

# Sell the Rumor, Buy the Fact?

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## Abstract

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**Keywords:** Rumor, Gradual Information Diffusion, Investor Inattention, Limits to Arbitrage

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# Sell the Rumor, Buy the Fact?

## **Abstract**

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## 1. Introduction

“Buy the Rumor, Sell the Fact” is an old market maxim.<sup>1</sup> Maiello (2004, p. 79) explains this as follows: “the hope for this kind of investor is that the market will like the rumor and the stock price will go up. Then, when the news confirms the rumor, the price will go higher and an investor could sell at a profit”. He goes on to say (p. 79) “Of course, the biggest risk is that an investor will act on false rumors. The first step in verifying a rumor is to figure out its source.” In this paper we document how a false rumor<sup>2</sup> wiped over \$4.2 billion off airline and related stocks in the US and led to inefficient pricing that persisted for four days. In doing so, we add to an emerging strand of literature that documents how media coverage affects stock returns (e.g. Huberman and Regev, 2001; Vega, 2006; Tetlock, 2007, 2008, 2009; Tetlock, Saar-Tsechansky, and MacSkassy, 2008; and Fang and Peress, 2009).

On September 8, 2008 an internet search retrieved a 2002 story detailing the bankruptcy of United Airlines leading to the incorrect conclusion that United Airlines was filing for bankruptcy again.<sup>3</sup> This bankruptcy “rumor” spread through the market resulting in United Airlines’ market value plunging by 73% (over \$1.1 billion). Other airline stocks and United Airline suppliers were also affected, with total value reductions of \$3.1 billion. Documenting that re-released stale news affects stock prices is neither new nor the major contribution of this paper. Huberman and Regev (2001) and Tetlock (2007) both present instances of this.

Our main contribution is related to what we suggest is the more puzzling aspect of the United Airlines episode - what happened after the rumor was clearly identified as being false.

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<sup>1</sup> A Google web search in 2009 returned over 5 million instances of this saying, although it is not clear where or when it originated.

<sup>2</sup> According to Peterson and Gist (1951, p. 159), a rumor is “an unverified account or explanation of events circulating from person to person and pertaining to an object, event, or issue in public concern.”

<sup>3</sup> United Airline is the major subsidiary of the Nasdaq listed UAL Corporation. It was UAL Corporation that filed for bankruptcy in 2002. However, throughout this paper we refer to the company as “United Airlines” or its ticker of UAUA.

While the prices, volumes, and bid-ask spreads of other airline stocks and United Airline supplier firms quickly returned to pre-rumor levels, the price of United Airlines remained depressed for four days, despite there being no obvious impediment preventing this inefficient pricing being removed by arbitrageurs. Our event is quite unique in this respect. The investors trading the stocks considered by earlier papers in the hours and days following the release of the stale news would likely have been unaware the news was not new.<sup>4,5</sup> In contrast, investors in our setting were left under no illusions as to the false nature of the bankruptcy rumor with United Airlines issuing the following statement within 20 minutes of the rumor affecting prices:

*“United Airlines today said reports that the company filed for bankruptcy are completely untrue and were caused by the irresponsible posting of a 6-year-old Chicago Tribune article by the Florida Sun Sentinel newspaper website with the date changed. The story was related to United's 2002 bankruptcy filing, and United has demanded a retraction from the Sun Sentinel and is launching an investigation. United exited bankruptcy in February 2006. United continues to execute its previously announced business plan to successfully navigate through an environment marked by volatile fuel prices and continues to have strong liquidity.”*<sup>6</sup>

Its stock was halted while the market was informed, and the news media gave extensive coverage to the false rumor and the impact it had on the stock price of United Airlines and related firms.<sup>7</sup> Our event therefore neatly satisfies the Cohen and Frazzini (2008) test for true episodes of investor inattention and mispricing. They state (p. 1978) “(i) any information thought to be overlooked by investors needs to be available to the investing public before prices evolve, and (ii) the information needs to be salient information that investors should be reasonably expected to gather.”

