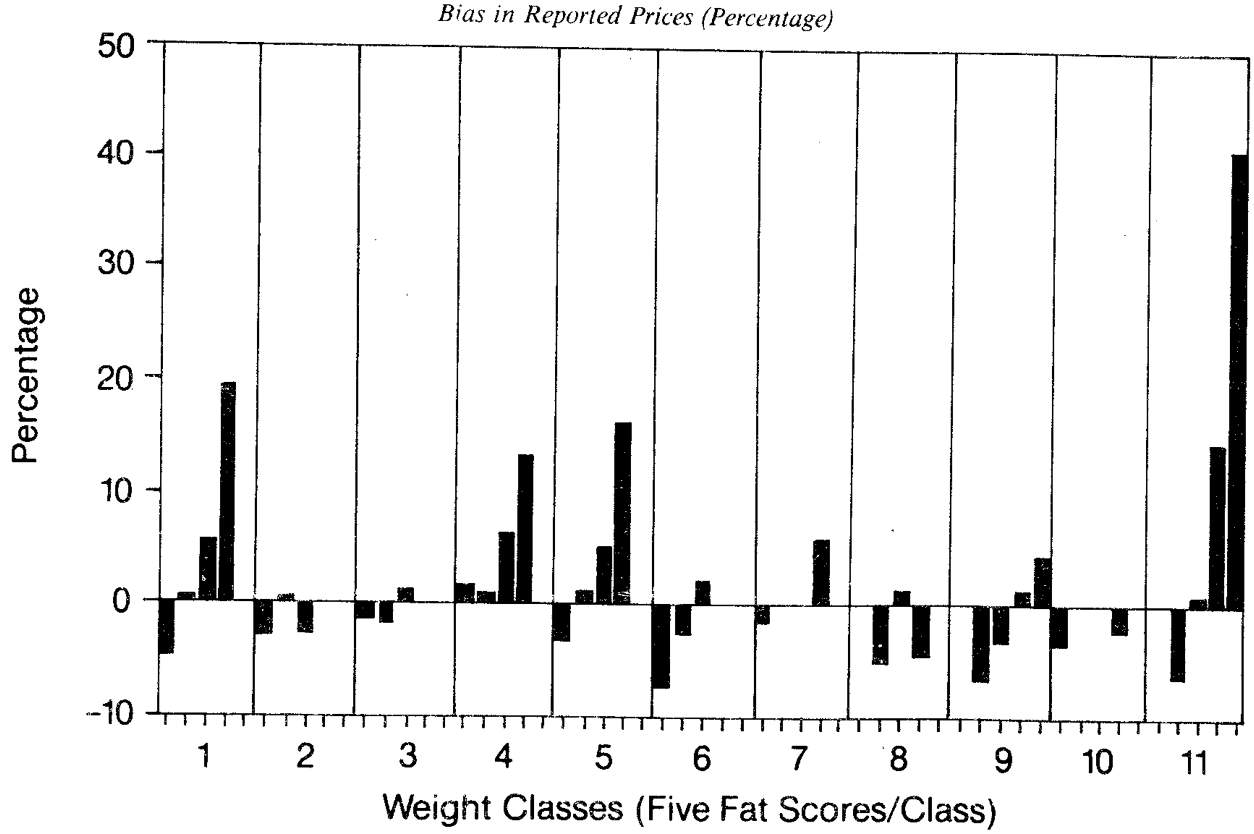
Weight class	Weight range (kg)	Fat depth (mm) Fat category by weight class				
		1	2	3	4	5
1	0–35	0–9	10–12	13–15	16–19	20+
2	35–40	0–10	11–13	14–16	17–20	21+
3	40–45	0–11	12–14	15–17	18–21	22+
4	45–50	0–11	12–14	15–17	18–21	22+
5	50–55	0–12	13–15	16–18	19–22	23+
6	55–60	0–13	14–16	17–19	20–23	24+
7	60–65	0–14	15–17	18–20	21–24	25+
8	65–70	0–15	16–18	19–21	22–25	26+
9	70–75	0–16	17–19	20–22	23–26	27+
10	75–80	0–17	18–20	21–23	24–27	28+
11	80+	0–18	19–21	22–24	25–28	29+

Figure 2: Bias in Reported Prices by Actual Weight and Fat Class of Pigs

Bias in Reported Prices (cents/kg)



Bias in Reported Prices (Percentage)



market reporting activities, but that hypothesis remains to be tested. A tendency to err towards the mean might reasonably be supposed to be a natural human one that would not be confined to pig market reporters. Similar mistakes might be expected of reporters for other types of animals and buyers and sellers of all types of animals. However, further work is needed before the results from the pig trial data can be extrapolated beyond the pig market to other livestock markets.

The majority of pigs are sold in the middle of the weight range where errors tended to be less important. Nevertheless, if reporters make errors in the field, as they did in the trial, there may be significant errors in reported prices for some classes of pigs. The classes to be reported are objects of choice. The trial results suggest that it is difficult to distinguish fat categories of pigs, but prices suggest it is important to be able to do so. If fewer classes were reported separately, fewer pigs would be reported in the wrong classes, but collapsing classes would involve a loss of information; a greater range of prices within each class in exchange for a reduction in the errors due to incorrect classification. To make an informed trade-off between the extent of bias and dispersion in reported prices requires, as a starting point, the types of information generated by this study. Our subjective judgement on this trade-off is that it would probably be better to report fewer fat categories of pigs.

We suggested earlier that an appropriate goal for any market information service is to be optimally inaccurate. Throughout Australia a variety of organisations are engaged in the production of market information on livestock and fruit and vegetable markets. Many of these carry out little, if any, formal assessment of the quality of the information they produce. Experience with the Victorian LMRS suggests that reporting errors will be more serious without routine monitoring of reporter accuracy. The Victorian LMRS data have been subject to continual scrutiny since the inception of the service, and the LMRS is believed to be at least as accurate and consistent as any other agricultural market information service. Nevertheless, LMRS reports are only estimates and these trial results indicate that the estimates may be biased. The results of econometric studies that use the data as if they were measured without error should, therefore, be treated cautiously, particularly attempts to model effects of fat and weight on prices (*e.g.* see West 1984).

It would be desirable to monitor and analyse reporter accuracy routinely, but detailed data, of the type used in this study are too expensive to collect except on a sporadic basis. For routine assessment smaller samples could be collected and analysed using graphs and simple statistical tests. This routine assessment could indicate where more detailed work would be worthwhile.

The difficulty with all such work is in deciding what is an acceptable degree of inaccuracy for each of the variables reported by the LMRS. It seems likely that the sensitivity of livestock price to fat depth and weight will be the main determinants of the cost of reporting errors. In the case of pigs, prices are very sensitive to fat depth and errors in estimating fat are likely to be comparatively important. While we would judge that it is too ambitious to attempt to report five fat categories for pigs, more information is needed to make an informed decision about this including information on what the users of LMRS data want, and information on the accuracy of the LMRS under field, as opposed to trial, conditions. Further work is required to collect this additional information and to extend the work done in this study to sheep and cattle markets.

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