The Response of Corn Futures Markets to Agro-Biotechnology News

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Paper presented at the Western Agricultural Economics Association Annual Meetings, Logan, Utah, July 8 to 11, 2001.

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Consumer perceptions of the potential negative side effects to the body and to the environment as well as consumer opinion regarding ethical issues of developing transgenic products has caused melee at times in the food marketing chain. This has prompted some firms, e.g., Frito Lay and Gerber, to publicly announce that grains and oilseeds produced using transgenic seed will not be used as an ingredient in the production of food. This research found little to support the notion that agro-biotechnology news and/ or recall/non-use announcements affected the CBOT corn futures market. As hypothesized, this result suggests that the market for non-transgenic corn is small relative to aggregate corn supply and demand, which the CBOT corn futures market represents.

The Response of Corn Futures Markets to Agro-Biotechnology News

Agro-biotechnology issues have attracted considerable attention over the past few years with expanded transgenic use in domestic crop production (Figure 1). In particular, consumer perceptions of the potential negative side effects to the body and to the environment as well as consumer opinion regarding ethical issues of developing transgenic products has caused melee at times in the food marketing chain. This has prompted some firms, e.g., Frito Lay and Gerber, to publicly announce that grains and oilseeds produced using transgenic seed will not be used as an ingredient in the production of food. Furthermore, the finding of the *Starlink*® gene (an unapproved variety for food use) in food products caused many food manufactures to further restrict the use of commodity grade corn in production. At the same time of these announcements biotechnology was receiving considerable media attention. Though food, seed, and industrial use of corn in the U.S. is estimated at 20% of annual production (USDA) there were indications of a negative overall market response to agro-biotechnology information.[1] The question arises, to what extent did firm non-use announcements and/or media coverage impact the aggregate market demand for corn? The objective of this research is to empirically analyze whether corn futures market prices react to firm non-use announcements of inputs developed having transgenic traits, and if the market does react, then the size of this impact will be measured. A secondary objective is to assess the impact of news media releases related to agro-biotechnology on the corn futures markets.

The Chicago Board of Trade (CBOT) corn futures contract specifications are for #2 yellow corn of U.S. origin of specific quality characteristics, e.g., test weight, damaged kernel.

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[1] Additionally the USDA estimated that of 1999 corn production 60% was for feed use and 20% was for the export markets. The export markets represent another concern, however, a considerable amount of the corn shipped via the export market is used for feed use.

Because the corn futures contract is specified as a deliverable commodity, at various locations along the Illinois and Ohio Rivers, discounts are assigned to delivered corn not meeting minimum quality specifications. Thus, the CBOT corn futures market represents the primary price discovery mechanism for aggregate corn production in the U.S., without regard to quality differentiated markets. Firm non-use announcements should only produce sustained impacts on futures price if the demand for non-gmo corn is sufficient to be represented by the market for commodity grade corn, as specified by the CBOT corn futures contract. Thus, determining whether the agro-biotechnology information is sustained in the market may provide an indication of the size of the market for non-GMO corn. That is, the CBOT corn futures market may have over-reacted to the new information and only short-term, i.e., inra-day, price responses may have occurred.

There has been substantial media coverage of agro-biotechnology issues, with the media reporting on both the pros and cons. Figure 2 is used to graphically depict the daily agro-biotechnology media releases, over the 1990 through 2000 period, for four media outlets with relatively wide circulation. There are, of course, periods of heavy and thin media coverage. The Question is, to what extent does media coverage and firm non-use announcements influence trader perceptions and thereby influence the markets? Also, it may be that media releases surrounding these announcements have a compounding effect by swaying public (trader) opinion over a series of days as more news enters the market after the initial release.

