ARE HOG AND PIG REPORTS INFORMATIVE?

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INTRODUCTION

Market efficiency suggests that if public information releases are informative, asset prices will quickly adjust to reflect altered investor beliefs about the value of that asset [Fama (1970), Beaver (1968)]. It follows that it is investor beliefs, driven by the flow of new information, that produce new valuations of an asset. These changes in beliefs may, according to rational expectations models, manifest themselves in the variability of asset price changes and changes in the level of trading volume. Measurement of these two variables prior to and after the introduction of new information establishes the significance of the information.

Controversy surrounds the value and usefulness of government commodity information reports such as United States Department of Agriculture (USDA) Hog and Pig Reports (HPRs) (December, 1969–December, 1994). Given new information technologies, reduced government budget allocations, and private information flows, Just (1983) argues that certain public information programs can be replaced by private sources. A study by Fortenberry and Sumner (1993) suggests that recently the

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informational value of USDA-supplied crop production reports has declined for the corn and soybean markets. Colling and Irwin (1990) find that HPRs provide new information to live hog futures. Carter and Galopin (1993) conclude that live hog futures traders are not informed by HPRs.

The goal of this study is to offer additional evidence on the controversy concerning the informational value of HPRs to the live hog and pork belly futures markets. Distinct from previous work, this article adopts an event analysis framework and (a) empirically tests information arrival from HPRs on both price and trading volume data of live hog futures, (b) tests information arrival from HPRs on both price and trading volume data of frozen pork belly futures, (c) reconstructs price and volume data from close of the release day to the close of the first and subsequent equilibrium trading days, (d) adjusts the event analysis for subsequent information flows in the days following the first calendar day after a report release, and (e) compares the adjusted data [from (d)] to an unadjusted data set. The methodologies permit the use of simple but robust statistical testing procedures. Additionally, they permit testing for information flow without recourse to expectations data. This may produce several advantages, depending on the situation. First, this reduces data requirements. There may arise instances when expectations data are not available. Second, use of expectations data requires the data to be analyzed for unbiasedness, efficiency, and forecast performance. Failure to pass one or more of these tests leaves the researcher in a quandary as to the suitability of the expectations data. Although all data and methodologies should be explored, use of the equilibrium trading day concept combined with both price and volume data allows for simple tests of information arrival.

Many event studies performed in securities and bond markets demonstrate the impact of different classes of new information, from unexpected earnings announcements to product recalls [see Fama (1991)]. In agricultural futures markets, government information releases such as HPRs, Cattle on Feed reports, and various crop reports typically provide new information to which markets react. Generally, this information is supplied at certain announced intervals throughout the year for livestock and poultry markets or throughout the growing season for various crops. Most of the information concerns supply variables.

The United States Department of Agriculture releases an HPR once every 3 months. These reports are the results of surveys taken by USDA to determine the market hog and breeding stock inventory in various states and farmer intentions to breed and farrow sows. USDA surveys hog

producers at approximately the first of the month four times per year: December, March, June, and September. HPRs are thought by the trade to typically constitute the single most important information flow to the pork complex. USDA also reports daily and weekly total hog slaughter figures, monthly cold storage reports, and monthly import and export estimates. Anecdotal evidence suggests these releases have a minor impact on live hog futures. However, for the pork belly market, monthly cold storage reports have an impact, especially during the cold storage season, December 1–August 1. Recent work by Colling, Irwin, and Zulauf (1994) find that frozen pork belly futures respond significantly to the information contained in cold storage reports over the period January, 1989–December, 1992. Additionally and in contrast to anecdotal history, they also find a significant but lesser response in live hog futures.

LITERATURE REVIEW

Several event studies that have been performed on the live hog futures markets generally conclude that this market is efficient and that prices adjust quickly to new information. Examining short-term price movements prior to and after the release of HPRs, Miller (1979), USDA (1977), and Hoffman (1980) find that live hog futures generally react quickly to the new information contained in HPRs. This reaction is most pronounced in nearby contracts. Schroder, Blair, and Mintert (1990) find no significant abnormal returns in live hog, live cattle, and feeder cattle markets following quarterly inventory releases. They also find an increase in subsequent futures price variability from the release of livestock inventory reports. In a more recent study, Colling and Irwin use the Pearce and Roley (1985) general model to examine market efficiency in the context of anticipated and unanticipated changes. Using prerelease survey data of trader expectations, they conclude that the live hog futures market is efficient by quickly incorporating unanticipated information.

