Swine - Price

THE IMPACT OF QUARTERLY HOG AND PIG REPORTS ON LIVE HOG FUTURES PRICES: AN EVENT STUDY OF MARKET EFFICIENCY

by

Michael A. Hudson, Stephen R. Koontz
and Wayne D. Purcell

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Department of Agricultural Economics
Virginia Polytechnic Institute and State University
Blacksburg, Virginia
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Economists, government policy makers, agricultural producers, and market analysts are interested in the performance of futures markets. Trade in futures contributes to the price discovery process for agricultural commodities. The question of whether futures markets register information efficiently thus becomes important.

Economists are interested in the efficiency of futures markets in responding to changes in the set of available information and in generating a consensus price which balances supply and demand. Policy makers determine the types of information gathered, the timing of releases, and are therefore interested in the ability of the futures markets to incorporate and register the impact of information. From the viewpoint of the agricultural producer, effective use of futures markets in attempts to reduce exposure to price risk requires that the markets accurately reflect available information. Producers are also involved in the process of providing information to government agencies, such as the USDA, and are therefore concerned with the frequency of reporting and the overall adequacy of the information base.

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*Research Associate, Research Assistant, and Professor, respectively, in the Department of Agricultural Economics, Virginia Tech, Blacksburg, Virginia.

In discussing empirical tests for efficiency in the stock market, Fama et al. (p. 1) noted

> "...the usual procedure for the analysis of market efficiency has been to infer market efficiency from the observed independence of successive price changes. There has been very little actual testing of the speed of adjustment of prices to specific kinds of information."

The *market efficiency* referred to here deals with the capacity of the market to reflect all currently available information. A market is said to be *efficient* if, at any point in time, all the available information has been registered in the price being observed.

Miller notes that the current state of knowledge regarding futures market efficiency is much like the state of the stock market literature prior to Fama et al. Numerous tests of the random walk model have been conducted for grain and livestock futures markets (e.g. Houthakker, Rocca, Stevenson and Bear, Cargill and Rausser, Clark, Mann and Heifner, Grauer, and Leuthold). The response of grain futures markets to information has been studied by Larson, Pearson and Houck, and Gorham. Larson examined the response of futures prices to general kinds of supply and demand information, concluding that 81 percent of the appropriate price change occurs within one day after the release of new information. Pearson and Houck examined the relationship between changes in crop production forecasts and changes in the price level for corn, soybeans, and wheat. Gorham compared the performance of the private information sector with USDA crop reports. The underlying assumption of Gorham's approach was that market prices would not be af-

fected by the reports if the information released by the USDA has been fully incorporated by the market and the observed price has registered the impact of that information. The significance of a change in the production forecast against the change in the futures prices from the day before and the day after the crop report was tested using regression analysis.

In the livestock sector, Miller, USDA (1977), and Hoffman have examined the response of futures prices to market information contained in USDA reports. Miller developed partial adjustment models to measure the relationship between specific kinds of information contained in the USDA hog and pig reports. Miller concluded that nearby live hog futures prices adjust quickly to new information, with one-half of the price adjustment occuring in less than a week. The distant contracts were slower to react, which the author attributed to a low volume of trading.

The USDA (1977) examined the response of live hog futures prices to the hog and pig reports over a four year period. Using weekly average prices before and after the report, prices were shown to move up and down about the same number of times after the release of the reports. Hoffman extended the USDA analysis in examining the response of live cattle futures prices to the release of the cattle on feed reports and the response of live hog futures prices to the hog and pig reports. Descriptive statistics indicated that live cattle futures prices increased almost twice as often as they declined, for both nearby and distant

contracts, following the release of the reports. Live hog futures prices for nearby contracts also increased more often than they declined, though for distant contracts hog futures prices decreased as often as they increased. The nearby and distant contracts moved in the same direction 89 percent of the time for cattle and 76 percent of the time for hogs.

The studies of Hoffman and Miller examined only the short term price changes in response to the release of the hog and pig reports. Miller employed price changes from the day before the release of the report to the day after the release. Hoffman employed average price for the week before and the the week after the release date. An alternative technique for the analysis of the response of futures prices to new information, which employs a longer time period around the report release, has been suggested by Chance (1983). The *event study method* employed by Chance is widely accepted and frequently employed in the stock market literature to examine the impact of periodic reports on security prices. This article examines the reaction of live hog futures prices to the quarterly release of USDA hog and pig reports via the event study method.

THEORETICAL FRAMEWORK

Price discovery in agricultural markets requires interpretation and incorporation of information in seeking a price which balances supply

and demand. Market efficiency measures the ability of a market to incorporate new information promptly and effectively and register the impact of new information in the form of price adjustments. In a market efficiency context, there are two dimensions to the process of information registration. First, there is the question of the speed and accuracy with which a market incorporates and registers new information. The market must interpret new information and generate, quickly and effectively, a price which reflects that new information. The second important dimension of the process of information registration revolves around the information set underlying the price discovery processes. A market could be efficient in the process of registering the impact of the information set to which market participants have access, but the day-to-day discovered price can diverge from the underlying equilibrium price if the information set is less than complete.

The question of futures market efficiency takes on a somewhat different dimension from the classic efficiency studies (e.g. Leuthold, Cargill and Rausser, Stevenson and Bear) when the adequacy of the information set is also considered. The standard procedure for analyzing futures market efficiency has been to infer efficiency from the serial independence of successive price changes. The frame of reference involved in such analysis was suggested by Fama (p. 56):

> "... an efficient market, characterized by numerous well-informed participants, should create prices which accurately reflect all current information. Thus, the commodity will be priced at a reasonable estimate of its intrinsic value. Price changes will reflect the emergence of new information and hence will be consistent with a random walk."

The implicit assumption for the random walk model is the random emergence of information.

Given the underlying assumption of the random emergence of information, the random walk model seems inappropriate for the analysis of the efficiency of agricultural commodity markets. The periodic release of USDA informational reports suggests that, although the day-to-day emergence of information is random, the flow of new information into the market occurs at specified intervals. The information set accessible to market participants on day $t-k$ can differ significantly from the set of information on day t (the report day) as k increases, depending on the ability of market participants to correctly anticipate the supply related information which is provided in the report.

Available Information versus Compiled Information

Studies which examine futures market efficiency often find inefficient markets, identifying nonrandom behavior inconsistent with the Fama hypothesis. The reasons for these results can be traced to the interpretation of the phrase *all current information* in the Fama criterion.

In the research literature, the above phrase is explicitly or implicitly interpreted to be *all available information*. There are, however, actually two kinds of information: (1) compiled information, information contained in publicly available market reports such as the quarterly hog and pig reports, and (2) available information, information which exists in a dissegregated sense but has not been compiled in report form.

The information in the USDA hog and pig reports is *available* prior to the release of USDA reports, but search costs apparently block compilation by the private sector. Once the USDA releases its market report, the available information is accessible to market participants and the live hog futures market registers the impact of the information. Market adjustments to such information, if the information is not accurately anticipated (e.g., farrowings are significantly higher than anticipated), will be nonrandom. Such nonrandom price adjustments would be identified as inefficiency using the classical tests for serial independence of price changes.

Applicability of the Event Study Method

The quarterly hog and pig reports fit the concept of a periodic *event* which has capacity to influence market prices. Comparisons of previously reported information (e.g. farrowing intentions) and updated information (e.g. actual farrowings) in successive reports allows classification of the reports with respect to their anticipated impact on prices. Within this classification, price movements prior to and following the release of the reports generate a picture of the process of market adjustment to newly compiled information.

To illustrate, assume a particular report indicates a significant increase in sow farrowings compared to the farrowing intentions in the previous report. Such a change in a supply variable would be expected to elicit a price decrease. The report would be classified as *bear-*

ish. If a downward price adjustment occurs following the report, the information contained in the report was apparently not previously known to market participants. Examination of the frequency, direction, and magnitude of price adjustments following the release of USDA reports provides a base for inferences regarding the efficiency of the futures market and the adequacy of the information set being employed by market participants.

DATA AND METHODS

Application of the event study method to examine price adjustments in response to quarterly hog and pig reports involves a multi-step procedure beginning with the analysis of the weak-form efficiency of the live hog futures market. The weak-form efficiency of the market was analyzed using a simple test of the martingale hypothesis and a test for serial independence of successive price changes. The second step in the analysis involved the development of classification schemes for the hog and pig reports using quantity variables contained in the reports. Price changes on the first trading day after the report and the algebraic sums of price changes five and ten days before and after the release date of the report were calculated. Correlations were computed between the classification ratios and the price changes. Cumulative price changes were also calculated for each of the futures contracts. Within the classification schemes, linear and quadratic time trend re-

gressions were fitted to the cumulative price changes to examine patterns of movement following the release of the reports. Finally, a measure of quantity drift was developed using the elasticity of demand for pork. The quantity drift variable provides insight into the degree of divergence between available and compiled information.

The Data

The data used for analysis covered the period from December 1973 through September 1983. Forty hog and pig reports were released during that period. Two futures contracts were examined for each of the hog and pig reports to allow analysis of the reaction of nearby and distant contracts to the information contained in the reports. The contracts and reports were aligned as follows:

Report	*Futures Contracts Analyzed*
March	June and October
June	August and December
September	December and April
December	February and June

Live hog futures price changes were recorded for each contract for the 38 days surrounding the release of the hog and pig reports. The 38 price changes resulted from differencing the futures prices for the 39 days around each report. This procedure provides 19 price changes before the release of the report, one price change between the release date and the first trading day following the report (labeled the "report day" change), and 18 price change following the report. A

period of 39 days allowed sufficient time before and after the report for information to be fully incorporated, but was not long enough to encompass significant supply responses.

Weak Form Efficiency of Live Hog Futures

Two simple tests for weak-form efficiency were conducted. A test of the martingale hypothesis required examining the means of the 38 price changes around the report releases for each of the futures contracts. The martingale hypothesis suggests that prices fully reflect all current information and the expected mean price change across the 38 changes would therefore be zero (Chance, 1984). The mean price change was significantly different from zero for three of the 80 futures contracts examined. With 80 contracts and a 0.05 significance level, four significant values would be expected solely by chance. The martingale hypothesis is, therefore, supported by the behavior of the live hog futures prices.

A second simple test of weak-form efficiency involves examining the serial independence of successive price changes. The Q-statistic measures the degree of autocorrelation present in a series by squaring and summing the successive estimated autocorrelation coefficients and correcting for degrees of freedom. First, the Q-statistic was computed for the 19 price changes prior to the report. Evidence of statistically significant (at the .05 level) serial dependence was found in five of the 80 contracts during the period prior to the report. Next, the Q-statistic was computed for the first price change after the report and the 18

days following the report. Serial dependence was again present in five of the 80 cases. Finally, the Q-statistic was computed for all 38 price changes surrounding the report. Statistically significant departure from serial independence as found in six of the 80 contracts. The results thus indicate evidence of serial correlation in live hog futures prices at the .05 level of significance. Further examination indicates that the serially correlated price changes tend to be associated with *surprising* reports.

Serial dependence in price changes following the release date of the reports would be expected if a report is a *surprise* and the information has not been correctly anticipated. A series of price changes in the same direction would be required to adjust to a significant change in future supplies of hogs. The results thus suggest that live hog futures prices exhibit serial correlation around the release of the hog and pig reports as price adjustments to the information contained in the report are completed. This result is consistent with Miller (p. 69):

> "... futures prices respond in the expected direction to this new information (contained in the hog and pig reports). Next, significant coefficients for the lagged dependent variables indicate that the futures market does not respond instantaneously to the new (hog and pig report) data."