Food processing firms, such as Gerbes and Frito Lay, and International markets for food use contract much of the corn production needed for processing with only residual purchasing in the commodity market place. Yet, news releases such as the following have been common over the past couple of years,

"Commodities column reports December corn futures at Chicago Board of Trade rose 5.50 cents to $2.06 a bushel, nearly a two-week high, on hopes that controversy over Starlink genetically modified corn will not hinder exports to Japan, largest buyers of US corn." (November 1, 2000, Wall Street Journal, "Corn Futures Rise as Worries over Japan Abate, Section C; Page 19, Column 1; Byline: Dyanna Decola)

The results of this analysis are important to hedgers and speculators so that they can assess the impact on their futures market position from the introduction of new information related to firm non-use announcements of agro-biotechnology inputs. Also, persons making marketing recommendations can use the information from this analysis to assess the timing of futures and options positions. As the use of agro-biotechnology increases and the controversy surrounding agro-biotechnology potential increases, the impact of new information into the marketplace will become more important.

Previous Research in the Agriculture Literature and Conceptual Model

An extensive literature exists on the reaction to markets from new information. For instance, Colling, Irwin, and Zulaf investigated the impact of "Export Inspections" reports on wheat, corn and soybean futures prices; Patterson and Brorsen analyzed the informational content of USDA export sales reports; Colling and Irwin analyzed the response of live hog futures prices to USDA *Hogs and Pigs Reports*; and Schroeder, Blair, and Mintert investigated opportunities for livestock futures trading profits around USDA Inventory Reports. Also, Lusk et al. analyzed lean hog and live cattle futures market price response to firm meat recall announcements. They found very little to suggest that either the live cattle or lean hog futures price responded to meat recalls. Saline and Hooker analyzed the impact of meat recalls on the stock price of three agribusinesses. Saline and Hooker concluded that no substantial long-run

impacts on stock performance were associated with the meat recall, though some short-term impacts were observed for the smaller firm.

Conceptual Model

Lence and Hayes developed a theoretical model for the situation in which the demand for non-transgenic corn varied from a small portion of non-transgenic supply to a large portion of non-transgenic supply. One of their conclusions was that the price of transgenic crops would decline only if the demand for non-transgenic corn exceeded non-transgenic corn supply. For such a case, the price of transgenic corn would be bid down to cause those on the fringe of preferring non-transgenic corn to switch to purchasing transgenic corn. Thus, in the simplest form the domestic demand for corn can be expressed as:

$$(1) \quad \alpha Q^S + (1-\alpha)Q^S = Q = \beta Q^D + (1-\beta)Q^D \ ,$$

where α is the percentage of supply of non-transgenic corn and β is the percentage of demand for non-transgenic corn. Thus, the price for non-transgenic corn is determined by:

$$(2) \quad P^{\text{non-transgenic}} = f(\beta Q, Z_1 \mid \beta = \alpha),$$

where Z_1 is a set of exogenous variables and it is assumed $\beta = \alpha$ so that the supply of non-transgenic corn equals the demand for non-transgenic corn. Because transgenic corn can not fulfill the quality requirements of non-transgenic corn the quantity of transgenic corn does not impact the price of non-transgenic corn. Alternatively, the price of "corn" is determined by:

(3) $P^{\text{corn futures}} = f\left([\beta Q + (1-\beta)Q], Z_2 ; \beta = \alpha\right),$

where Z_2 is a set of exogenous variables and it is assumed $\beta = \alpha$ so that the supply of transgenic corn plus non-transgenic corn equals the demand for transgenic corn plus non-transgenic corn. That is, either transgenic or non-transgenic corn can supply the demand for "corn." The motivation for our study is to attempt to determine the level of β and α, i.e. whether $\beta > \alpha$. If $\beta > \alpha$, then the corn futures price will need to adjust down to cause some of the purchasers of non-transgenic corn to switch to being indifferent. Thus, information impacting the level β should have an impact on the corn futures market if $\beta > \alpha$.

Now add in one other situation, Starlink corn not allowed for food use, thus, equation (3) is re-specified as:

(4) $P^{\text{corn futures}} = f\left([\beta Q + (1-\delta)(1-\beta)Q], Z_2 ; \beta = \alpha\right),$

where, δ is the percentage of the transgenic corn that can not enter the food supply due to domestic or foreign government restriction on use. The quantity unavailable in this case is equal to the percentage of transgenic crop that enlists the unwanted characteristics. Thus for this case, we seek to determine whether δ (say greater than the percentage of the corn futures representing demand for food quality corn) is large enough to affect unrestricted corn use even in the instance of surprise information entering the market place. This is tested via two different methods: using a simple graphical analysis on Starlink and empirically analyzing the impact of media releases on the CBOT corn futures. Our hypothesis is that these markets represent niche

markets, thus, either firm recall/non-use announcements or media news releases on agro-biotechnology will not impact the corn futures price.