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<sup>4</sup> Huberman and Regev (2001) note the New York Times published a follow-up article seven days after the release of the stale news highlighting what had happened. This implies that investors gathering news from mass media would have been aware that the news was stale until this point.

<sup>5</sup> The work of Huang and Liu (2007) implies it is rational for investors to rely on mass media for news rather than verifying its accuracy.

<sup>6</sup> <http://ir.united.com/phoenix.zhtml?c=83680&p=irol-newsArticle&ID=1194726&highlight>

<sup>7</sup> [http://www.forbes.com/2008/09/08/ual-tribune-bankruptcy-biz-media-cz\\_ja\\_0908ualstory2.html](http://www.forbes.com/2008/09/08/ual-tribune-bankruptcy-biz-media-cz_ja_0908ualstory2.html)

To be sure, we are not suggesting the sequence of events that led to the United Airlines stale news being retracted so publicly are likely to be repeated in future. However, we do suggest this single event and, in particular, the lack of correction of the price of United Airlines to pre-stale-news-release levels over the following four days provides some interesting insights into a puzzle that is not easily explained by existing theories of investor behavior. We are not the first to suggest inferences can be made from the unique situation surrounding a single firm (e.g. Dammon, Dunn, and Spatt, 1993; Huberman and Regev, 2001; and Chan, Hameed, and Lau, 2003), but we leave it to the reader to decide whether this is the case in this paper.<sup>8</sup>

In addition to the critical difference of investors in our setting quickly becoming aware that the re-released news was stale, there are other differences between our work and the seminal paper of Huberman and Regev (2001). For instance, there is the issue of whether mispricing constitutes inefficiency based on the widely accepted Jensen (1978) representation of the efficient markets hypothesis, which suggests a market is efficient providing economic profits (risk-adjusted returns net of all costs) are not available. The Huberman and Regev (2001) biotechnology company increased following the release of the stale news. However, Lamont and Thaler (2003) show that even large mispricing can sometimes not be exploited due to short sale constraints, which raises the possibility that investors were unable to short the biotechnology stock in question and remove the mispricing. In contrast to much of the “inefficiency” documented in the literature<sup>9</sup>, an investor could simply take a long position to exploit the inefficient pricing in United Airlines.

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<sup>8</sup> Dammon, Dunn, and Spatt (1993) document mis-pricing in the bonds of RJR Nabisco Holdings. Huberman and Regev (2001) show a prominent article regarding a potential cure for cancer resulted in a sharp increase in the price of a biotechnology company even though news of the potential breakthrough had been reported early. Chan, Hameed, and Lau (2003) use the delisting of the Jardine Group from Hong Kong to show prices are affected by “country-specific investor sentiment.”

<sup>9</sup> In a related paper, Lesmond, Schill, and Zhou (2004) suggest the momentum effect, which is often presented as compelling evidence against market efficiency, is illusory due to the amount of “profit” that is dependent on short sales of small illiquid stocks, which is very costly in reality.

Secondly, our finding that other airline companies and UAUA supplier firms recovered from their UAUA rumor-induced decline within the day, yet the stock price of United Airlines remained depressed for four days is a puzzling given the gradual information diffusion and investor inattention hypotheses. The clear explanation of events that lead to the false news and statement that UAUA was most certainly not entering bankruptcy is more relevant for UAUA so these hypotheses the stock price of UAUA should react more quickly. Finally, United Airlines is a widely followed stock with a pre-stale news release market capitalization over ten times larger than the company considered by Huberman and Regev (2001). This implies that information costs, which Fama (1991) suggests are an important component of tests of the “economically more sensible” version of the efficient markets hypothesis are considerably lower in our setting.