However, a notable exception to these conclusions is a recent study by Carter and Galopin. They approach the concept of market efficiency with a different criterion. If HPRs contain new information, then a trader in possession of this information prior to release of the report should be able to make statistically significant positive risk-adjusted profits. With the use of a 10-year period, they "test and fail to reject the hypothesis that a private futures trader risk-adjusted profits are zero if he obtains the report one day before its official release" (p. 711). They conclude that quarterly HPRs provide no new information to the market, and the market is efficient because it has already discounted the HPR information.

TABLE I
Determination of Impact of Hogs and Pigs Report Information on Selected Nearby and Distant Pork Complex Futures

Calendar Year	*Market Hog Estimate Impact Upon*	*Breeding Hog Estimate Impact Upon*
Panel A: Impact on Nearby and Distant Live Hog Futures		
Mar 1 HPR	June futures	December futures
Jun 1 HPR	August futures	April futures*
Sep 1 HPR	December futures	June futures*
Dec 1 HPR	February futures	October futures*
Panel B: Impact on Nearby Frozen Pork Belly Futures		
Mar 1 HPR	May futures	
Jun 1 HPR	August futures	
Sep 1 HPR	N/A	
Dec 1 HPR	February futures	

*Future which matures the next year.

A crucial issue concerning informational content of HPRs is public versus private information and their credibility. USDA crop reports in some agricultural markets may provide only a small or declining portion of the information market participants use to make decisions. For example, Baur and Orazem (1994) examine orange juice futures and find that USDA crop reports explain less than 50% of price variation after release of the report. Garcia, Irwin, Leuthold, and Yang (1994) find declining market response to USDA crop reports in corn and soybeans over time. In the grain markets and some other agricultural markets credible private information is apparently available. If the pork futures market is efficient, the significance of price response to the information contained in HPRs should reflect the importance and frequency of other public and private information.

The studies mentioned above use price as the metric to analyze and test. A significant increase in price variability points to information arrival. But many studies also point to changes in the level of trading volume as indicating information arrival. Beaver and Morse (1981) find an increase in volume after annual and quarterly accounting earnings announcements. Karpoff (1987) reviews the literature to date and for commodity prices and documents a positive correlation between volume and the absolute change in price. French, Leftwich, and Uhrig (1989) test the impact of scheduled crop announcements on corn, soybeans, and wheat prices, volume, and open interest. They find unusually low volume prior to announcements and unusually high volume after announcements. They suggest that volume may decline prior to a scheduled announcement due a widening of the bid-ask spread from trader uncertainty

concerning the impending report or traders waiting for the report to rebalance their portfolios. After release of a report, volume may increase "if postponed trades are consummated, if investors rebalance their portfolios because of wealth or risk affects of the announcement, if the bid-ask spread declines as the (previously) uninformed investors resume trading, or if traders disagree about the implications of the announcement" [French et. al. (1989, p. 2)]. A premise of this study is that regardless of the reason specified above, increasing volume after the release of an HPR indicates the arrival of new information to the market. Increasing volume then provides both a separate indicator of information arrival and a confirmation of information arrival in addition to increasing price variance.

METHODOLOGY AND SAMPLE

An HPR contains two key pieces of information upon which traders typically focus.[1] First is the total market hogs inventory and second is the breeding stock inventory. Although Colling and Irwin analyze hog futures in five time horizons to capture the information impact of changes in market hog and breeding stock inventory, this study follows the definitions of time horizons used by Hudson, Koontz, and Purcell (1984). They define a nearby live hog futures contract as one that matures within 4 months of the release of an HPR and a distant contract as one which matures more than 8 months after the HPR release date. Using their scheme, Table I outlines the information impact of a given HPR upon a particular live hog future and a pork belly future. Examination of the nearby contract focuses on trader beliefs of the market hog inventory and examination of the distant contract focuses on trader ideas concerning the breeding herd inventory.

For the frozen pork belly futures market, information about the market hog inventory generally has an immediate impact on trader beliefs. Along with monthly cold storage holding, weekly reports from the Chicago Mercantile Exchange on frozen pork belly movement in and out of Exchange-approved warehouses and retail bacon movement,[2] these variables define the supply available for and movement of the pork belly crop year. The crop year is viewed by most of the trade as October 1 to September 30 of the following year. At the end of the crop year, frozen pork bellies delivered on the August contract may not be redelivered on next

[1]The implied model of trader information usage follows personal observations of and conversations with traders in the live hog and pork belly futures pits by Mann.