Empirical Model:

To analyze whether the corn futures market price responds to firm recall/non-use announcements of transgenic produced inputs and agro-biotechnology news releases, the methodology of Colling and Irwin and Lusk et al. is followed. The current analysis differs from that of Colling and Irwin in the all non-use announcements are new information to the market, whereas, Colling and Irwin accounted for the effect on futures market prices from pre-release estimates.

This study extends previous research by including a variable to capture the possible compounding effect of new information on markets as the popular press picks up on the announcement in the days following the initial release. The empirical models to be estimated for this analysis are:

(5) $[(\text{Corn Futures Price })^{O}_{t+i}] - [(\text{Corn Futures Price})^{S}_{t-1}] =$

$\Omega_0 + \Omega_1$ Quantity of Agro-Biotechnology News Releases $+ \Omega_2$ Nearby Contract x

Quantity of Agro-Biotechnology News Releases $+ \Omega_3$ Foodstuffs Index $+ \Omega_4$ Other

USDA News Releases $+ \omega_t$

(6) $[(\text{Corn Futures Price })^{O}_{t+i}] - [(\text{Corn Futures Price})^{S}_{t-1}] =$

$\Omega_0 + \Omega_1$ Firm Recall/Non-Use Event $+ \Omega_2$ Quantity of Agro-Biotechnology News

Releases $+ \Omega_3$ Foodstuffs Index $+ \Omega_4$ Other USDA News Releases $+ \omega_t$,

where superscripts O and S refer to opening and settle, respectively, t refers to day, i refers to days after the announcement (i= 0,1, 2, . ..). The dependent variable is specified as the difference between the opening corn futures price on the day $t + i$ after the recall, non-use, or general media release and the corn futures settlement price on day t-1. This period was chosen to account for the inability to determine when the non-use announcement officially became public relative to the trading period. For example, a firm non-use announcement may have occurred at 3 p.m. on Tuesday and the information would not enter the market until Wednesday. A similar procedure was used by Lusk et al.

Three separate corn futures contracts were evaluated to capture seasonality in the marketing year, i.e., at different times of the year information may have different impacts. The contract months December, May, and July were analyzed over the period 1995 to December 2000.

The media release variable is a continuous variable that represents the total number of media releases on day t from the Wall Street Journal, Washington Post, USA Today, and Daily Telegraph. This value ranged from zero to nineteen. An interaction term was specified to determine whether information may have had a greater impact closer to the expiration month. Note, for this analysis expiration is defined as the months prior to the next closest contract used in this study, i.e., May is the nearby month from the end of the December contract in the previous year until expiration of the May contract. Additionally, a variable was specified to capture the compounding impact of news releases. That is, there may be several follow-up releases to the initial release that cause the event to appear more dramatic than it really is.

$$(7) \qquad \sum_{l=t}^{t\text{-}3} \beta_l \text{Media Coverage}_l$$

where, a two day lag is used and the weights $\beta_t = 0.50$, $\beta_{t-1} = 0.25$, $\beta_{t-2} = 0.25$. Newer information into the marketplace is expected to have a greater impact than older information, so a weighting scheme is assigned for the accumulation of news releases over the period specified by the change in futures prices, i.e., dependent variable, over a series of days.

Other announcements are specified as 0 or 1 binary variables with a 1 assigned to the day of the respective announcements, zero otherwise. This variable was included to account for movements in the corn futures market due to regularly scheduled USDA news releases. The announcements are expected to have varied impacts depending on the type of announcement. The Foodstuffs Index was included to account for exogenous changes in the grain and oilseed markets, i.e., all other market movements.