Classification of Reports

The futures contracts selected for analysis provide a nearby contract and a six month distant contract for each of the quarterly hog and pig reports. To facilitate the analysis of pre- and post-report price movements, the reports were classified in terms of expected effects on prices for the nearby and distant contracts. Five classification ratios were developed. Three of the classification ratios relate to the distant contracts and two relate to the nearby contracts.

The classification ratios for the distant contract were developed to account for quantity variables in the report which would affect the available supply of hogs one to six months in the future. Ratio 1 measures the differential between actual farrowings and the farrowing intentions reported in the previous hog and pig report. All ratios are defined more explicitly at the bottom of Table 2.

Ratio 2 attempts to measure for the relationship between farrowing intentions and light market hogs. The ratio is computed by using, for example, the sum of market hogs under 60 pounds and market hogs between 60 and 119 pounds from the March report and farrowing intentions for the December to February period in the December report. Ratio 2 thus provides further insight into actual farrowings as they relate to farrowing intentions and incorporates any variation in litter size.

The ratio of total market hogs to lagged actual farrowings (two quarters back) plus farrowing intentions from the previous quarter is defined as Ratio 3. This ratio will indirectly measure the number of

gilts held for breeding, since total market hogs in the current period should approximately equal the sum of lagged intentions and actual farrowings lagged two quarters.

The two ratios for the nearby contracts relate heavy hogs and total market hogs to lagged actual farrowings. Ratio 4 is computed using the sum of market hogs in the 120 to 179 pound group and the over 180 pound group from the current report to actual farrowings in the previous report. Ratio 5 is the ratio of total market hogs in the current report to actual farrowings in the previous report. These two ratios measure the relationship between farrowings in the most recent quarter and market hogs which will go to slaughter in the current quarter, the quantity variables which should influence the price of the nearby contract.

Classification of the reports as bullish, bearish, or neutral required the identification of a neutral range for each of the ratios. The hog and pig reports are considered to have an error factor up to plus or minus two percent (USDA, 1977). To provide a conservative error band, ratios which indicated a change of three percent or more in the positive direction were classified as bearish and ratios with a three percent or greater change in the negative direction were classified as bullish. Ratios with less than a three percent change were classified as neutral. Table 1 presents a summary of the classifications and the ranges of the ratios.

TABLE 1. REPORT CLASSIFICATION FREQUENCIES FOR ALTERNATIVE RATIOS AND RANGES OF RATIOS BY REPORT.

Classification	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5
		Number of reports			
BULLISH	9	11	8	13	6
BEARISH	11	15	11	14	12
NEUTRAL	20	14	21	13	22
Report		Range of Ratio (High/Low)			
MARCH	-12.18	-11.81	-10.35	-10.02	-8.38
	6.34	12.12	6.51	11.69	7.23
JUNE	-5.63	-4.18	-6.36	-10.93	-6.34
	7.20	5.38	6.54	8.59	7.74
SEPTEMBER	-3.28	-5.14	-3.07	-5.26	-5.95
	4.42	6.52	4.97	8.11	6.22
DECEMBER	-4.50	-6.44	-8.38	-12.09	-8.21
	6.79	4.77	7.03	8.83	9.43

Examination of the report classifications and ranges of the ratios in Table 1 provides insight into the variability of the ratios and the consistency of report classification across ratios. For the distant contracts, Ratio 1 and Ratio 3 are virtually the same in terms of report classification. Ratio 2, also for the distant contracts, classifies fewer reports as neutral, with a significant increase in the number of bearish classifications. The ranges of the three ratios exhibit common behavior across the four reports. Each of the ratios has its widest range in the March report.

The ratios used to classify the nearby contracts, Ratio 4 and Ratio 5, differ in their classification of bullish and neutral reports. Each identifies a similar number of bearish reports. Ratio 4 identifies significantly more reports as bullish and is more variable than Ratio 5. The nearby ratios have their widest ranges in the March report for Ratio 4 and the December report for Ratio 5.

The March report would be expected to have a wide range in terms of the ratios given the weather related uncertainty involving sow farrowings and pigs saved per litter during the winter months. The June and September reports would be expected to exhibit less ratio variability due to their timing relative to the peak farrowing periods of the year. The June report follows a period when farrowings are high and the September report precedes a period of large farrowings. There is also less weather uncertainty related to farrowings to impact these reports. The December report is also subject to weather related variabil-

ity emerging from conception problems during the hot summer months. The variability of the ratios suggests that March and December reports, especially March, are *surprises* more often than the June and September reports. The market appears to be *information starved* prior to these reports, suggesting the private sector has difficulty in compiling accurate information during the months prior to release of the March and December reports.

The classification ratios are presented in Table 2 in terms of percentage deviations from expected levels. For example, a value of -8.77 in the column labeled Ratio 1 indicates that actual farrowings were 8.77 percent below farrowing intentions in the previous report.

Algebraic Sums of Price Changes

Table 2 also presents the algebraic sums of the price changes around the report day and the percentage price change after 10 days. The price movements five and ten days prior to the report show no obvious pattern. There is a tendency for a change in the direction of price movement between the 10 and five day sums as indicated by the smaller absolute values of the five days sums. This may be due in part to *evening up* on the part of traders prior to the report.

The algebraic sums of price changes following the reports indicate that the adjustments after five days tend to be in the same direction as the 10-day adjustments. There is no clear pattern regarding the relative magnitude of the moves. In some cases, the five day move is lar-

TABLE 2. CLASSIFICATION RATIOS, ALGEBRAIC SUMS, AND PERCENTAGE PRICE ADJUSTMENTS FOR QUARTERLY HOG AND PIG REPORTS, DECEMBER 1973 THROUGH SEPTEMBER 1983.

Report	Contract	Classification Ratios*					Algebraic Sums of Price Changes					Percent Price Change**
							Prior to Release		Report	Post Release		
		Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio 5	10 days	5 days	Day	5 days	10 days	
March 74	June 74				11.69	5.47	-4.60	-2.15	-0.95	1.73	2.43	7.13
March 74	Oct 74	- 1.57	3.27	6.51			-3.82	-0.90	-0.95	0.70	-0.38	- 1.01
March 75	June 75				5.11	- 0.83	3.25	0.85	1.50	1.43	1.30	2.87
March 75	Oct 75	- 8.77	1.69	2.36			2.65	1.50	1.50	1.70	1.30	2.94
March 76	June 76				4.59	7.23	2.95	0.80	-0.18	-0.13	3.27	7.09
March 76	Oct 76	4.65	6.57	6.37			2.35	1.05	-1.23	-1.47	0.88	2.17
March 77	June 77				- 2.43	- 2.70	3.57	0.63	-1.45	-2.13	0.13	0.34
March 77	Oct 77	2.01	- 0.70	- 0.70			2.60	0.75	-1.50	-2.25	-0.25	- 0.68
March 78	June 78				-10.02	- 8.38	-0.85	-2.20	1.50	2.88	3.05	6.18
March 78	Oct 78	-12.18	-11.81	-10.35			-1.48	-2.18	1.50	4.98	5.40	12.78
March 79	June 79				- 4.56	- 0.44	-1.00	-0.08	-1.50	-4.37	-4.52	- 8.82
March 79	Oct 79	3.71	1.39	- 0.57			-0.90	-0.73	-1.50	-4.12	-4.90	-10.65
March 80	June 80				0.21	2.11	-2.40	-1.45	-1.50	-4.55	-6.10	-15.99
March 80	Oct 80	2.97	6.70	3.90			-1.38	-0.15	-1.50	-3.95	-5.30	-13.44
March 81	June 81				- 3.19	- 0.15	-4.50	-1.10	1.50	5.27	4.85	10.71
March 81	Oct 81	- 5.66	- 0.15	- 1.57			-3.30	-0.67	1.50	7.27	7.80	17.12
March 82	June 82				- 3.96	- 4.47	0.95	-1.12	1.50	2.72	3.90	7.11
March 82	Oct 82	- 6.34	1.69	- 1.27			2.47	1.42	1.50	3.05	3.15	5.94
March 83	June 83				3.41	0.03	0.41	0.99	-1.50	-3.66	-2.14	- 3.90
March 83	Oct 83	6.34	12.12	4.67			0.13	0.55	1.50	-2.23	-1.48	- 3.16
June 74	Aug 74				0.12	6.27	4.28	3.55	1.50	6.75	9.27	30.82
June 74	Dec 74	- 2.46	- 3.38	- 0.78			3.52	2.88	1.50	4.63	6.45	20.33
June 75	Aug 75				6.87	7.74	3.95	1.23	0.68	-1.65	-1.95	- 3.54
June 75	Dec 75	- 5.63	- 2.21	1.69			1.32	-0.20	1.33	-1.52	-1.98	- 4.00
June 76	Aug 76				- 4.42	2.30	-1.30	-1.23	1.28	1.28	-0.15	- 0.54
June 76	Dec 76	4.65	5.38	2.43			-1.72	-1.15	0.38	0.85	0.90	2.11
June 77	Aug 77				-10.93	- 6.34	-1.10	0.10	1.50	3.75	2.38	5.54
June 77	Dec 77	- 3.87	- 4.45	- 6.36			-0.48	0.10	1.50	2.73	-0.15	- 0.39
June 78	Aug 78				- 3.54	- 4.45	-5.37	-4.00	1.50	0.77	1.70	3.76
June 78	Dec 78	- 2.38	- 3.04	- 3.40			-4.55	-2.50	1.50	4.08	4.23	9.86
June 79	Aug 79				- 4.33	- 2.92	-2.00	-2.25	0.03	-0.62	1.65	4.51
June 79	Dec 79	- 1.75	- 4.18	- 3.95			-0.43	-1.28	0.35	-1.27	0.18	0.49
June 80	Aug 80				- 2.69	- 2.67	3.85	0.25	1.50	1.95	3.50	8.87
June 80	Dec 80	- 2.36	- 2.67	- 3.03			2.92	-0.50	1.50	1.90	3.00	7.06
June 81	Aug 81				2.77	- 0.17	-3.45	-2.23	0.63	-1.77	-1.07	- 1.94
June 81	Dec 81	1.72	3.87	2.86			-1.75	-1.25	1.13	-2.65	-1.97	- 3.49
June 82	Aug 82				8.59	- 1.05	2.20	1.28	1.22	-0.45	-0.53	- 0.89
June 82	Dec 82	- 3.68	3.56	3.99			1.72	1.65	1.50	1.13	0.03	0.05
June 83	Aug 83				7.55	3.39	-1.10	0.50	-0.75	1.57	-0.55	- 1.26
June 83	Dec 83	7.20	7.11	6.54			-0.53	1.22	-1.40	-0.60	-1.75	- 4.30

TABLE 2. (Continued)