[2]In 1989, weekly retail bacon slicings figures were discontinued and are now released on a monthly basis.

year's contracts, and thus all frozen pork bellies should be consumed. Public information on both immediate hog availability and pork belly movement become crucial to trader decision making. Further, because movement analysis is so crucial, information from HPRs may become just one of several public and private information sources that impact futures and may have only a marginal impact.

This study measures price variability from the percentage return in price defined as the natural log of price in period, t, minus the natural log of price in period, $t - 1$. An adjusted or normalized volume series is created by dividing volume by open interest. Because the impact of the information release on a specific nearby or distant contract is crucial, volume and open interest for that individual contract is used. This accounts for the changing use by the market of an individual contract over its lifetime.

Analysis of quarterly HPR releases for the period 1970 to 1994 produces 100 events to examine and is designated the complete data set. A complete data set of price and volume is constructed for nearby live hog futures, distant live hog futures, and nearby frozen pork belly futures.[3] A second reduced data set is developed that eliminates those events with information on days after the release day. If the release day is defined as day 0, the *Wall Street Journal Index* (WSJ) is examined for information releases concerning hog and pork belly markets after the release of an HPR.[4] Those HPR event windows with information on calendar trading days 2–5 are eliminated. This reduces the number of HPR events in the data set from 100 to 74 for nearby live hog contracts, 72 events for pork belly contracts and 71 events for distant live hog contracts. The reduced data set contains no subsequent information flows into the market other than the sometime reporting of the WSJ of the information about the contents of an HPR on calendar day 1. Information published in the WSJ the next morning (day 1) is considered an extension of the information flow from the previous afternoon news wires (day 0). This information is available to all traders prior to the opening of trading on day 1. Whether

[3]Individual contract futures price and volume data are from Techtools, Inc., 980 N. Federal Highway, Boca Raton, FL 33432. Release dates of individual HPRs are taken from the front page of each HPR from December, 1969 to December, 1994. For distant contracts, only 95 events are studied in the all events data set. The 1970–71 April live hog futures and 1970–72 October futures are eliminated from the data sets because of nearly nonexistent volume. Also, data for the August, 1974 and February, 1975 contracts are eliminated because of irregularities.

[4]The *Wall Street Journal Index* is examined for information on hogs and pork under the following topical headings: beef, cattle, commodities, commodity markets, commodity prices, Commodities and Exchange Commission, Commodity Futures Commission, futures trading, hogs, livestock, meat, and pork.

this second reduced data set is needed is unclear. Anecdotal evidence from traders point to instances where subsequent information published in the WSJ about the market being at the price limit for the day (either up or down) because of release of an HPR influences investors to react further to the HPR. If information flows subsequent to the release of an HPR are random, then the need to adjust the basic event data set is attenuated. Also, if one views the natural experiment of the event study as containing these random reports from major new sources, such as the WSJ, then an adjusted reduced data set is unnecessary. One of the purposes of this study is to determine if this is indeed the case and to compare the empirical results.

For each data set, two study designs are developed. The first study design utilizes a 10-calendar-trading-day event window around the release day for each quarterly report. Price and normalized volume are aggregated and analyzed 50 calendar trading days prior to a release and 5 days afterwards. Several reasons support the choice of a 10-day window. First, a 10-day window allows the accommodation of the significant number of limit price changes that occur in live hog futures as a result of the release of an HPR.[5] A 5-day period after the report permits prices to fully adjust to new information. Second, it is an a priori belief that traders begin to take positions some time prior to release of the HPR. A 5-day period prior to the report allows for this possibility. Third, the 10-day window study design allows for comparison with the concept of an equilibrium trading day, which is introduced next.