A two-limit Tobit model estimation procedure should be used to account for limit moves associated with futures prices. Alternatively, if no limit moves occur, then ordinary least squares estimation of equation (1) is sufficient. Because limit moves occurred for a very low percentage of the trading days analyzed in this study, those observations were dropped in lieu of using a two-limit tobit model. Additionally, futures markets are represented by periods varying volatility in the market. Previous research, e.g., Patterson and Brorsen, have suggested the GARCH(1,1) model to adequately account for the periods of varying volatility. Thus, a GARCH(1,1) model is estimated for both equation (5) and (6) using *Shazam* 8.0. Non-stationarity of the dependent variable is typically an issue when dealing with time-series daily data; however, because the dependent variable is specified in differences a non-stationary series was deemed not be an issue.

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Data

       Daily Chicago Board of Trade (CBOT) corn futures prices were obtained from Bridge. Similarly, the Food Stuffs Index was obtained from Bridge. Report dates for the various USDA releases were obtained from the National Agricultural Statistical Service. Dates of firm non-use and recall announcements were obtained through global content searcher for major media publication outlets through Lexis-Nexis. Similarly, data for media coverage was obtained via key word searches in Lexis-Nexis.

Results

Tables 1 through 3 provide estimation results of various event study models on agro-biotechnology media announcements. The period January 1995 through December 2000 was initially used for estimation. First, various alternative lag structures were used for the dependent variable, i.e. $[(\text{Corn Futures Price})^O_{t+i}]- [(\text{Corn Futures Price})^S_{t-1}]$, and it was determined that no significant difference in the parameter estimates occurred from choosing i between 1 and 4. Thus, $i = 1$ was used for the estimation of all models. Second, a two period lag was chosen for the news media variable as described previously. This model is reported in Table 2. Various other lag structures were evaluated with insignificant impacts on the magnitude of the coefficient. Last, the model reported in Table 3 represents a model that is the same as that reported in Table 2 with the exception that the data only covers the January 1998 through December 2000 period.

       GARCH(1,1) models were estimated for each specification to account for changes in the error variance over the period of analysis. The models estimated tended to have very little explanatory power. This is typical with this type of analysis. It is difficult to capture all the

factors that lead to between day futures market changes, e.g., speculative traders taking profits or minimizing losses.

To conserve space, primary focus is given to the Media variables. In general, agro-biotechnology media releases did not have an impact on the CBOT corn futures market. The exception would be for the nearby period of the July futures contract ($-0.004). This event is difficult to explain. A review of the data shows nothing unordinary about this period. Though the variable is statistically significant, the economical significance of this variable is marginal ($20/ 5,000 bushel contract). Additionally, the media variable in levels was positive and significant, thus, reducing the impact of the nearby media releases on the July corn futures contract.

Based on this initial analysis, it appears as though there is little evidence to support inter-day price movements due to agro-biotechnology news. This, of course, does not preclude the possibility of intra-day price movements due to the news. Such intra-day movements may impact speculator trading, however, the scope of analyzing intra-day price changes is far too complex to analyze. Particularly, when there is great difficulty in assessing when the news releases occurred.

Starlink

Figures 3 and 4 are used to graphically depict the response of the May CBOT corn futures contract to recall and/or non-use announcements surrounding the use of *Starlink* corn in the food supply.[2] Figure 3 indicates the changes in futures between the day after the event and the day prior to the event. Figure 4 is for the period four days after the event and the days prior to the event. Clearly, the impact on the corn futures price is mixed for either time period used.

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[2] Note, some of the announcements made with respect to *Starlink* were that in general the firm would not use transgenic inputs regardless of genetics.

Specifically, because no consistent trend is present the change in price observed may have been due to a multitude of factors. In one of the regression models specified, a shorter time period is used and recall/non-use announcements are used as an explanatory variable (Table 4). Twenty-six significant recall/non-use announcements occurred during the 1998 to 200 time period. Interestingly, the announcement variable was positive for the May and July models. Again, the media event had a negative impact on the July corn futures price. The positive affect on corn futures from the event announcement can't be explained, however, this model supports the hypothesis that adverse agro-biotechnology announcements have little impact on the corn futures market, thus the size of the non-transgenic market is relatively small.