Report	Contract	Classification Ratios*					Prior to Release			Post Release		Percent Price Change
		Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio 5	10 days	5 days	Report	5 days	10 days	
Sept 74	Dec 74				- 4.09	- 5.95	2.30	1.93	0.50	3.80	4.43	11.32
Sept 74	Apr 75	- 1.78	5.26	- 0.54			3.15	2.05	-0.15	2.53	3.00	7.08
Sept 75	Dec 75				3.03	3.03	3.78	0.55	1.45	1.80	3.30	5.25
Sept 75	Apr 76	3.42	6.52	4.71			2.00	-1.30	0.85	-1.45	2.28	4.13
Sept 76	Dec 76				3.98	4.74	-2.52	-0.90	-0.90	-2.08	-2.08	- 6.19
Sept 76	Apr 77	2.53	5.40	4.97			-3.05	-1.00	0.95	-2.75	-1.70	- 5.22
Sept 77	Dec 77				0.80	4.51	0.53	0.78	-0.50	-0.70	-2.13	- 5.61
Sept 77	Apr 78	4.42	- 0.38	1.41			0.63	-0.25	-0.65	-1.05	-1.85	- 5.62
Sept 78	Dec 78				- 0.38	2.09	1.60	2.43	1.50	1.85	3.32	6.42
Sept 78	Apr 79	- 3.28	- 5.14	- 1.88			2.68	2.02	1.03	1.65	3.93	8.38
Sept 79	Dec 79				- 5.26	- 1.54	1.30	-0.48	-1.50	-2.95	-4.07	-10.51
Sept 79	Apr 80	0.10	- 3.13	- 3.07			1.72	-0.48	-1.50	-4.15	-4.20	-10.44
Sept 80	Dec 80				2.59	- 0.11	1.52	1.50	-1.50	-0.50	-1.52	- 3.06
Sept 80	Apr 81	- 1.14	- 0.47	0.47			1.85	1.38	-1.50	-0.68	-2.73	- 5.26
Sept 81	Dec 81				3.87	3.26	-0.18	-1.40	-1.42	-2.82	-2.97	- 5.76
Sept 81	Apr 82	3.64	3.17	3.47			-0.45	-0.70	-1.50	-3.85	-3.85	- 7.91
Sept 82	Dec 82				8.11	6.22	-3.13	0.05	1.50	2.05	-3.07	- 5.09
Sept 82	Apr 83	- 2.15	- 3.26	2.18			-1.25	0.60	1.50	1.95	-0.68	- 1.25
Sept 83	Dec 83				4.83	1.87	0.60	0.12	-1.15	-0.72	-2.10	- 5.03
Sept 83	Apr 84	- 0.62	- 1.10	1.29			0.19	-1.38	-1.20	-1.47	-2.71	- 5.73
Dec 73	Feb 74				8.83	9.43	0.05	0.38	-1.50	1.30	3.42	7.95
Dec 73	June 74	- 2.25	4.16	7.03			-0.50	-0.77	-1.43	2.45	4.67	10.88
Dec 74	Feb 75				7.17	2.37	-1.75	-0.97	-1.48	-2.85	-3.20	- 7.39
Dec 74	June 75	- 1.21	4.77	4.77			-0.93	-1.05	-1.45	-2.75	-3.25	- 7.07
Dec 75	Feb 76				4.27	3.15	-1.55	1.53	-1.23	0.02	0.15	0.32
Dec 75	June 76	- 0.80	0.91	2.27			-0.82	0.38	-0.20	2.05	2.15	5.01
Dec 76	Feb 77				- 2.99	- 1.35	1.72	0.27	1.50	1.90	0.90	2.42
Dec 76	June 77	2.94	0.55	- 0.88			1.70	1.20	1.50	2.32	1.92	5.26
Dec 77	Feb 78				-12.09	- 8.21	2.55	1.73	1.37	1.62	3.55	8.24
Dec 77	June 78	- 1.84	- 6.44	- 8.38			0.95	0.72	1.50	3.33	4.65	11.89
Dec 78	Feb 79				- 5.22	0.59	-1.57	-0.22	-1.50	-2.90	-1.60	- 3.17
Dec 78	June 79	5.75	1.68	- 0.41			-2.15	-1.00	-1.50	-2.67	-1.40	- 2.91
Dec 79	Feb 80				- 6.30	- 5.46	0.03	-1.77	-0.58	0.82	-1.38	- 3.30
Dec 79	June 80	- 4.50	- 5.46	- 5.55			0.78	-1.85	0.32	2.07	-0.50	- 1.14
Dec 80	Feb 81				1.28	0.16	-0.23	-0.63	-1.50	-4.50	-5.05	-10.09
Dec 80	June 81	6.79	3.32	2.07			1.02	-0.08	-1.50	-6.07	-7.17	-12.69
Dec 81	Feb 82				2.58	- 2.16	-2.52	0.85	1.50	3.37	4.55	10.89
Dec 81	June 82	- 2.01	- 4.60	- 2.18			-2.08	1.47	1.50	4.05	5.28	12.22
Dec 82	Feb 83				2.06	0.77	1.10	-0.70	0.90	-0.70	1.52	2.62
Dec 82	June 83	8.92	1.11	1.24			1.65	0.07	0.20	-1.22	0.40	0.71

* The classification ratios are defined as follows:

Intermediate Contract Classifications:
Ratio 1 = (actual farrowings) / (1 quarter lagged 2nd intentions);
Ratio 2 = ((under 60#)+(60-119#) market hogs) / (1 quarter lagged 2nd intentions);
Ratio 3 = (total market hogs) / ((2 quarter lagged actual farrowings)+(1 quarter lagged 2nd intentions);

Nearby Contract Classifications:
Ratio 4 = ((120-179#)+(over 180#) market hogs) / (1 quarter lagged actual farrowings);
Ratio 5 = (total market hogs)/(1 quarter lagged actual farrowings).

The figures in the table represent deviations from 100 percent.

** The percentage price adjustment is computed as the ratio of the +10 day algebraic sum and the closing price on the day the Hog and Pig report is released. Note that this day differs from the "report day" above, which measures the price change on the first trading day after the report is released.

ger than the 10-day move and, in other cases, the opposite is true. The price movements on the day after the report, the column labeled "report day," tend to be in the same direction as the five and 10-day post report sums.

Examination of the price changes in Table 2 shows a high frequency of limit moves ($1.50 per cwt.) immediately after the report. There are a total of 42 such limit price moves following the 80 hog and pig reports. Of the 42 limit moves, 15 follow March reports, 9 follow June reports, 8 follow September reports, and 10 are in response to December reports. It should be noted that the occurrence of initial limit price moves is not restricted to those reports where the classification ratios show large deviations from expected levels. This reflects a potential weakness in the classification schemes. The classifications relate actual data in the hog and pig reports to previously reported intentions. The price response of the futures market, however, is dependent upon the difference between the *actual numbers* and what industry analysts *expected*. The data in Table 2 suggest that analysts are not very successful in formulating accurate expectations regarding information in the forthcoming hog and pig reports.

The percentage price change in Table 2 is computed using the 10-day algebraic sum following the report and the closing price (1:55 PM, eastern standard time) on the day the report is released (3:00 PM, eastern standard time). The percentage price change ranges from -15.99 to +30.82, although this is somewhat misleading when the price

level across the data period is considered. During the data period, hog prices ranged from $25.00 cwt. to $65.00 per cwt. The percentage price changes are nonetheless useful in examining net price adjustments and in analyzing the relationship of price changes to quantity changes.

The behavior of the futures contracts examined against the March report indicates that the market adjusts well to the information contained in the report. The frequency of large price moves following the report, coupled with the variability in the data implied by the classification ratios, reinforces the need for more information. Given that the markets seem to be information starved coming into the March reports, the frequency with which reports are released should be examined. The futures contracts examined against the June report also adjust reasonably well to the information in the report. There are, however, occasional adjustments which seem to be in the wrong direction. There are fewer dramatic adjustments to the September and December reports, and the direction and magnitude of the responses appears to be generally correct.

Correlation Analysis of Classifications and Algebraic Sums

The estimated correlation coefficients between the classification ratios, algebraic sums of price changes, first day price changes, and percentage price changes were computed for each of the reports. The estimated coefficients appear in Table 3.

TABLE 3. CORRELATIONS OF CLASSIFICATION RATIOS AND ALGEBRAIC SUMS OF PRICE CHANGES FOR NEARBY AND DISTANT CONTRACTS.

Report	Algebraic Sum	Distant Contracts			Nearby Contracts	
		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5
MARCH	-10 DAY	-0.086 (0.813)*	0.145 (0.689)	0.073 (0.841)	-0.045 (0.902)	-0.144 (0.691)
	-5 DAY	0.253 (0.481)	0.561 (0.091)	0.508 (0.134)	0.214 (0.553)	0.216 (0.547)
	REPORT DAY	-0.648 (0.043)	-0.221 (0.539)	-0.409 (0.239)	-0.309 (0.384)	-0.445 (0.198)
	+5 DAY	-0.832 (0.003)	-0.575 (0.082)	-0.531 (0.114)	-0.092 (0.799)	-0.228 (0.526)
	+10 DAY	-0.723 (0.018)	-0.544 (0.104)	-0.515 (0.128)	-0.001 (0.998)	-0.118 (0.746)
	% PRICE CHANGE	-0.717 (0.019)	-0.559 (0.093)	-0.526 (0.119)	0.059 (0.871)	-0.074 (0.839)
JUNE	-10 DAY	-0.344 (0.329)	-0.191 (0.597)	0.056 (0.877)	0.331 (0.351)	0.537 (0.109)
	-5 DAY	-0.045 (0.903)	0.125 (0.730)	0.334 (0.345)	0.361 (0.305)	0.587 (0.074)
	REPORT DAY	-0.833 (0.003)	-0.613 (0.059)	-0.532 (0.113)	-0.459 (0.182)	-0.267 (0.456)
	+5 DAY	-0.295 (0.407)	-0.435 (0.208)	-0.475 (0.166)	-0.398 (0.254)	0.051 (0.888)
	+10 DAY	-0.249 (0.489)	-0.473 (0.168)	-0.441 (0.202)	-0.388 (0.268)	0.013 (0.972)
	% PRICE CHANGE	-0.249 (0.487)	-0.459 (0.181)	-0.384 (0.274)	-0.275 (0.442)	0.152 (0.676)

TABLE 3. (Continued).

Report	Algebraic Sum	Distant Contracts RATIO 1	RATIO 2	RATIO 3	Nearby Contract RATIO 4	RATIO 5
SEPTEMBER	-10 DAY	-0.362 (0.303)	-0.137 (0.705)	-0.644 (0.044)	-0.575 (0.082)	-0.596 (0.118)
	-5 DAY	-0.712 (0.021)	-0.322 (0.365)	-0.577 (0.081)	-0.355 (0.314)	-0.436 (0.208)
	REPORT DAY	-0.198 (0.583)	0.076 (0.835)	0.318 (0.371)	0.134 (0.712)	0.161 (0.658)
	+5 DAY	-0.662 (0.037)	-0.187 (0.604)	-0.230 (0.523)	-0.032 (0.930)	-0.258 (0.472)
	+10 DAY	-0.369 (0.294)	0.141 (0.698)	-0.071 (0.844)	-0.318 (0.371)	-0.428 (0.218)
	% PRICE CHANGE	-0.435 (0.209)	0.126 (0.729)	-0.087 (0.812)	-0.275 (0.442)	-0.460 (0.181)
DECEMBER	-10 DAY	0.278 (0.437)	-0.104 (0.774)	-0.234 (0.515)	-0.529 (0.115)	-0.374 (0.287)
	-5 DAY	0.128 (0.723)	-0.265 (0.459)	-0.209 (0.562)	-0.099 (0.785)	-0.028 (0.938)
	REPORT DAY	-0.249 (0.488)	-0.788 (0.006)	-0.712 (0.021)	-0.429 (0.215)	-0.589 (0.073)
	+5 DAY	-0.675 (0.032)	-0.635 (0.048)	-0.397 (0.256)	-0.154 (0.670)	-0.231 (0.521)
	+10 DAY	-0.498 (0.142)	-0.488 (0.152)	-0.251 (0.483)	-0.066 (0.855)	-0.058 (0.873)
	% PRICE CHANGE	-0.488 (0.152)	-0.501 (0.146)	-0.273 (0.446)	-0.074 (0.839)	-0.063 (0.864)

* The figures in parenthesis represent the significance level of the test of the null hypothesis that the correlation is actually equal to zero.