As a second study design, percentage price change and normalized volume data are reconstructed into an equilibrium trading day configuration. An equilibrium trading day is defined as a nonlimit daily close to the next nonlimit daily close. This approach has been used in one form or another in other studies [e.g., Baur and Orazem, Colling and Irwin, Garcia and Leuthold (1992), and Garcia et al.]. Because of the institutional constraint of price limits during any trading day the market is open, if prices close at the upper or lower limit, all orders typically are not filled. If traders have outstanding unfilled orders, a limit close cannot be considered an equilibrium price. As a result, not all information is incorporated into price and trading volume for the day. The equilibrium trading day construction permits equilibrium price and volume analysis. As an

[5]Chicago Mercantile Exchange rules permit prices to change during a day's trading session from the previous day's close only by a given maximum amount. For live hog futures, this change is 1½ per pound and for pork belly futures it is 2 per pound.

example, the cumulative return from close of day 0 (release day) to equilibrium trading day 1 is defined as the natural logarithm of close of the first nonlimit day after release minus the natural logarithm of the closing price of the release day. Using similar logic, volume is summed from day 0 to equilibrium trading day 1 before dividing by open interest for that day. As with the first study design, F tests measure the change in price variance. Here, however, the change is from one equilibrium trading day to the next and the F test measures a cross-sectional comparison of price variance of equilibrium trading day 0 to equilibrium trading day 1. Similar analysis holds for comparisons of levels of trading volume using a t test. Additionally, this approach permits use of standard nonparametric tests should sufficient degrees of freedom be absent.

The study designs and data sets permit use of simple but robust statistical tests with large degrees of freedom. All tests have 30 degrees of freedom or more. For the 10-day window study design, an F test compares the price variance of the percentage change price series for the 5-day period prior to release through the 5-day period afterwards. A t test compares average normalized volume for each period. With the equilibrium trading day study design, an F test compares the price variance of both price series of day 0 to equilibrium trading day 1 and subsequent days. Similarly, a t test compares normalized volume for day 0 to equilibrium day 1. Each study design is applied to both data sets: the complete data set, which includes all events, and the reduced data set, which is adjusted for subsequent information flow.

HYPOTHESES

Two hypotheses are tested for information arrival. First, does a statistically significant increase in price variability occur after the release of the HPR? Second, does a statistically significant change occur in the level of trading volume? The changes or shifts in level of trading volume can be positive or negative, leading to two-tailed tests.

Formally stated, testing for price variability yields the following null and alternative hypothesis:

H1,0: For each price data series and after the release of the HPRs, there is no change in price variance.

H1,1: For each price data series and after the release of the HPRs, price variance increases.

Second, testing for changes in the level of trading volume yields null and alternative hypotheses as

H2,0: For each volume data series and after the release of the HPRs, there is no change in the level of trading volume.

H2,1: For each volume data series and after the release of the HPRs, trading volume increases (decreases).

RESULTS

Live Hog Futures

First, results of the equilibrium trading days study design with the use of the complete data set show a significant increase in price variability and level of normalized trading volume for both nearby and distant contracts of live hog futures (see Tables II and III). Test results of the reduced data set on percentage price change and normalized volume also show significant increases from day 0 to equilibrium trading day 1. Additionally, the time period 1970–1994 is divided in half to determine if the results are time dependent. In both subperiods price and volume analysis indicate statistical significance.

Second, the results from the 10-day window study design are not as robust. For nearby live hog futures, results indicate significant increases in price variability and normalized volume. However, for distant futures, test results indicate an increase in price variability but not volume. This contrasts with the positive results from the equilibrium study design on both price and volume.

Third, these results are consistent across both data sets; that is, the results for each study design hold for each data set.

Fourth, analysis suggests the possibility of continued information arrival on equilibrium trading day 2. With the use of the percentage price series and the all-events data set, price variability for nearby futures from day 0 to equilibrium trading day 2 shows an increase but is not significant at the 10% level. The p value is 0.13. However, volume does significantly increase. For distant hog futures, price variability increases significantly, whereas the level of trading volume declines significantly. The increases in price variability and level of trading volume suggest continued information arrival on day 2. The significant decline in trading volume on day 2 for distant futures is a puzzle. It is speculated that the information flow to a distant contract may be different than a nearby contract. Tests for day 3 on nearby and distant futures (not reported here) show no significant change in price variability and level of trading volume from day 0 (release day).