Discussion

Consumer concerns, echoed via firm non-use and recall announcements of transgenic produced inputs, have caused some producers to decrease the percentage of acres planted to transgenic crops. On one hand producers perceive there to be decreased demand for conventionally produced commodities because of firm non-use/recall announcements, and on the other hand researchers (e.g., Ballenger, Bohman and Gehlhar) have indicated limited supply and demand shifts due to biotechnology. Are producer perceptions correct, or have researchers adequately accounted for all factors? Assuming the corn futures market is efficient, new information suggesting a demand shift should affect the market if the non-transgenic proportion of the market is at all large.

This research found little to support the notion that agro-biotechnology news and/ or recall/non-use announcements affected the CBOT corn futures market. As hypothesized, this

result suggests that the market for non-transgenic corn is small relative to aggregate corn supply and demand, which the CBOT corn futures market represents.

There are, of course, limitations of this study and follow-up analysis required. First, appropriately specifying the agro-biotechnology media variable would entail using the ratio of positive to negative releases instead of levels. Second, there are likely econometric issues that have not been accounted for in this study. Third, assessing when exactly the news releases first appeared can be rather difficult and may cause errors-in-variables problems. Last, a more thorough review of the business literature may yield alternative methods for analyzing the impact of "surprise" events on price. As specialized futures markets develop, e.g., see Parcell for a discussion of the Tokyo Grain Exchange Non-GMO soybean futures contract, it may become to feasible to analyze these markets directly to determine the size of specialized market.

References

Ballenger, N., M. Bohman and M. Gehlhar, "Biotechnology: Implications for US corn and Soybean Trade, *Agricultural Outlook*, April 2000, pp. 24-28.

Bridge Financial Data Center (CD-ROM). Bridge Financial, 20 S. Wacker Drive, Suite 1810, Chicago, Illinois.

Colling, P.L., and S.H. Irwin. "The Reaction of Live Hog Futures Prices to USDA Hogs and Pigs Reports." *Amer. J. Agr. Econ.* 72(February 1990):84-94.

Colling, P.L., S.H. Irwin, and C.R. Zulauf. "Reaction of Wheat, Corn, and Soybean Futures Prices to USDA "Export Inspections" Reports." *Rev. Agr. Econ.* 18(January 1996)127-36.

Kalaitzandonakes, N. "A Farm Level Perspective on Agrobiotechnology: How Much Value And For Whom?" *AgBioForum* 2(Spring 1999): http://www.agbioforum.missouri.edu/

Lusk, J., and T. Schroeder. "Effects of Meat Recalls on Futures Market Prices." Presented paper at NCR-134 *Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management*, ed. T.C. Schroeder, pp. 1-19. Dept. of Agr. Econ., Kansas State University, 2000.

Lence, S., and D. Hayes. "Response To an Asymmetric Demand for Attributes: an Application to the Market For Genetically Modified Ccrops." Presented paper at NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management, ed. T.C. Schroeder, pp. 1-31. Dept. of Ag. Econ., Kansas State University, 2001.

Parcell, J.L. "An Initial Look at the Tokyo Grain Exchange Non-GMO Soybean Contract." *Journal of Agribusiness* 19, no. 1 (Spring 2001): 85-92

Patterson, P., and B.W. Brorsen. "USDA Export Sales Report: Is it News?" *Rev. Agr. Econ.* 15(May 1993):367-378.

Salin, V., and N. H. Hooker. "Stock Market Reaction to Food Recalls." *Rev. Agr. Econ.* 23(2001):33-46.

Schroeder, T., J. Blair, and J. Mintert. "Abnormal Returns in Livestock Futures Prices Around USDA Inventory Report Releases." *N. Cent. J. Agr. Econ.* 12(1990)293-304.

SHAZAM. *Econometrics Computer Program Users Reference Manual, Version* 8.0. New York, NY, McGraw Hill, 1993.