The theoretically expected signs for the correlation coefficients of the ratios and the five and ten day pre-report algebraic sums are not well defined. If analysts anticipate the report information correctly, and the market begins to adjust prior to release of the report, the correlations should be negative. For example, a large value for Ratio 1 suggests actual farrowings were significantly greater than farrowing intentions. If analysts glean this information from slaughter, the level of sow slaughter, slaughter weights, etc., then pre-report price moves should be downward when the ratio is large. On the other hand, if the information has already been registered in price, no significant correlations would be expected between the ratios and the pre-report sums.

The correlations between the first day, post-report five and 10 day sums, the percentage price changes, and the ratios should be negative. An increase in the ratio indicates a bearish outlook and should elicit a negative price response. Conversely, a decrease in the ratios suggests a bullish outlook and should elicit a positive price response.

In general, the estimated correlations are of the correct sign, indicating the live hog futures market adjusts in the appropriate direction to new information. This is consistent with the findings of Miller. The ratios for the distant contracts (Ratio 1, Ratio 2, and Ratio 3) show little association with the algebraic sums before the report for the March, June, and December reports. The September report, however, seems to adjust prior to the report and in the correct direction indicated by the ratios. Price movements on the report day and the algebraic

sums following the report also show the correct adjustment. Ratio 1 is particularly strong against the March report, but is less highly correlated with post-report moves for the other reports. This result is a further indication of the fact that the March report is more variable. The estimated correlations for each of the ratios measuring the more distant outlook show stronger correlations with the five and 10-day post report sums for the March contract than for the other contracts. After the June report, for example, it appears the one-day adjustment is sufficient. The five and 10-day post report algebraic sums are not highly correlated with the distant ratios. The correlation between Ratio 1 and the 10 day post report sum for the March report, in sharp contrast, is significant at the .02 level.

The nearby contract ratios show little correlation with any of the price movements. The largest coefficients occur on the first day, though none are significant at the .05 level. The nearby contracts appear to adjust to the information in the report immediately following its release and then move with the distant contracts. The results of estimated correlations of the nearby and distant contract algebraic sums confirm this behavior. The results are not presented here, but indicate the five and 10 day post report sums for the nearby and distant contracts to be strongly correlated. Though at first this result may be surprising, it can be explained in terms of supply and demand. The adjustments of the distant contract reflect changes in expectations of the distant supply of hogs. The nearby prices will also adjust to re-

flect these changes. For example, a surprisingly bullish report in terms of expected supply at a distant point raises price expectations for that distant time period. These higher price expectations increase the demand for hogs in the current time period as packers seek hogs to kill and put into storage, and producers respond to the improved price outlook by holding back gilts to breed.

Overall, the correlation analyses suggest that the distant contracts adjust in the correct direction to new information. The classification ratios for the distant period appear useful in predicting the direction of price adjustments. For nearby contracts, price adjustments occur in the appropriate direction following the release of the report, but once the distant contracts start to adjust, the nearby contracts tend to move with the distant contracts. The nearby ratios would, therefore, be more useful in predicting the report day price adjustments. Once again, the March contract shows evidence of being information starved prior to the report. The strength of the correlation coefficients of the distant ratios, against the algebraic sums following the report, indicate the need for large price adjustments following the March report.

Analysis of Cumulative Price Changes

The analysis of cumulative price changes provides additional insight into the movement of live hog futures prices around the release of the hog and pig reports. In contrast to the algebraic sums of price changes, which provide measures of the net change after a specified

period of time, the cumulative change provides a day-to-day view of the price adjustments to the information contained in the reports. The cumulative average price changes were computed by summing the price changes from day -38 through day +38 to accumulate the price change each day. For example, the cumulative price change for day -36 is equal to the sum of the price change on day -38, day -37, and day -36. The value of the cumulative average price change on day -35 would be computed by adding the price change on day -35 to the previous sum. Intuitively, the computation of cumulative price changes provides a means by which a pattern of price movement can be identified.

The cumulative price changes were plotted for each of the reports to examine patterns of price adjustment. For reports classified as bullish the cumulative plots indicated an upward adjustment following the report. Prices tended to move downward following the bearish reports. No price pattern was discernable following the neutral reports. The major price adjustments occur during the ten days following the release of the report and the cumulative price change series tended to level off beyond ten days. Prior to the report, no systematic pattern of movements was detected.

Regression analysis was used to estimate linear and quadratic time trends in the cumulative price change series. The quadratic trend was examined to account for rapid post report price adjustments followed by dampened adjustments. The regressions were estimated using the entire

cumulative price series from day -38 to day +38 for the distant contracts. Based on observation of the plots, indicating the majority of the price adjustment within 10 days of the report, the regressions were then replicated using the cumulative series from day 0 to day +10. Regression results for the distant contracts using the day 0 to day +10 series are reported in Table 4. These results are similar to those for the day -38 to day +38 series. The nearby contracts were not examined, as the correlation analyses indicated little association between the classification ratios and the pre- and post-report price adjustments for these contracts.

For reports classified as bullish by Ratio 1, positive intercepts indicate the mean price adjustment after the report is upward. The linear and quadratic trends are both positive, with the latter dampening as the distance from the report increases. Neither the linear nor the quadratic trend coefficients are statistically significant. The bearish reports exhibit negative intercepts, indicating the mean price move is in the appropriate direction. The trends are negative and the quadratic trend is dampened in the positive direction as the distance from the report increases. The linear and quadratic trend coefficients are not statistically significant. Neutral reports, as classified by Ratio 1, show insignificant intercepts and little evidence of a linear or quadratic trend. The estimated trends for Ratio 2 and Ratio 3 display similar behavior.

TABLE 4. ESTIMATION OF LINEAR AND QUADRATIC TIME TRENDS IN CUMULATIVE DAILY PRICE CHANGES FOR TEN DAYS FOLLOWING THE RELEASE OF THE HOG AND PIG REPORTS BY CLASSIFICATION, DECEMBER 1973 THROUGH SEPTEMBER 1983, NEARBY CONTRACTS.

Ratio	Classification*	Model	Estimated Coefficient Intercept	Time	Time**2
1	Bullish (N=9)	Linear	.18195E+01	.87068E-01	
			(.0030)**	(.3249)	
		Quadratic	.11466E+01	.03977E+01	-.25883E-02
			(.2617)	(.3092)	(.4143)
	Bearish (N=11)	Linear	-.16934E+01	-.38636E-01	
			(.0013)	(.6083)	
		Quadratic	-.07693E+01	-.04651E+01	.35542E-01
			(.3742)	(.1622)	(.1879)
	Neutral (N=20)	Linear	.37929E-01	.83725E-01	
			(.9323)	(.2044)	
		Quadratic	-.77146E-01	.01368E+01	-.44260E-02
			(.9192)	(.6384)	(.8514)
2	Bullish (N=11)	Linear	.16247E+01	.82194E-01	
			(.0020)	(.2812)	
		Quadratic	.09959E+01	.03353E+01	-.24185E-01
			(.2576)	(.2689)	(.3760)
	Bearish (N=15)	Linear	-.08653E+01	-.26176E-01	
			(.0356)	(.6643)	
		Quadratic	-.04092E+01	-.02367E+01	.17545E-01
			(.5564)	(.3746)	(.4174)
	Neutral (N=14)	Linear	-.02182E+01	.44692E-01	
			(.6714)	(.5558)	
		Quadratic	-.01629E+01	.19115E-01	.21284E-02
			(.8526)	(.9545)	(.9377)

TABLE 4. (continued)

Ratio	Classification*	Model	Estimated Coefficient Intercept	Time	Time**2
3	Bullish (N=8)	Linear	.11924E+01	.60920E-01	
			(.0527)	(.4979)	
		Quadratic	.05200E+01	.03712E+01	-.25860E-01
			(.6160)	(.3508)	(.4229)
	Bearish (N=11)	Linear	-.10341E+01	.20674E-01	
			(.0106)	(.7257)	
		Quadratic	-.05538E+01	-.02012E+01	.18489E-02
			(.4159)	(.4399)	(.3820)
	Neutral (N=21)	Linear	.03428E+01	.22431E-01	
			(.4311)	(.7267)	
		Quadratic	.03481E+01	.19983E-01	.20396E-03
			(.6384)	(.9438)	(.9929)

* The reports are classified as Bullish, Bearish, or Neutral using a three percent deviation of the ratio. The figures in () identify the number of reports in each classification.

** The figures in () represent the significance level of the test of the null hypothesis that the coefficient is equal to zero.

The analysis of trends in the cumulative price changes suggests that price adjustments occur in the correct direction in response to the new information contained in the hog and pig reports. Bullish reports elicit positive price responses, bearish reports elicit negative price responses, and neutral reports elicit essentially no response. Significant time trends are not found in any of the series, though the evidence of both linear and quadratic trends is stronger (as judged by smaller p-values) for the bullish and bearish reports than for the neutral reports. Overall, the analysis suggests that prices adjust in the correct direction following the release of the hog and pig reports, but there is no statistically strong evidence of trend in the cumulative price changes.

Analysis of Quantity Drift

Leuthold and Hartman examined the semi-strong form efficiency of the live hog futures market. Using an econometric model, the authors demonstrated their ability to predict live hog futures prices better than the futures market, thereby generating trading profits due to what they called inefficiency in the futures market. In this study, price adjustments are identified as occuring in response to new information contained in the quarterly hog and pig reports. If the market is semi-strong form efficient, the magnitude of the price adjustments should reflect a change in expected supply consistent with the change in the supply variables in the report. That is, a 15 percent increase in price

in the 10 days after the report would, theoretically, reflect a shift in the supply curve along a demand curve, given the underlying elasticity of demand. On the other hand, if the market has adequate information prior to the report, large price adjustments should not occur.

To examine the change in quantity implied by the price response to the report, the concept of a *quantity drift* was introduced. Using the percentage price change from Table 2 and the elasticity of demand, an implicit percentage change in quantity can be computed. The computed percentage change in quantity estimates the quantity drift, the extent to which the set of *compiled* information has diverged from the set of *available* information.

The quantity drift figures in Table 5 were computed employing the -.7 demand elasticity for pork at the retail level, reported by Chavas. The estimates provide a conservative estimate of quantity divergence, given that the farm level elasticity of demand will be smaller. Even so, 49 of the 80 measures of drift or divergence reported in Table 5 fall outside a range of -3.0 to +3.0 percent and 25 fall outside a range of -5.0 to +5.0 percent. The overall range is -21.6 to +11.2. It is clear why a relatively high percentage of the quarterly hog and pig reports during the data period were viewed as *shocks* to the industry and ushered in dramatic price adjustments. Industry analysts simply do not have, at their disposal and in a usable form, the information needed to discover the market clearing price. A three month period is sufficient time for breeding and marketing decisions by producers to change the

TABLE 5. ESTIMATED QUANTITY DRIFT FOR NEARBY AND DISTANT CONTRACTS USING THE PERCENTAGE PRICE ADJUSTMENT IN THE TEN DAYS FOLLOWING THE RELEASE OF THE HOG AND PIG REPORTS AND THE ESTIMATED ELASTICITY OF DEMAND.