TABLE II

Analysis of Variance of Change in Prices and Changes in the Level of Trading Volume for Nearby Live Hog Futures Contracts. Analysis of Nearby Live Hog Futures Contracts Test on Information Arrival about Market Hog Inventory. *F* Test and *t* Test are Based on Cross-Sectional Comparison of Data in One Trading Period to the Next

Panel A: Analysis of Variance of Change in Prices and F-Test of Significance for Nearby Live Hog Futures

Data Set	*Study Design*	*Data Type*	*Trading Period Analyzed*	*Time Period*	*Variance of Changes in Price*	
					Pre	*Post*
Complete data set	Equilibrium trading days	Percentage price change	Day 0 to day 1	1970–1994	2.01	14.396***
			Day 0 to day 1	1970–1982	2.72	16.49***
			Day 0 to day 1	1983–1994	1.267	12.467***
			Day 0 to day 2	1970–1994	2.01	2.509
	Calendar trading days	Percentage price change	10-day window	1970–1994	2.308	3.386***
Reduced data set	Equilibrium trading days	Percentage price change	Day 0 to day 1	1970–1994	1.69	14.18***
	Calendar trading days	Percentage price change	10-day window	1970–1994	2.00	3.324***

Panel B: Analysis of Change in Level of Trading Volume and t-Test Significance for Nearby Live Hog Futures

Data Set	*Study Design*	*Data Type*	*Trading Period Analyzed*	*Time Period*	*Mean Level of Trading Volume*		*Percentage Change in Level of Trading Volume*
					Pre	*Post*	
Complete data set	Equilibrium trading days	Normalized volume	Day 0 to day 1	1970–1994	0.305	0.532***	+74.4%
			Day 0 to day 1	1970–1962	0.328	0.559***	+70.4%
			Day 0 to day 1	1983–1994	0.280	0.503***	+79.6%
			Day 0 to day 2	1970–1994	0.305	0.375***	+23.0%
	Calendar trading days	Normalized volume	Ten-day window	1970–1994	0.309	0.346***	+12.0%
Reduced data set	Equilibrium trading days	Normalized volume	Day 0 to day 1	1970–1994	0.30	0.525***	+75%
	Calendar trading days	Normalized volume	Ten-day window	1970–1994	0.304	0.342***	+12.5%

*Significant at the 10% level; *t* tests are two-tailed tests.
**Significant at the 5% level; *t* tests are two-tailed tests.
***Significant at the 1% level; *t* tests are two-tailed tests.

TABLE III

Analysis of Variance of Change in Prices and Changes in the Level of Trading Volume for Distant Live Hog Futures Contracts. Analysis of Distant Live Hog Futures Contracts Test on Information Arrival about Breeding Stock Inventory

Panel A: Analysis of Variance of Change in Prices and F Test of Significance for Distant Live Hog Futures

Data Set	*Study Design*	*Data Type*	*Trading Period Analyzed*	*Time Period*	*Variance of Change in Price*	
					Pre	*Post*
Complete data set	Equilibrium trading days	Percentage price change	Day 0 to day 1	1970–1994	1.514	20.545***
			Day 0 to day 1	1970–1962	2.286	28.388***
			Day 0 to day 1	1983–1994	.791	13.278***
			Day 0 to day 2	1970–1994	1.514	2.203***
	Calendar trading days	Percentage price change	Ten-day window	1970–1994	1.774	3.549***
Reduced data set	Equilibrium trading days	Percentage price change	Day 0 to day 1	1970–1994	1.609	15.493***
	Calendar trading days	Percentage price change	Ten-day window	1970–1994	1.899	3.506***

Panel B: Analysis of Change in Level of Trading Volume and t *Test Significance for Distant Live Hog Futures*

Data Set	*Study Design*	*Data Type*	*Trading Period Analyzed*	*Time Period*	*Mean Level of Trading Volume*		*Percentage Change in Level of Trading Volume*
					Pre	*Post*	
Complete data set	Equilibrium trading days	Normalized volume	Day 0 to Day 1	1970–1994	0.234	0.341***	+45.1%
			Day 0 to Day 1	1970–1982	0.245	0.334***	+36.3%
			Day 0 to Day 1	1963–1994	0.222	0.348***	+56.8%
			Day 0 to Day 2	1970–1994	0.234	0.177***	−24.4%
	Calendar trading days	Normalized volume	Ten-day window	1970–1994	0.157	0.164	+4.5%
Reduced data set	Equilibrium trading days	Normalized volume	Day 0 to day 1	1970–1994	0.241	0.319**	+32.4%
	Calendar trading days	Normalized volume	Ten-day window	1970–1994	0.163	0.164	0%

*Significant at the 10% level; two-tailed test.
**Significant at the 5% level; two-tailed test.
***Significant at the 1% level; two-tailed test.