Our paper is also related to that of Kaplanski and Levy (2009) who show airline disasters result in an announcement day abnormal market return of  $-0.34\%$ <sup>10</sup>, which is largely reversed over the next two days. However, there is an important difference between our two papers. Airlines disasters are value-relevant and can be expected to have an impact on price, but Kaplanski and Levy (2009) show investors overreact to the magnitude of this impact. Prior to the publication of their paper boundedly rational investors may have been unaware of this phenomenon and therefore not have devoted time to exploiting it. In our setting investors were made quickly made aware the catalyst for the mispricing was false yet the inefficient pricing was 30 times larger and persisted for twice as long.<sup>11</sup>

When we started this project there appeared to be no other paper that considered this event. However, we have recently become aware of the work of Carvalho, Klagge, and

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<sup>10</sup> We calculate this from their Table 1 which has an unconditional average return of 0.048% and average airline disaster day return of -0.295%.

<sup>11</sup> The United Airlines “event” has implications for several other strands of the literature. Busse and Green (2002) find prices of stocks mentioned on CNBC respond within seconds and information is typically incorporated within a minute. Chordia, Roll, and Subrahmanyam (2005) find that stocks tend to take between five and 60 minutes converge to efficient levels. Our evidence regarding the lack of return to pre-rumor levels in the stock price of United Airlines suggests there can be big exceptions to these results

Moench (2009). Their paper also documents the events surrounding the incorrect United Airlines bankruptcy news, although, as expected given the independent nature of the papers, there are important differences between our work and theirs.

We show, using data for 1-minute intervals, the microstructure dynamics (returns, volumes, bid-ask spreads, and volatility) of UAA and all firms in the airline and airline-related industries. Based on these results we conclude other airline companies quickly reacted to the news that the UAA bankruptcy rumor was false and were trading above their pre-UAA rumor levels within two-hours. On the other hand, UAA remained substantially below its pre-rumor level for an extended period (4 days). We interpret these results to indicate that negative sentiment towards the airline industry in general is not driving the slow UAA response. Carvalho, Klagge, and Moench (2009) conclude that other airline companies take a similar period as UAA (5 days or more) to return to “normal” levels. Their conclusion is based on data for 4 airlines and counterfactual analysis around a three-factor asset pricing model.

We are also interested in the reaction of UAA suppliers to the bankruptcy rumor and subsequent retraction. Cohen and Frazzini (2008) suggest that supplier firms react with a lag to important customer firm news due to investor inattention and the gradual diffusion of information. We show that UAA supplier firms quickly respond to the UAA statement that the bankruptcy rumor is false, yet UAA remains below its pre-rumor price for four days. This is puzzling given the investor inattention and the gradual information diffusion hypotheses.

There is debate on precisely when the global financial crisis commenced, but we show that general investor fear, which reached extreme levels as the crises intensified, was not

elevated, but instead close to its ten-year average during the period we consider. This does not therefore appear to be contributing to the inefficient pricing of UAAU.<sup>12</sup>

The rest of this paper is organized as follows: Section 2 describes the sequence of events that resulted in the UAAU rumor. Our data is outlined in Section 3. The results are presented and discussed in Section 4, while Section 5 concludes the paper.

## 2. Rumor Timeline

There have been numerous stories devoted to the United Airlines bankruptcy rumor. While there is a broad consensus on the timing of the key events, some articles do refer to slightly different times. Where there is a discrepancy we provide times which reflect the consensus. The key events are presented in Table 1 and discussed below. All times in this section are stated as EDT to aid readability. There has been much debate about how the mistake arose.<sup>13</sup> We do not wish to appear to have view on who is responsible.