Report	Futures Contract	Estimated Quantity Drift	Percentage Price Change	Futures Contract	Estimated Quantity Drift	Percentage Price Change
MARCH	June 74	-4.992	7.131	Oct 74	0.711	-1.015
	June 75	-2.008	2.868	Oct 75	-2.056	2.938
	June 76	-4.968	7.097	Oct 76	-1.521	2.173
	June 77	-0.238	0.340	Oct 77	0.473	-0.676
	June 78	-4.329	6.184	Oct 78	-8.943	12.775
	June 79	6.174	-8.820	Oct 79	7.453	-10.648
	June 80	11.193	-15.990	Oct 80	9.404	-13.435
	June 81	-7.494	10.706	Oct 81	-11.987	17.124
	June 82	-4.977	7.110	Oct 82	-4.159	5.941
	June 83	2.731	-3.902	Oct 83	2.214	-3.162
JUNE	Aug 74	-21.576	30.823	Dec 74	-14.232	20.331
	Aug 75	2.478	-3.541	Dec 75	2.801	-4.002
	Aug 76	0.219	-0.313	Dec 76	-1.474	2.105
	Aug 77	-3.874	5.535	Dec 77	0.274	-0.392
	Aug 78	-2.633	3.761	Dec 78	-6.899	9.856
	Aug 79	-3.156	4.508	Dec 79	-0.340	0.486
	Aug 80	-6.210	8.872	Dec 80	-4.945	7.064
	Aug 81	1.361	-1.944	Dec 81	2.445	-3.493
	Aug 82	0.624	-0.891	Dec 82	-0.037	0.053
	Aug 83	0.885	-1.264	Dec 83	3.012	-4.303
SEPTEMBER	Dec 74	-7.921	11.315	Apr 75	-4.953	7.075
	Dec 75	-3.672	5.246	Apr 76	-2.894	4.134
	Dec 76	4.317	-6.168	Apr 77	3.656	-5.223
	Dec 77	3.929	-5.613	Apr 78	3.936	-5.623
	Dec 78	-4.491	6.415	Apr 79	-5.863	8.375
	Dec 79	7.358	-10.511	Apr 80	7.310	-10.443
	Dec 80	2.144	-3.063	Apr 81	3.679	-5.255
	Dec 81	4.029	-5.756	Apr 82	5.534	-7.906
	Dec 82	3.563	-5.090	Apr 83	0.873	-1.247
	Dec 83	3.519	-5.028	Apr 84	4.013	-5.733
DECEMBER	Feb 74	-5.567	7.953	June 74	-7.611	10.873
	Feb 75	5.176	-7.395	June 75	4.951	-7.073
	Feb 76	-0.222	0.318	June 76	-3.508	5.012
	Feb 77	-1.692	2.418	June 77	-3.682	5.260
	Feb 78	-5.770	8.242	June 78	-8.321	11.887
	Feb 79	2.218	-3.168	June 79	2.039	-2.912
	Feb 80	2.313	-3.304	June 80	0.801	-1.144
	Feb 81	7.060	-10.086	June 81	8.880	-12.686
	Feb 82	-7.620	10.885	June 82	-8.552	12.217
	Feb 83	-1.833	2.618	June 83	-0.498	0.712

* Quantity drift is estimated using the percent change in price from Table 1 and the estimated retail elasticity of demand (-0.7) from Chavas.

underlying supply, but analysts do not learn the magnitude of the already initiated or even completed supply response until the next quarterly report. Apparently, the costs of assembling the needed information exceed the discounted value of that information to private firms and industry trade groups.

There are at least three sources of the drift or divergence in the quantity data available to analysts:

(1) The statistical error in the data in the hog and pig reports. A 95 percent confidence interval requires a plus or minus 2 percent error factor (USDA, 1979). The range of plus or minus 3 percent used here was a more conservative figure.

(2) The frequency of the reports is a second source of divergence. For three months between reports, the market must infer from observable series (total slaughter, sow slaughter, the hog-corn ratio) what producers are doing in terms of herd expansion or contraction. The record in Table 5 suggests, at best, only a limited ability to draw correct inferences from the data series which are compiled and accessible.

(3) Related to the frequency issue, the absence of widely available and reliable information on the breakdown of

total slaughter into barrow and gilt slaughter thwarts analysts' attempts to monitor the production cycle in hogs. If this breakdown were available in the monthly (or weekly) slaughter data, the frequency of the hog and pig reports would be less critical.

Further examination of Table 5, within the context of ratios in Table 2, adds evidence to the concern about adequacy of information. The October 1979 futures recorded a 10.648 percent decline in price in response to the March report, although Ratio 1 for the March 1979 report was only 103.71. The initial tendency is to say "the price adjustment is too large," suggesting market inefficiency. But the key is that the +3.71 departure from 100 comes from *actual* farrowings, for the December 1978 through February 1979 period, which were up 16 percent from the previous year, in contrast to final intentions in the December 1978 report which were up 12 percent from the previous year. The set of compiled information was apparently not adequate for the market to register the rumors of heavy pig loss due to bad weather and still pick up the heavy rate of expansion which was occurring. The March report was, therefore, a shock and required a major price adjustment.

Based on the analysis of the quantity drift, there is clearly reason to question the adequacy of the information base in the hog markets. Nonrandom movements in price following a report which offers numbers that were unexpected and significantly different from those being used in discovering pre-report prices should not, therefore, be used as evi-

dence of market inefficiency. The problem could be in the divergence between available and compiled information and does not prove inefficient evaluation of compiled data.

SUMMARY AND CONCLUSIONS

Use of the event study method to examine the efficiency of the live hog futures market provides insight into both the adequacy of the available information and the efficiency of the market. Prices in live hog futures markets adjust to new information in the hog and pig reports rapidly and, in general, move in the appropriate direction. The market appears, however, to lack sufficient information, particularly prior to the March report. The magnitude of the price adjustments in the 10 days following the reports suggests the information on which traders are acting is often significantly different from the "true" underlying information set.

The weak-form efficiency tests conducted here provide little reason to question the efficiency of the live hog futures market. The maringale hypothesis is supported at the .05 level of significance. The hypothesis of serial independence of price changes cannot be rejected at the .10 level of significance. Moreover, examination of the location of the serially dependent price changes indicates any evidence of inefficiency is related to price adjustments around the hog and pig reports. The problem is one of inadequate information, not inefficient market processes.

Classification schemes based on ratios of quantity variables between successive reports provide a basis for segmenting the data and analysis of the direction and magnitude of price adjustments both before and after the release of the hog and pig reports. Price changes generally appear to be in the correct direction. Correlation analysis of the classification schemes and post-report price changes, and regression analysis of cumulative price changes following the reports, support the conclusion that the market responds in the correct direction to new information contained in the reports. The magnitude of the sustained day-to-day price changes required to get back on an equilibrium price path has led some analysts to incorrectly conclude that the market is inefficient.

The magnitude of the apparent divergence between the information set used by analysts and the true underlying information set on future supplies of hogs was estimated using observed post-report price changes and the demand elasticity for pork. The range of this *quantity drift* variable indicates that a supply response between reports can create significant differences between the information set being used by market participants and the true information set. This divergence prevents the live hog futures market from discovering the true equilibrium price. Large price adjustments following the reports are then required. The issue thus becomes a question of the availability of or the quality of information set and not the ability of the futures market to efficiently register information.

The analysis supports the following conclusions:

1. The live hog futures market is generally efficient in registering the impact of new information accessible to industry analysts. Evidence of inefficiency, in the form of nonrandom day-to-day price changes, tends to occur following the release of quarterly hog and pig reports which contain information which has not been accurately anticipated by the industry.

2. The estimates of quantity drift, or divergence between the compiled information and the available information (information not compiled and not accessible to analysts), are sufficiently large to suggest the primary problem in the live hog futures markets is a lack of information, not a lack of market efficiency. Further, conventional tests of market efficiency, such as analysis of the serial independence of successive price changes, are inappropriate when there is a significant divergence between the compiled information set and the available information set.

3. The live hog futures market is an information starved market. Quarterly releases of reports allow an unknown supply response to develop between reports. The absence of a widely and publicly available breakdown of barrow and gilt slaughter, on a monthly or

weekly basis, prevents analysts from inferring the supply response with acceptable accuracy. To improve the price performance of the live hog futures market, either the hog and pig reports should be released more frequently, barrow and gilt slaughter should be disaggregated in the periodic estimates of slaughter, or both changes should be made.

APPENDIX ONE

Correlations of Classification Ratios, Algebraic Sums and Percentage Price Changes for Nearby and Distant Live Hog Futures Contracts by Report

TABLE A1.1. CORRELATIONS OF CLASSIFICATION RATIOS, ALGEBRAIC SUMS, AND PERCENTAGE PRICE CHANGES FOR THE NEARBY CONTRACT AGAINST THE MARCH HOG AND PIG REPORT.

	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	-10 DAY	-5 DAY	REPORT DAY	+5 DAY	+10 DAY	% PRICE CHANGE
RATIO 1	1.000										
RATIO 2	0.000	1.000									
RATIO 3	0.000	0.000	1.000								
RATIO 4	0.000	0.000	0.000	1.000							
RATIO 5	0.000	0.000	0.000	0.805 (0.005)	1.000						
-10 DAY	0.000	0.000	0.000	-0.045 (0.902)	-0.144 (0.691)	1.000					
-5 DAY	0.000	0.000	0.000	0.214 (0.553)	0.216 (0.547)	0.756 (0.012)	1.000				
REPORT DAY	0.000	0.000	0.000	-0.309 (0.384)	-0.445 (0.198)	0.030 (0.938)	-0.249 (0.488)	1.000			
+5 DAY	0.000	0.000	0.000	-0.092 (0.799)	-0.228 (0.526)	-0.229 (0.525)	-0.414 (0.235)	0.869 (0.001)	1.000		
+10 DAY	0.000	0.000	0.000	-0.001 (0.998)	-0.118 (0.746)	0.021 (0.955)	-0.183 (0.613)	0.754 (0.012)	0.922 (0.000)	1.000	
% PRICE CHANGE	0.000	0.000	0.000	0.059 (0.871)	-0.074 (0.839)	0.002 (0.996)	-0.147 (0.686)	0.694 (0.026)	0.898 (0.000)	0.989 (0.000)	1.000

The figures in parenthesis represent the probability of a larger value of the correlation coefficient under the null hypothesis that the correlation coefficient is actually zero, i. e. the significance level.

TABLE A1.2. CORRELATIONS OF CLASSIFICATION RATIOS, ALGEBRAIC SUMS, AND PERCENTAGE PRICE CHANGES FOR THE DISTANT CONTRACT AGAINST THE MARCH HOG AND PIG REPORT.