Frozen Pork Belly Futures

Table IV presents the results on nearby pork belly futures where, based on the results from the live hog analysis, only the equilibrium trading day study design is utilized. Price variability and level of normalized trading volume increase significantly after release of HPRs. This is true for the complete and reduced data sets. Similar to the live hog analysis, the time periods are divided in half and both price and volume are significant. Tests on both data sets indicate continued information flow on day 2 as both price variance and change in level of normalized trading volume is significant. Tests on day 3 (not reported here) are generally not significant.

CONCLUDING COMMENTS

First, similar to Colling and Irwin (and several previous studies), this study finds that new information arrives in the live hog futures market because of the release of USDA HPRs. Additionally, evidence from tests on frozen pork belly futures suggests information arrival in that market from HPRs. Increasing price variability and level of trading volume from HPRs reflects changing trader beliefs for both nearby and distant contracts of live hog futures and nearby pork belly futures. The findings on live hog futures contrast with those of Carter and Galopin. The fact that the information of an HPR is known prior to release and no statistically significant risk-adjusted profits are made does not, per se, imply that HPRs contain no new information. Colling and Irwin (1995) in a forthcoming comment point out that the risk adjustment used by Carter and Galopin is narrow and unrealistic. With the use of different and more realistic levels of risk aversion, Colling and Irwin show that a trader would make significant profits from advance knowledge of HPRs.

Second, subsequent information flows into the pork futures complex after release of an HPR are apparently random and do not have a measurable impact on futures.

Third, use of the equilibrium trading concept allows a more focused use of price and volume data to ascertain information arrival. This approach permits use of simple but robust testing procedures. This approach also permits investigation of information arrival on subsequent equilibrium trading days.

Fourth, this study finds evidence of a continued reaction to HPR releases on the second equilibrium trading day for both live hog and pork belly futures. Implications concerning market efficiency are left to the reader.

TABLE IV

Analysis of Variance of Change in Prices and Changes in the Level of Trading Volume for Nearby Frozen Pork Belly Futures Contracts. Analysis of Nearby Frozen Pork Belly Futures Contracts Test on Information Arrival about Market Hog Inventory. *F* test and *t* Test are Based on Cross-Sectional Comparison of Data in One Trading Period to the Next

Panel A: Analysis of Variance of Change in Prices and F Test of Significance for Nearby Frozen Pork Belly Futures

Data Set	*Study Design*	*Data Type*	*Trading Period Analyzed*	*Time Period*	*Variance of Changes in Price*	
					Pre	*Post*
Complete data set	Equilibrium trading days	Percentage price change	Day 0 to day 1	1970–1994	3.25	47.75***
			Day 0 to day 1	1970–1962	4.14	43.96***
			Day 0 to day 1	1963–1994	2.38	51.98***
			Day 0 to day 2	1970–1994	3.25	4.71*
Reduced data set	Equilibrium trading days	Percentage price change	Day 0 to day 1	1970–1994	2.72	37.64***
			Day 0 to day 2	1970–1994	2.72	5.05**

Panel B: Analysis of Change in Level of Trading Volume and t-Test Significance for Nearby Frozen Pork Belly Futures

Data Set	*Study Design*	*Data Type*	*Trading Period Analyzed*	*Time Period*	*Mean Level of Trading Volume*		*Percentage Change in Level of Trading Volume*
					Pre	*Post*	
Complete data set	Equilibrium trading days	Normalized volume	Day 0 to day 1	1970–1994	0.429	0.791***	+84.4%
			Day 0 to day 1	1970–1962	0.492	0.833***	+89.3%
			Day 0 to day 1	1983–1994	0.364	0.747***	+105%
			Day 0 to day 2	1970–1994	0.429	0.556***	+29.6%
Reduced data set	Equilibrium trading days	Normalized volume	Day 0 to day 1	1970–1994	0.409	0.713***	+74.3%
			Day 0 to day 2	1970–1994	0.409	0.521***	+27.4%

*Significant at the 10% level; *t* tests are two-tailed tests.
**Significant at the 5% level; *t* tests are two-tailed tests.
***Significant at the 1% level; *t* tests are two-tailed tests.

Fifth, this study demonstrates the price data alone may not be sufficient for testing information arrival. Volume data, if available, provides a second metric and may reveal results price data do not. For example, tests on normalized volume for nearby live hog futures indicate significance on the second equilibrium trading day when price variance does not. Also, the tests on normalized volume for pork belly futures on the second day provide a strong indication of continued information arrival where test results on price variance are weaker.

Because the information from government reports continues to impact markets, the issues of information flow, cost of public information, and market efficiency will continue to be an area of important inquiry.

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