United Airlines (UAL) Corporation, the parent company of United Airlines, filed for Chapter 11 bankruptcy protection on December 9, 2002.<sup>14</sup> This was documented by the Chicago Tribune on this day<sup>15</sup> and this article was subsequently included in the company's online database<sup>16</sup>, which includes archives of stories published by the Chicago Tribune and The South Florida Sun-Sentinel newspapers. The archived article was visited by a member of the public at 1:00:34 EDT, Sunday September 7, 2009 via the Sun-Sentinel website. Due to low internet traffic volumes at this time, it is thought that this single visit caused the article to

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<sup>12</sup> Even if risk aversion in general was elevated it would seem an unlikely complete explanation for the four day period it took for UAAU to return to pre-stale-news levels given that stocks in the same industry rebounded in minutes following the United Airlines statement which made it clear it was not re-entering bankruptcy.

<sup>13</sup> <http://googlenewsblog.blogspot.com/2008/09/update-on-united-airlines-story.html>;

<http://www.tribune.com/pressroom/releases/2008/09102008.html>

<sup>14</sup> <http://news.bbc.co.uk/1/hi/business/2556225.stm>

<sup>15</sup> <http://www.encyclopedia.com/doc/1G1-119971980.html>

<sup>16</sup> <http://www.tribune.com/pressroom/releases/2008/09102008.html>



later become listed under "Popular Stories Business: Most Viewed" section of the Sun-Sentinel's webpage.<sup>17</sup> On the same day, the Google WebCrawler visited the website at 1:36:57 am EDT<sup>17</sup> and crawled the story, which had the headline "UAL Files for Bankruptcy". The story did not have a standard newspaper article dateline so it was indexed as being new and subsequently included on Google News. The first referral to The Sun-Sentinel website via Google News was made at 1:39:59 a.m. EDT and traffic increased during the course of the day.<sup>17</sup>

An employee of a third-party news agency, Income Securities Advisor, conducted a routine Google Internet-search retrieved the six-year old article with the current date. The headline "United Airlines: Files for Ch. 11, to cut costs by 20%" was subsequently posted on Bloomberg news at around 10:53 a.m. EDT.<sup>18</sup> A sell-off of United Airlines' stock ensued, and at 11:00:10 a.m. EDT UAU shares traded at \$3.25, a 73% decline from their opening trade price of \$12.18. A trading halt on UAU stock was imposed by the NASDAQ at 11:06:57 a.m. EDT<sup>19</sup> following denials of the bankruptcy claims by United Airlines at 11:06 a.m. EDT.<sup>20</sup> The bankruptcy headline was then removed by Bloomberg and a correction was issued.<sup>19</sup> At around midday, United Airlines issued a formal statement denying the bankruptcy rumors, which very clearly explained the sequence of events that led to the old story being re-released as new (see excerpt in introduction).<sup>21</sup> Trading on UAU's stock resumed at 12:30 p.m. EDT. Its price trended downwards during the afternoon's trading session to a close of \$10.92.

[Insert Table 1 About Here]

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<sup>17</sup> <http://googlenewsblog.blogspot.com/2008/09/update-on-united-airlines-story.html>

<sup>18</sup> [http://www.forbes.com/2008/09/08/ual-tribune-bankruptcy-biz-media-cz\\_ja\\_0908ualstory2.html](http://www.forbes.com/2008/09/08/ual-tribune-bankruptcy-biz-media-cz_ja_0908ualstory2.html)

<sup>19</sup> <http://247wallst.com/2008/09/08/ual-confusion-c/>

<sup>20</sup> <http://www.itworld.com/node/54925>

<sup>21</sup> [http://money.aol.com/news/articles/qp/pr/\\_a/united-airlines-issues-statement/rfid137807463?channel=%22pf%22](http://money.aol.com/news/articles/qp/pr/_a/united-airlines-issues-statement/rfid137807463?channel=%22pf%22)

<http://ir.united.com/phoenix.zhtml?c=83680&p=irol-newsArticle&ID=1194726&highlight>