	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	-10 DAY	-5 DAY	REPORT DAY	+5 DAY	+10 DAY	% PRICE CHANGE
RATIO 1	1.000										
RATIO 2	0.770 (0.009)	1.000									
RATIO 3	0.667 (0.009)	0.885 (0.000)	1.000								
RATIO 4	0.000	0.000	0.000	1.000							
RATIO 5	0.000	0.000	0.000	0.000	1.000						
-10 DAY	-0.086 (0.813)	0.145 (0.689)	0.073 (0.841)	0.000	0.000	1.000					
-5 DAY	0.253 (0.481)	0.561 (0.091)	0.508 (0.134)	0.000	0.000	0.816 (0.004)	1.000				
REPORT DAY	-0.648 (0.043)	-0.221 (0.539)	-0.409 (0.239)	0.000	0.000	0.030 (0.934)	0.039 (0.914)	1.000			
+5 DAY D4	-0.832 (0.003)	-0.575 (0.082)	-0.531 (0.114)	0.000	0.000	-0.256 (0.474)	-0.256 (0.476)	0.738 (0.015)	1.000		
+10 DAY	-0.723 (0.018)	-0.544 (0.104)	-0.515 (0.128)	0.000	0.000	-0.083 (0.819)	-0.143 (0.693)	0.693 (0.026)	0.955 (0.000)	1.000	
% PRICE CHANGE	-0.717 (0.019)	-0.559 (0.093)	-0.526 (0.119)	0.000	0.000	-0.082 (0.822)	-0.164 (0.651)	0.691 (0.027)	0.945 (0.000)	0.998 (0.000)	1.000

The figures in parenthesis represent the probability of a larger value of the correlation coefficient under the null hypothesis that the correlation coefficient is actually zero, i. e. the significance level.

TABLE A1.3. CORRELATIONS OF CLASSIFICATION RATIOS, ALGEBRAIC SUMS, AND PERCENTAGE PRICE CHANGES FOR THE NEARBY CONTRACT AGAINST THE JUNE HOG AND PIG REPORT.

	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	-10 DAY	-5 DAY	REPORT DAY	+5 DAY	+10 DAY	% PRICE CHANGE
RATIO 1	1.000										
RATIO 2	0.000	1.000									
RATIO 3	0.000	0.000	1.000								
RATIO 4	0.000	0.000	0.000	1.000							
RATIO 5	0.000	0.000	0.000	0.623 (0.054)	1.000						
-10 DAY	0.000	0.000	0.000	0.331 (0.351)	0.537 (0.109)	1.000					
-5 DAY	0.000	0.000	0.000	0.361 (0.305)	0.587 (0.074)	0.882 (0.000)	1.000				
REPORT DAY	0.000	0.000	0.000	-0.459 (0.182)	-0.267 (0.456)	0.207 (0.566)	0.091 (0.802)	1.000			
+5 DAY	0.000	0.000	0.000	-0.398 (0.254)	0.051 (0.888)	0.311 (0.381)	0.526 (0.118)	0.387 (0.269)	1.000		
+10 DAY	0.000	0.000	0.000	-0.388 (0.268)	0.013 (0.972)	0.343 (0.331)	0.419 (0.228)	0.444 (0.198)	0.872 (0.001)	1.000	
% PRICE CHANGE	0.000	0.000	0.000	-0.275 (0.442)	0.152 (0.676)	0.406 (0.244)	0.499 (0.141)	0.404 (0.247)	0.852 (0.001)	0.987 (0.000)	1.000

The figures in parenthesis represent the probability of a larger value of the correlation coefficient under the null hypothesis that the correlation coefficient is actually zero, i. e. the significance level.

TABLE A1.4. CORRELATIONS OF CLASSIFICATION RATIOS, ALGEBRAIC SUMS, AND PERCENTAGE PRICE CHANGES FOR THE DISTANT CONTRACT AGAINST THE JUNE HOG AND PIG REPORT.

	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	-10 DAY	-5 DAY	REPORT DAY	+5 DAY	+10 DAY	% PRICE CHANGE
RATIO 1	1.000										
RATIO 2	0.789 (0.006)	1.000									
RATIO 3	0.580 (0.079)	0.893 (0.000)	1.000								
RATIO 4	0.000	0.000	0.000	1.000							
RATIO 5	0.000	0.000	0.000	0.000	1.000						
-10 DAY	-0.344 (0.329)	-0.191 (0.597)	0.056 (0.877)	0.000	0.000	1.000					
-5 DAY	-0.045 (0.903)	0.125 (0.730)	0.334 (0.345)	0.000	0.000	0.755 (0.012)	1.000				
REPORT DAY	-0.833 (0.003)	-0.613 (0.059)	-0.532 (0.113)	0.000	0.000	0.215 (0.551)	-0.064 (0.861)	1.000			
+5 DAY D4	-0.295 (0.407)	-0.435 (0.208)	-0.475 (0.166)	0.000	0.000	0.111 (0.760)	0.248 (0.490)	0.426 (0.219)	1.000		
+10 DAY	-0.249 (0.489)	-0.473 (0.168)	-0.441 (0.202)	0.000	0.000	0.201 (0.577)	0.168 (0.643)	0.420 (0.227)	0.865 (0.001)	1.000	
% PRICE CHANGE	-0.249 (0.487)	-0.459 (0.181)	-0.384 (0.274)	0.000	0.000	0.277 (0.437)	0.269 (0.453)	0.421 (0.226)	0.826 (0.003)	0.984 (0.000)	1.000

The figures in parenthesis represent the probability of a larger value of the correlation coefficient under the null hypothesis that the correlation coefficient is actually zero, i. e. the significance level.

TABLE A1.5. CORRELATIONS OF CLASSIFICATION RATIOS, ALGEBRAIC SUMS, AND PERCENTAGE PRICE CHANGES FOR THE NEARBY CONTRACT AGAINST THE SEPTEMBER HOG AND PIG REPORT.

	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	-10 DAY	-5 DAY	REPORT DAY	+5 DAY	+10 DAY	% PRICE CHANGE
RATIO 1	1.000										
RATIO 2	0.000	1.000									
RATIO 3	0.000	0.000	1.000								
RATIO 4	0.000	0.000	0.000	1.000							
RATIO 5	0.000	0.000	0.000	0.789 (0.007)	1.000						
-10 DAY	0.000	0.000	0.000	-0.575 (0.082)	-0.596 (0.118)	1.000					
-5 DAY	0.000	0.000	0.000	-0.355 (0.314)	-0.436 (0.208)	0.526 (0.118)	1.000				
REPORT DAY	0.000	0.000	0.000	0.134 (0.712)	0.161 (0.658)	0.115 (0.751)	0.493 (0.148)	1.000			
+5 DAY	0.000	0.000	0.000	-0.032 (0.930)	-0.258 (0.472)	0.290 (0.416)	0.740 (0.014)	0.834 (0.003)	1.000		
+10 DAY	0.000	0.000	0.000	-0.318 (0.371)	-0.428 (0.218)	0.636 (0.048)	0.729 (0.017)	0.655 (0.040)	0.791 (0.006)	1.000	
% PRICE CHANGE	0.000	0.000	0.000	-0.275 (0.442)	-0.460 (0.181)	0.569 (0.086)	0.743 (0.014)	0.662 (0.037)	0.850 (0.001)	0.982 (0.000)	1.000

The figures in parenthesis represent the probability of a larger value of the correlation coefficient under the null hypothesis that the correlation coefficient is actually zero, i. e. the significance level.

TABLE A1.6. CORRELATIONS OF CLASSIFICATION RATIOS, ALGEBRAIC SUMS, AND PERCENTAGE PRICE CHANGES FOR THE DISTANT CONTRACT AGAINST THE SEPTEMBER HOG AND PIG REPORT.

	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	-10 DAY	-5 DAY	REPORT DAY	+5 DAY	+10 DAY	% PRICE CHANGE
RATIO 1	1.000										
RATIO 2	0.564 (0.089)	1.000									
RATIO 3	0.629 (0.051)	0.675 (0.032)	1.000								
RATIO 4	0.000	0.000	0.000	1.000							
RATIO 5	0.000	0.000	0.000	0.000	1.000						
-10 DAY	-0.362 (0.303)	-0.137 (0.705)	-0.644 (0.044)	0.000	0.000	1.000					
-5 DAY	-0.712 (0.021)	-0.322 (0.365)	-0.577 (0.081)	0.000	0.000	0.543 (0.105)	1.000				
REPORT DAY	-0.198 (0.583)	0.076 (0.835)	0.318 (0.371)	0.000	0.000	-0.214 (0.552)	0.163 (0.654)	1.000			
+5 DAY	-0.662 (0.037)	-0.187 (0.604)	-0.230 (0.523)	0.000	0.000	0.362 (0.304)	0.756 (0.011)	0.543 (0.105)	1.000		
+10 DAY	-0.369 (0.294)	0.141 (0.698)	-0.071 (0.844)	0.000	0.000	0.489 (0.151)	0.528 (0.117)	0.685 (0.028)	0.750 (0.012)	1.000	
% PRICE CHANGE	-0.435 (0.209)	0.126 (0.729)	-0.087 (0.812)	0.000	0.000	0.514 (0.129)	0.581 (0.078)	0.642 (0.045)	0.791 (0.006)	0.991 (0.000)	1.000

The figures in parenthesis represent the probability of a larger value of the correlation coefficient under the null hypothesis that the correlation coefficient is actually zero, i. e. the significance level.

TABLE A1.7. CORRELATIONS OF CLASSIFICATION RATIOS, ALGEBRAIC SUMS, AND PERCENTAGE PRICE CHANGES FOR THE NEARBY CONTRACT AGAINST THE DECEMBER HOG AND PIG REPORT.

	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	-10 DAY	-5 DAY	REPORT DAY	+5 DAY	+10 DAY	% PRICE CHANGE
RATIO 1	1.000										
RATIO 2	0.000	1.000									
RATIO 3	0.000	0.000	1.000								
RATIO 4	0.000	0.000	0.000	1.000							
RATIO 5	0.000	0.000	0.000	0.865 (0.001)	1.000						
-10 DAY	0.000	0.000	0.000	-0.529 (0.115)	-0.374 (0.287)	1.000					
-5 DAY	0.000	0.000	0.000	-0.099 (0.785)	-0.028 (0.938)	0.111 (0.759)	1.000				
REPORT DAY	0.000	0.000	0.000	-0.429 (0.215)	-0.589 (0.073)	0.477 (0.163)	0.345 (0.329)	1.000			
+5 DAY	0.000	0.000	0.000	-0.154 (0.670)	-0.231 (0.521)	0.224 (0.534)	0.477 (0.163)	0.697 (0.025)	1.000		
+10 DAY	0.000	0.000	0.000	-0.066 (0.855)	-0.058 (0.873)	0.229 (0.525)	0.626 (0.053)	0.649 (0.042)	0.880 (0.000)	1.000	
% PRICE CHANGE	0.000	0.000	0.000	-0.074 (0.839)	-0.063 (0.864)	0.218 (0.545)	0.652 (0.041)	0.649 (0.043)	0.878 (0.000)	0.996 (0.000)	1.000

The figures in parenthesis represent the probability of a larger value of the correlation coefficient under the null hypothesis that the correlation coefficient is actually zero, i. e. the significance level.

TABLE A1.8. CORRELATIONS OF CLASSIFICATION RATIOS, ALGEBRAIC SUMS, AND PERCENTAGE PRICE CHANGES FOR THE DISTANT CONTRACT AGAINST THE DECEMBER HOG AND PIG REPORT.