United States Department of Agriculture, National Agricultural Statistical Service (NASS). *Crop Progress*. Various Issues, 1995-2000.

United States Department of Agriculture, National Agricultural Statistical Service (NASS). *Crop Production*. Various Issues, 1995-2000.

United States Department of Agriculture, National Agricultural Statistical Service (NASS). *Weather*. Various Issues, 1995-2000.

United States Department of Agriculture, National Agricultural Statistical Service (NASS). *Hogs and Pigs*. Various Issues, 1995-2000.

United States Department of Agriculture, National Agricultural Statistical Service (NASS). *Cattle on Feed*. Various Issues, 1995-2000.

United States Department of Agriculture, National Agricultural Statistical Service (NASS). *Export Intentions*. Various Issues, 1995-2000.

Table 1. Empirical Model of Affects on Change in Corn Futures Price from Aro-Biotechnology News Releases (January 1995 through December 2000)

	May	July	December
Media	0.4E-03	0.001**	0.6E-04
	(0.563)	(0.017)	(0.898)
Nearby x Media	0.4E-03	-0.004 ***	0.002***
	(0.507)	(<0.01)	(0.008)
Foodstuffs Index	0.004***	0.004***	0.004***
	(<0.01)	(<0.01)	(< 0.01)
Other Releases	-0.004***	-0.003*	-0.004**
	(<0.01)	(0.09)	(0.013)
Constant	-0.8E-03	-0.002*	-0.001
	(0.498)	(0.08)	(0.287)
R – squared	0.113	0.117	0.108
# observations	1576	1526	1512
Mean of Dep. Variable	-0.001098	-0.00182	-0.00196

Note: p-values in parentheses. ***, ***, and * asterisks represent statistical significance at the 99%, 95%, and 90% level respectively.

Table 2. Empirical Model of Affects on Change in Corn Futures Price from Aro-Biotechnology News Releases where News Leases Accumulated over a 3-day Moving Average (January 1995 through December 2000)

	May	July	December
Media	0.3E-03	0.8E-03	-0.3E-03
	(0.683)	(0.217)	(0.672)
Nearby x Media	0.7E-03	-0.004***	0.038**
	(0.395)	(<0.01)	(0.038)
Foodstuffs Index	0.004***	0.004***	0.004***
	<0.01)	(<0.01)	(< 0.01)
Other Releases	-0.004***	-0.003*	-0.004**
	(<0.01)	(0.07)	(0.013)
Constant	-0.9E-04	-0.001	-0.7E-03
	(0.941)	(0.264)	(0.570)
R – squared	0.113	0.117	0.108
# observations	1576	1526	1512
Mean of Dep. Variable	-0.001098	-0.00182	-0.00196

Note: p-values in parentheses. ***, ***, and * asterisks represent statistical significance at the 99%, 95%, and 90% level respectively.

Table 3. Empirical Model of Affects on Change in Corn Futures Price from Aro-Biotechnology News Releases where News Leases Accumulated over a 3-day Moving Average (January 1998 through December 2000)

	May	July	December
Media	0.6E-03	0.001*	-0.1E-03
	(0.942)	(0.06)	(0.863
Nearby x Media	0.9E-03	-0.004***	0.002**
	(0.608)	(<0.01)	(0.044)
Foodstuffs Index	0.003***	0.004***	0.003***
	(<0.01)	(<0.01)	(< 0.01)
Other Releases	-0.004*	-0.003*	-0.004**
	(<0.053)	(0.09)	(0.028)
Constant	-0.2E-03	-0.004***	-0.003
	(0.157)	(0.01)	(0.112)
R – squared	0.108	0.124	0.108
# observations	838	838	838
Mean of Dep. Variable	-0.0036	-0.0043	-0.0038

Note: p-values in parentheses. ***, ***, and * asterisks represent statistical significance at the 99%, 95%, and 90% level respectively.