### 3. Data

Daily price, volume, and shares outstanding data are obtained from the CRSP database and intraday tick quote, trade price, and volume data are obtained from Reuters DataScope via SIRCA<sup>22</sup> for the September 3, 2008 to September 15, 2008 period. Data are obtained for UAU and the 14 other companies which share the SIC code of 4512 (Air Transportation, Scheduled) with UAU and the 17 companies which have an SIC code of 45XX (Air Transportation, Scheduled, Air Courier Services, Air Transportation, Nonscheduled, and Airports, Flying Fields, and Airport Terminal Services). We include all companies which have these SIC codes and have the required data. We also obtain data for the S&P 500 index fund (SPDR). In order to check, the impact of the rumor on the stock price of customers of UAU, we follow Cohen and Frazzini (2008) and search company annual reports for Regulation SFAS 131 disclosures for firms deriving 10% or more of their yearly sales or profits from UAU. We find that no companies meet these criteria. Airline supplier firms appear to have a diverse customer base. As a second step, we search the website of all Airline supplier industry firms (SIC codes 3720, 3721, 3724, and 3728) to see if any of these companies make mention of UAU being an important customer. While these firms will have a weaker supplier link to UAU than that considered by Cohen and Frazzini (2008), we suggest it is plausible that these companies will react to the UAU rumor given investors will be aware of their relationship with UAU. We find three companies (AAR Corporation, Genesis Lease Limited, and Rockwell Collins Incorporated) mention UAU as an important customer so we include these in our sample. Finally, S&P 500 Volatility Index (VIX) data are obtained from Global Financial Data (GFD).

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<sup>22</sup> <http://www.sirca.org.au/>

#### 4. Results and Discussion

Figure 1a shows the reaction of UAU, firms with the identical SIC code (4512 - Air Transportation, Scheduled), firms with the same broader SIC code (45XX), and the S&P 500 ETF (SPDR) to the United Airlines Bankruptcy rumor. The 4512 and 45XX indices we create are value weighted. These indices and the SPDR are given a starting value equal to that of UAU to aid comparison. All results are generated using end of 1-minute interval quote mid prices to avoid bid-ask bounce issues.<sup>23</sup> Figure 1a shows the price of UAU started to decline around the time Bloomberg reported the bankruptcy rumor at 10.53 am. UAU traded at its intraday low of \$3.25, which represents a decline of 73% from its opening trade price, during the interval beginning 11.00 am. The last mid-price in this interval, as shown in Figure 1a, is \$3.89. Companies in the same industry were affected by the UAU rumor. The average loss of firms with the same SIC code as UAU (4512) was 12% in the 11.00 am interval, which is when its low point for the day occurred. In contrast, the broader market was down just 1.7% from its open at this point. The price of UAU increased prior to the 11:06:57 am trading halt, as United Airlines discredited the bankruptcy story, and increased further when trading resumed at 12.30 am.

[Insert Figure 1a About Here]

While the initial reaction of UAU and other airline stocks to the bankruptcy rumor is not expected in a world of full information, it is not surprising given the way investors obtain news in reality. In what Huang and Liu (2007) suggest is a rational approach, investors typically source company “news” from trusted financial news sources rather than official

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<sup>23</sup> Qualitatively identical results are obtained when transaction prices and/or average prices for each interval are used.

company sources. In doing so, investors are assuming that the efficiency benefits more than offset the expected costs given the low probability that trusted news sources will report a major story inaccurately.<sup>24</sup> Moreover, the initial reaction is predicted by LeRoy (2004) who explains it is rational for investors who identified the bankruptcy story as a false rumor to sell United Airlines stock on the basis that many investors would learn of the rumor and sell.

However, lack of a rebound in the United Airlines stock price to pre-rumor levels is a puzzle. Investors certainly reacted as expected in regards to other airline stocks. Their prices rebounded rapidly when it became evident the United Airlines bankruptcy story was not true as shown in Figures 1a and 1b. For instance, both 4512 and 45XX firms traded above their opening price levels, at 12.54 p.m., just two hours after the UAU A rumor began affecting prices. The general market did trend down slightly during the afternoon with the SPDR closing down 0.7% from its opening levels and appears to have affected stocks in industry 4512 which were down 1.9% from the opening. However, stocks in industry 45XX were up 1.5%. In contrast, UAU A closed the day over 11% lower than its opening price.