	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	-10 DAY	-5 DAY	REPORT DAY	+5 DAY	+10 DAY	% PRICE CHANGE
RATIO 1	1.000										
RATIO 2	0.439 (0.204)	1.000									
RATIO 3	0.219 (0.542)	0.925 (0.000)	1.000								
RATIO 4	0.000	0.000	0.000	1.000							
RATIO 5	0.000	0.000	0.000	0.000	1.000						
-10 DAY	0.278 (0.437)	-0.104 (0.774)	-0.234 (0.515)	0.000	0.000	1.000					
-5 DAY	0.128 (0.723)	-0.265 (0.459)	-0.209 (0.562)	0.000	0.000	0.102 (0.779)	1.000				
REPORT DAY	-0.249 (0.488)	-0.788 (0.006)	-0.712 (0.021)	0.000	0.000	0.311 (0.382)	0.679 (0.031)	1.000			
+5 DAY D4	-0.675 (0.032)	-0.635 (0.048)	-0.397 (0.256)	0.000	0.000	-0.055 (0.880)	0.390 (0.265)	0.729 (0.017)	1.000		
+10 DAY	-0.498 (0.142)	-0.488 (0.152)	-0.251 (0.483)	0.000	0.000	-0.159 (0.661)	0.464 (0.177)	0.622 (0.055)	0.931 (0.000)	1.000	
% PRICE CHANGE	-0.488 (0.152)	-0.501 (0.146)	-0.273 (0.446)	0.000	0.000	-0.125 (0.730)	0.518 (0.125)	0.638 (0.046)	0.923 (0.000)	0.994 (0.000)	1.000

The figures in parenthesis represent the probability of a larger value of the correlation coefficient under the null hypothesis that the correlation coefficient is actually zero, i. e. the significance level.

APPENDIX TWO

Estimated Linear and Quadratic Time Trends in Cumulative Price Changes Using Three and Four Percent Deviations to Classify Reports

TABLE A2.1. ESTIMATION OF LINEAR AND QUADRATIC TIME TRENDS IN CUMULATIVE DAILY PRICE CHANGES BY REPORT CLASSIFICATION ACROSS ALL REPORTS USING A THREE PERCENT DEVIATION OF RATIO 1.

Report Classification	Variable	Estimated Coefficient	P-value¬1
BULLISH (N=9)¬2			
Linear Model	Intercept	.20617E+01	.0001
	Time	.47939E-01	.2484
Quadratic Model	Intercept	.15287E+01	.0562
	Time	.17427	.2690
	Time**2	-.69220E-02	.3918
BEARISH (N=11)			
Linear Model	Intercept	-.17169E+01	.0001
	Time	-.30404E-01	.3486
Quadratic Model	Intercept	-.16266E+01	.0098
	Time	-.55045E-01	.6873
	Time**2	.11734E-02	.8528
NEUTRAL (N=20)			
Linear Model	Intercept	.32438	.3920
	Time	.34454E-02	.2762
Quadratic Model	Intercept	-.14327	.8133
	Time	.16120	.2238
	Time**2	-.60735E-02	.3240

¬1 The P-value is the significance level of the test of the null hypothesis that the coefficient is equal to zero.

¬2 The number of reports within each classification.

TABLE A2.2. ESTIMATION OF LINEAR AND QUADRATIC TIME TRENDS IN CUMULATIVE DAILY PRICE CHANGES BY REPORT CLASSIFICATION ACROSS ALL REPORTS USING A THREE PERCENT DEVIATION OF RATIO 1, TEN DAYS POST REPORT.

Report Classification	Variable	Estimated Coefficient	P-value¬1
BULLISH (N=9)¬2			
Linear Model	Intercept	.18195E+01	.0030
	Time	.87068E-01	.3249
Quadratic Model	Intercept	.11466E+01	.2617
	Time	.39766	.3092
	Time**2	-.25883E-02	.4143
BEARISH (N=11)			
Linear Model	Intercept	-.16934E+01	.0013
	Time	-.38636E-01	.6083
Quadratic Model	Intercept	-.76932	.3742
	Time	-.46514	.1622
	Time**2	.35542E-01	.1879
NEUTRAL (N=20)			
Linear Model	Intercept	.37929E-01	.9323
	Time	.83725E-01	.2044
Quadratic Model	Intercept	-.77146E-01	.9192
	Time	.13684	.6384
	Time**2	-.44260E-02	.8514

¬1 The P-value is the significance level of the test of the null hypothesis that the coefficient is equal to zero.

¬2 The number of reports within each classification.

TABLE A2.3. ESTIMATION OF LINEAR AND QUADRATIC TIME TRENDS IN CUMULATIVE DAILY PRICE CHANGES BY REPORT CLASSIFICATION ACROSS ALL REPORTS USING A FOUR PERCENT DEVIATION OF RATIO 1.

Report Classification	Variable	Estimated Coefficient	P-value¬1
BULLISH (N=6)¬2			
Linear Model	Intercept	.18536E+01	.0037
	Time	.98081E-01	.0627
Quadratic Model	Intercept	.14075E+01	.1637
	Time	.21975	.3205
	Time**2	-.57937E-02	.5706
BEARISH (N=6)			
Linear Model	Intercept	-.12459E+01	.0017
	Time	-.45504E-01	.1628
Quadratic Model	Intercept	-.10391E+01	.0982
	Time	-.10119	.4578
	Time**2	.26856E-02	.6721
NEUTRAL (N=28)			
Linear Model	Intercept	.21328	.4610
	Time	.79091E-02	.7433
Quadratic Model	Intercept	-.58889E-01	.8989
	Time	.82137E-01	.4192
	Time**2	-.35347E-02	.4523

¬1 The P-value is the significance level of the test of the null hypothesis that the coefficient is equal to zero.

¬2 The number of reports within each classification.

TABLE A2.4. ESTIMATION OF LINEAR AND QUADRATIC TIME TRENDS IN CUMULATIVE DAILY PRICE CHANGES BY REPORT CLASSIFICATION ACROSS ALL REPORTS USING A FOUR PERCENT DEVIATION OF RATIO 1, TEN DAYS POST REPORT.

Report Classification	Variable	Estimated Coefficient	P-value¬1
BULLISH (N=6)¬2			
Linear Model	Intercept	.16903E+01	.0337
	Time	.12193E-01	.2923
Quadratic Model	Intercept	.94659	.4786
	Time	.46518	.3639
	Time**2	-.28604E-01	.4909
BEARISH (N=6)			
Linear Model	Intercept	-.11945E+01	.0102
	Time	-.54221E-01	.4194
Quadratic Model	Intercept	-.71853	.3546
	Time	-.27392	.3568
	Time**2	.18308E-01	.4476
NEUTRAL (N=28)			
Linear Model	Intercept	.57394E+01	.8698
	Time	.32993E-01	.5228
Quadratic Model	Intercept	.11450	.8475
	Time	.66374E-02	.9768
	Time**2	.21963E-02	.9056

¬1 The P-value is the significance level of the test of the null hypothesis that the coefficient is equal to zero.

¬2 The number of reports within each classification.

TABLE A2.5. ESTIMATION OF LINEAR AND QUADRATIC TIME TRENDS IN CUMULATIVE DAILY PRICE CHANGES BY REPORT CLASSIFICATION ACROSS ALL REPORTS USING A THREE PERCENT DEVIATION OF RATIO 2.

Report Classification	Variable	Estimated Coefficient	P-value¬1
BULLISH (N=11)¬2			
Linear Model	Intercept	.20009E+01	.0001
	Time	.11782E-01	.7655
Quadratic Model	Intercept	.14559E+01	.0558
	Time	.16042	.3351
	Time**2	-.70780E-02	.3578
BEARISH (N=15)			
Linear Model	Intercept	-.65537	.0586
	Time	-.58738E-01	.0424
Quadratic Model	Intercept	-.95391	.0858
	Time	.22681E-01	.8519
	Time**2	-.38771E-02	.4904
NEUTRAL (N=14)			
Linear Model	Intercept	-.44279	.2558
	Time	.88390E-01	.0069
Quadratic Model	Intercept	-.21737	.7277
	Time	.26914E-01	.8442
	Time**2	.29275E-02	.6440

¬1 The P-value is the significance level of the test of the null hypothesis that the coefficient is equal to zero.

¬2 The number of reports within each classification.

TABLE A2.6. ESTIMATION OF LINEAR AND QUADRATIC TIME TRENDS IN CUMULATIVE DAILY PRICE CHANGES BY REPORT CLASSIFICATION ACROSS ALL REPORTS USING A THREE PERCENT DEVIATION OF RATIO 2, TEN DAYS POST REPORT.

Report Classification	Variable	Estimated Coefficient	P-value¬1
BULLISH (N=11)¬2			
Linear Model	Intercept	.16247E+01	.0020
	Time	.82194E-01	.2812
Quadratic Model	Intercept	.99594	.2576
	Time	.33528	.2689
	Time**2	-.24185E-01	.3760
BEARISH (N=15)			
Linear Model	Intercept	-.86534	.0356
	Time	-.26176E-01	.6643
Quadratic Model	Intercept	-.40918	.5564
	Time	-.23671	.3746
	Time**2	.17545E-01	.4174
NEUTRAL (N=14)			
Linear Model	Intercept	-.21819	.6714
	Time	.44692E-01	.5558
Quadratic Model	Intercept	-.16285	.8526
	Time	.19115E-01	.9545
	Time**2	.21284E-02	.9377

¬1 The P-value is the significance level of the test of the null hypothesis that the coefficient is equal to zero.

¬2 The number of reports within each classification.

TABLE A2.7. ESTIMATION OF LINEAR AND QUADRATIC TIME TRENDS IN CUMULATIVE DAILY PRICE CHANGES BY REPORT CLASSIFICATION ACROSS ALL REPORTS USING A FOUR PERCENT DEVIATION OF RATIO 2.

Report Classification	Variable	Estimated Coefficient	P-value¬1
BULLISH (N=7)¬2			
Linear Model	Intercept	.22737E+01	.0001
	Time	.20728E-02	.5968
Quadratic Model	Intercept	.13454E+01	.0734
	Time	.27390	.0963
	Time**2	-.12056E-01	.1134
BEARISH (N=9)			
Linear Model	Intercept	-.28761	.4916
	Time	-.63792E-01	.0686
Quadratic Model	Intercept	-.13075E+01	.0502
	Time	.21438	.1424
	Time**2	-.13246E-01	.0505
NEUTRAL (N=23)			
Linear Model	Intercept	-.21224	.5230
	Time	.42449E-01	.1263
Quadratic Model	Intercept	.14081	.7914
	Time	-.53835E-01	.6447
	Time**2	.45850E-02	.3960

¬1 The P-value is the significance level of the test of the null hypothesis that the coefficient is equal to zero.

¬2 The number of reports within each classification.

TABLE A2.8. ESTIMATION OF LINEAR AND QUADRATIC TIME TRENDS IN CUMULATIVE DAILY PRICE CHANGES BY REPORT CLASSIFICATION ACROSS ALL REPORTS USING A FOUR PERCENT DEVIATION OF RATIO 2, TEN DAYS POST REPORT.

Report Classification	Variable	Estimated Coefficient	P-value¬1
BULLISH (N=7)¬2			
Linear Model	Intercept	.17112E+01	.0009
	Time	.11766	.1098
Quadratic Model	Intercept	.11996E+01	.1574
	Time	.35379	.2750
	Time**2	-.19678E-01	.4535
BEARISH (N=9)			
Linear Model	Intercept	-.10788	.0236
	Time	.77141E-01	.2679
Quadratic Model	Intercept	-.90483	.2613
	Time	-.31737E-02	.9918
	Time**2	.66929E-02	.7887
NEUTRAL (N=23)			
Linear Model	Intercept	.93028E-01	.8221
	Time	-.15310E-01	.8019
Quadratic Model	Intercept	.19099	.7862
	Time	-.60519E-01	.8225
	Time**2	.37674E-02	.8634

¬1 The P-value is the significance level of the test of the null hypothesis that the coefficient is equal to zero.