Table 4. Empirical Model of Affects on Change in Corn Futures Price from Aro-Biotechnology News Releases and Firm Non-Use Announcements (January 1998 through December 2000)

	May	July	December
Recall / Non-use Announcement	0.015** (0.038)	0.001* (0.06)	0.011 (0.102)
Media	0.2E-04 (0.979)	-0.004*** (<0.01)	0.005 (0.930)
Foodstuffs Index	0.3E-03*** (<0.01)	0.004*** (<0.01)	0.3E-03*** <0.01)
Other Releases	-0.001 (0.538)	-0.003* (0.09)	-0.4E-03 (0.803)
Constant	-0.004*** (<0.01)	-0.004*** (0.01)	-0.003** (0.019)
R – squared	0.103	0.099	0.084
# observations	838	838	838
Mean of Dep. Variable	-0.0036	-0.0043	-0.0038

Note: p-values in parentheses. ***, ***, and * asterisks represent statistical significance at the 99%, 95%, and 90% level respectively.

Figure 1. Percentage of Corn Crop Planted using Biotechnology Varieties Compared to Hybrid Seed Corn.
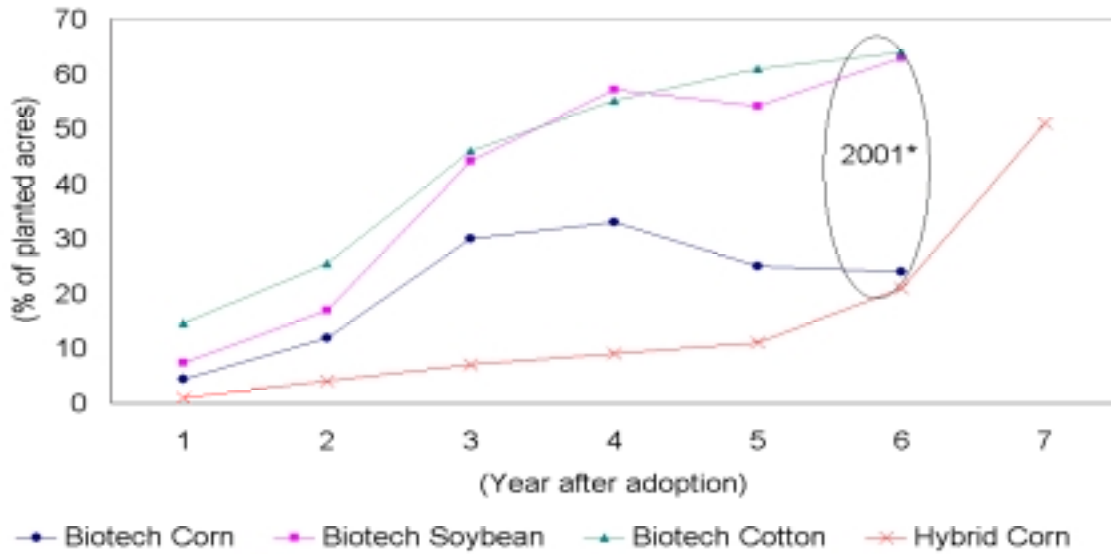

Figure 2. Daily Media Releases from Wall Street Journal, Washington Post, USA Today, and Great Britain Daily Telegraph Related to Agro-biotechnology (January 1990 to December 2000).
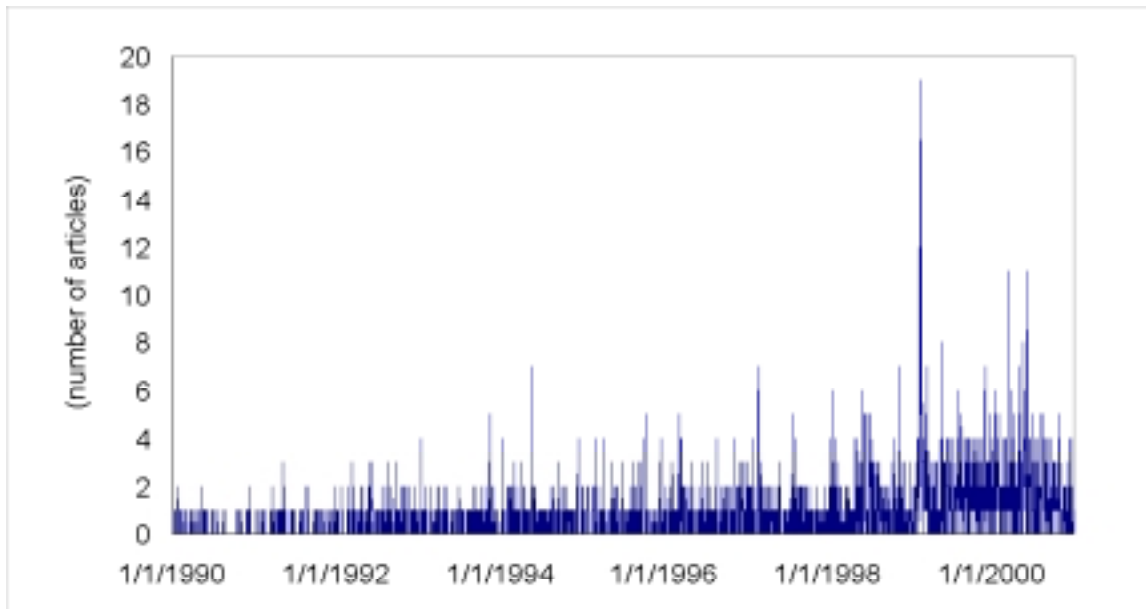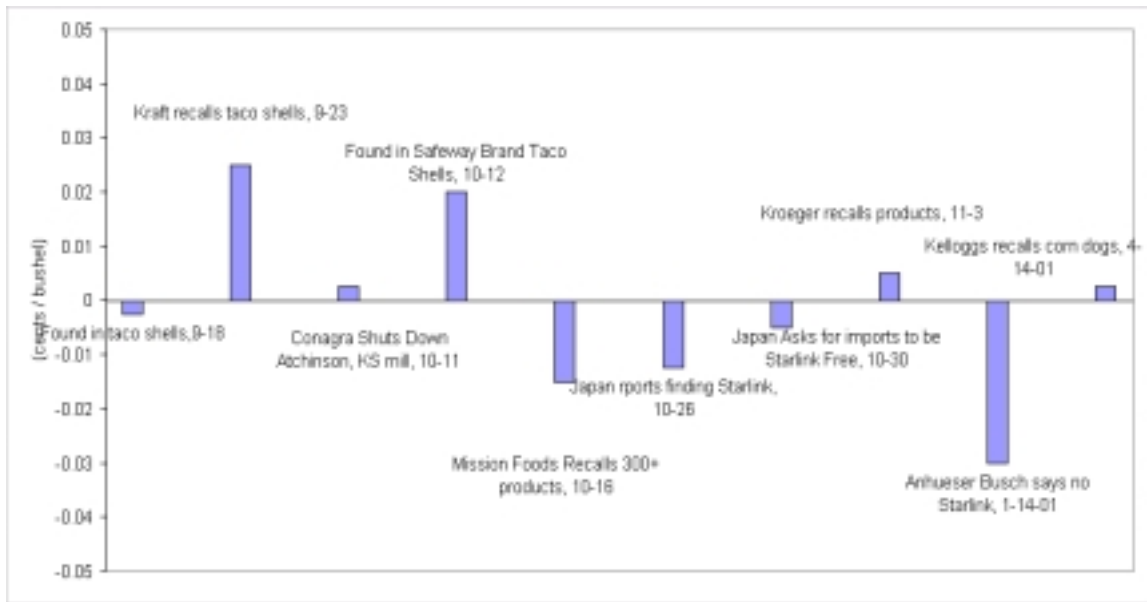
Figure 3. News Releases Related to Non-use or Recall Announcements of Starlink[®] Corn and Change in May Corn Futures Price From the Day Before the Release to the Day After the Release (FuturesOpen$_{t+1}$ – FuturesSettle$_{t-1}$).

Figure 4. News Releases Related to Non-use or Recall Announcements of Starlink[®] Corn and Change in May Corn Futures Price From the Day Before the Release to 4 Days After the Event (FuturesOpen$_{t+4}$ – FuturesSettle$_{t-1}$).