¬2 The number of reports within each classification.

TABLE A2.9. ESTIMATION OF LINEAR AND QUADRATIC TIME TRENDS IN CUMULATIVE DAILY PRICE CHANGES BY REPORT CLASSIFICATION ACROSS ALL REPORTS USING A THREE PERCENT DEVIATION OF RATIO 3.

Report Classification	Variable	Estimated Coefficient	P-value¬1
BULLISH (N=8)¬2			
Linear Model	Intercept	.18056E+01	.0004
	Time	-.49894E-01	.2358
Quadratic Model	Intercept	.93633E+01	.2448
	Time	.18717	.2889
	Time**2	-.11289E-01	.1673
BEARISH (N=11)			
Linear Model	Intercept	-.57791	.1059
	Time	-.56647E-01	.0579
Quadratic Model	Intercept	-.11790E+01	.0395
	Time	.10729	.3910
	Time**2	-.78068E-02	.1778
NEUTRAL (N=21)			
Linear Model	Intercept	.12105	.7303
	Time	.65209E-01	.0266
Quadratic Model	Intercept	.32682	.5616
	Time	.90897E-02	.9413
	Time**2	.26724E-02	.6398

¬1 The P-value is the significance level of the test of the null hypothesis that the coefficient is equal to zero.

¬2 The number of reports within each classification.

TABLE A2.10. ESTIMATION OF LINEAR AND QUADRATIC TIME TRENDS IN CUMULATIVE DAILY PRICE CHANGES BY REPORT CLASSIFICATION ACROSS ALL REPORTS USING A THREE PERCENT DEVIATION OF RATIO 3, TEN DAYS POST REPORT.

Report Classification	Variable	Estimated Coefficient	P-value[1]
BULLISH (N=8)[2]			
Linear Model	Intercept	.11924E+01	.0527
	Time	.60920E-01	.4979
Quadratic Model	Intercept	.52003	.6160
	Time	.37124	.3508
	Time**2	-.25860E-01	.4229
BEARISH (N=11)			
Linear Model	Intercept	-.10341E+01	.0106
	Time	.20674E-01	.7257
Quadratic Model	Intercept	-.55338	.4159
	Time	-.20119	.4399
	Time**2	.18489E-01	.3820
NEUTRAL (N=21)			
Linear Model	Intercept	.34284	.4311
	Time	.22431E-01	.7267
Quadratic Model	Intercept	.34814	.6384
	Time	.19983E-01	.9438
	Time**2	.20396E-03	.9929

[1] The P-value is the significance level of the test of the null hypothesis that the coefficient is equal to zero.

[2] The number of reports within each classification.

TABLE A2.11. ESTIMATION OF LINEAR AND QUADRATIC TIME TRENDS IN CUMULATIVE DAILY PRICE CHANGES BY REPORT CLASSIFICATION ACROSS ALL REPORTS USING A FOUR PERCENT DEVIATION OF RATIO 3.

Report Classification	Variable	Estimated Coefficient	P-value¬1
BULLISH (N=4)¬2			
Linear Model	Intercept	.28584E+01	.0001
	Time	-.38739E-01	.4163
Quadratic Model	Intercept	.20447E+01	.0271
	Time	.18316	.3604
	Time**2	-.10567E-01	.2547
BEARISH (N=8)			
Linear Model	Intercept	-.46741	.2650
	Time	-.43408E-01	.2151
Quadratic Model	Intercept	-.17882E+01	.0073
	Time	.31680	.0295
	Time**2	-.17153E-01	.0111
NEUTRAL (N=28)			
Linear Model	Intercept	-.54324E-01	.8638
	Time	.33519E-01	.2052
Quadratic Model	Intercept	.14827	.7702
	Time	-.21733E-01	.8452
	Time**2	.26311E-02	.6094

¬1 The P-value is the significance level of the test of the null hypothesis that the coefficient is equal to zero.

¬2 The number of reports within each classification.

TABLE A2.12. ESTIMATION OF LINEAR AND QUADRATIC TIME TRENDS IN CUMULATIVE DAILY PRICE CHANGES BY REPORT CLASSIFICATION ACROSS ALL REPORTS USING A FOUR PERCENT DEVIATION OF RATIO 3, TEN DAYS POST REPORT.

Report Classification	Variable	Estimated Coefficient	P-value¬1
BULLISH (N=4)¬2			
Linear Model	Intercept	.23689E+01	.0005
	Time	.50271E-01	.5703
Quadratic Model	Intercept	.81677	.4329
	Time	.78907	.0584
	Time**2	-.59698E-01	.0697
BEARISH (N=8)			
Linear Model	Intercept	-.14519E+01	.0007
	Time	.12904	.0361
Quadratic Model	Intercept	-.10782E+01	.1273
	Time	-.43469E-01	.8716
	Time**2	.14376E-01	.5107
NEUTRAL (N=28)			
Linear Model	Intercept	.14472	.7089
	Time	-.61044E-02	.9149
Quadratic Model	Intercept	.30101	.6480
	Time	-.78236E-01	.7567
	Time**2	.60110E-02	.7693

¬1 The P-value is the significance level of the test of the null hypothesis that the coefficient is equal to zero.

¬2 The number of reports within each classification.

APPENDIX THREE

Estimated Quantity Drift for Five and Ten Day Post Report Algebraic Sums of Price Changes

TABLE A3.1. ESTIMATED QUANTITY DRIFT FOR FIVE AND TEN DAY POST REPORT ALGEBRAIC SUMS, NEARBY CONTRACTS.

Contract	Year	10 Day Drift	10 Day Change	5 Day Drift	5 Day Change
JUNE	74	-4.992	7.131	-3.554	5.077
JUNE	75	-2.008	2.868	-2.208	3.155
JUNE	76	-4.968	7.097	0.198	-0.282
JUNE	77	-0.238	0.340	3.895	-5.565
JUNE	78	-4.329	6.184	-4.088	5.839
JUNE	79	6.174	-8.820	5.969	-8.527
JUNE	80	11.193	-15.990	8.349	-11.927
JUNE	81	-7.494	10.706	-8.143	11.634
JUNE	82	-4.977	7.110	-3.471	4.959
JUNE	83	2.731	-3.902	4.671	-6.673
AUG	74	-21.576	30.823	-15.711	22.444
AUG	75	2.478	-3.541	2.097	-2.996
AUG	76	0.219	-0.313	-1.869	2.669
AUG	77	-3.874	5.535	-6.105	8.721
AUG	78	-2.633	3.761	-1.192	1.704
AUG	79	-3.156	4.508	1.186	-1.694
AUG	80	-6.210	8.872	-3.460	4.943
AUG	81	1.361	-1.944	2.251	-3.215
AUG	82	0.624	-0.891	0.530	-0.757
AUG	83	0.885	-1.264	-2.526	3.609
DEC	74	-7.921	11.315	-6.794	9.706
DEC	75	-3.672	5.246	-2.003	2.862
DEC	76	4.317	-6.168	4.317	-6.168
DEC	77	3.929	-5.613	1.291	-1.845
DEC	78	-4.491	6.415	-2.502	3.575
DEC	79	7.358	-10.511	5.333	-7.619
DEC	80	2.144	-3.063	0.705	-1.008
DEC	81	4.029	-5.756	3.826	-5.465
DEC	82	3.563	-5.090	-2.379	3.399
DEC	83	3.519	-5.028	1.207	-1.724
FEB	74	-5.567	7.953	-2.116	3.023
FEB	75	5.176	-7.395	4.610	-6.586
FEB	76	-0.222	0.318	-0.030	0.042
FEB	77	-1.692	2.418	-3.573	5.104
FEB	78	-5.770	8.242	-2.633	3.761
FEB	79	2.218	-3.168	4.020	-5.743
FEB	80	2.313	-3.304	-1.374	1.963
FEB	81	7.060	-10.086	6.291	-8.987
FEB	82	-7.620	10.885	-5.644	8.062
FEB	83	-1.833	2.618	0.844	-1.206

* Quantity drift is estimated using the percent change in price from the Table and the estimated retail elasticity of demand from Chavas, AJAE, Feb 1983. This estimate actually provides a conservative measure of the actual quantity drift.

TABLE A3.2. ESTIMATED QUANTITY DRIFT FOR FIVE AND TEN DAY POST REPORT ALGEBRAIC SUMS, DISTANT CONTRACTS.

Contract	Year	10 Day Drift	10 Day Change	5 Day Drift	5 Day Change
OCT	74	0.711	-1.015	-1.309	1.870
OCT	75	-2.056	2.938	-2.689	3.842
OCT	76	-1.521	2.173	2.541	-3.630
OCT	77	0.473	-0.676	4.257	-6.081
OCT	78	-8.943	12.775	-8.247	11.781
OCT	79	7.453	-10.648	6.267	-8.953
OCT	80	9.404	-13.435	7.009	-10.013
OCT	81	-11.987	17.124	-11.172	15.960
OCT	82	-4.159	5.941	-4.027	5.753
OCT	83	2.214	-3.162	3.335	-4.765
DEC	74	-14.232	20.331	-10.216	14.594
DEC	75	2.801	-4.002	2.151	-3.072
DEC	76	-1.474	2.105	-1.392	1.988
DEC	77	0.274	-0.392	-4.990	7.128
DEC	78	-6.899	9.856	-6.654	9.506
DEC	79	-0.340	0.486	2.398	-3.426
DEC	80	-4.945	7.064	-3.132	4.474
DEC	81	2.445	-3.493	3.289	-4.699
DEC	82	-0.037	0.053	-1.407	2.010
DEC	83	3.012	-4.303	1.033	-1.475
APR	75	-4.953	7.075	-4.177	5.967
APR	76	-2.894	4.134	1.840	-2.629
APR	77	3.656	-5.223	5.914	-8.449
APR	78	3.936	-5.623	2.234	-3.191
APR	79	-5.863	8.375	-2.461	3.516
APR	80	7.310	-10.443	7.223	-10.318
APR	81	3.679	-5.255	0.916	-1.309
APR	82	5.534	-7.906	5.534	-7.906
APR	83	0.873	-1.247	-2.502	3.575
APR	84	4.013	-5.733	2.177	-3.110
JUNE	74	-7.611	10.873	-3.993	5.704
JUNE	75	4.951	-7.073	4.189	-5.985
JUNE	76	-3.508	5.012	-3.345	4.779
JUNE	77	-3.682	5.260	-4.449	6.356
JUNE	78	-8.321	11.887	-5.959	8.512
JUNE	79	2.039	-2.912	3.888	-5.554
JUNE	80	0.801	-1.144	-3.314	4.735
JUNE	81	8.880	-12.686	7.518	-10.740
JUNE	82	-8.552	12.217	-6.559	9.371
JUNE	83	-0.498	0.712	1.520	-2.172

* Quantity drift is estimated using the percent change in price from the Table and the estimated retail elasticity of demand from Chavas, AJAE, Feb 1983. This estimate actually provides a conservative measure of the actual quantity drift.

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