In Figure 1c we plot the closing prices of UAU A on the days around the event day. United Airlines declined to \$9.97 two days after the event day. It then increased to \$11.36 four days after the event day, but it was not until five days after the event that it had fully recovered to its pre-rumor levels. We plot the cumulative abnormal returns of UAU A using three different benchmarks, average 4512 industry returns (excluding UAU A) average 45XX industry returns (excluding both UAU A and 4512), and market (S&P 500 Index Fund – SPDR) returns in Figure 1d (equal-weighted) and Figure 1e (value-weighted). The UAU A cumulative abnormal returns, which display a similar pattern to the price graph in Figure 1c, are negative until day 5 in each instance. This reflects the fact that neither the 4512 or 45XX

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<sup>24</sup> To be clear, we do not wish to be seen as attributing blame for the UAU A bankruptcy rumor to any party.

industry, nor the market (SPDR) declined dramatically over this period. This shows up more clearly in Figure 1d due to the presence of one large firm outlier in Figure 1e.

[Insert Figure 1b About Here]

[Insert Figure 1c About Here]

[Insert Figure 1d About Here]

[Insert Figure 1e About Here]

We present granger causality results in Table 2. These are based on the null hypothesis that UAU price movements do not granger cause the price movement in 4512 and 45XX stocks. All results are generated using the Granger causality F-test based on a 1-minute intraday quote midpoint return. We use the Granger causality approach to measure how much of the current 4512 and 45XX returns are captured by lagged UAU returns.<sup>25</sup> We are able to strongly reject the null hypothesis that UAU returns do not granger cause the movements in other airline stock prices in the 4512 and 45XX industries on event day (the day the UAU bankruptcy rumor affects the UAU stock price) prior to the trading halt. The results presented in Table 2 show the F-statistic is 93.71 for the null hypothesis involving 4512 returns and 16.08 for the null hypothesis involving 45XX returns. UAU returns do not, in general, granger cause 4512 returns prior to event day or following the event day based on 5% statistical significance levels. These results are consistent with those documented in Figures 1a-1c. Price movements in United Airlines influence price movements in other airline shares on the day of the bankruptcy rumor prior to the trading halt, but a decoupling takes place after the rumor is retracted. The prices of other airline stocks rebound but the price of United Airlines remains depressed.

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<sup>25</sup> All Granger causality results are based on 5 lags. Specifications based on other number of lags show qualitatively similar findings.

[Insert Table 2 About Here]

There are many examples of companies remaining overvalued for no apparent fundamental reason (e.g. Lamont and Thaler, 2003), but it is typically found that there are impediments to rational arbitragers removing this “inefficiency”, such as short sales constraints. In our setting, there is no apparent factor preventing prices returning to normal levels. Any market participant could have simply purchased undervalued United Airlines stock. The fact prices did not return to pre-rumor levels therefore leaves open the possibility that irrational negative investor sentiment, as described by Lee, Shleifer, and Vishny (1991) and others, towards United Airlines was pervasive.

This delayed reaction coupled with the rapid adjustment of other airline stocks is interesting from a gradual information diffusion perspective. Hong, Torous, and Valkanov (2007, p. 371) articulate this theory as: “Intuitively, investors in market  $k$  rationally condition on all information associated with market  $k$ . As a result, the price is efficient with respect to own asset information. Hence the own serial correlation is zero. However, investors in asset market  $Y$  ignore or cannot process the information from  $X$ , including past returns.” Hong, Torous, and Valkanov (2007) show how gradual information diffusion results in some industries leading the broader market. The evidence we provide is inconsistent with this and is therefore somewhat of a puzzle. Companies in the identical (4512) and related (45XX) industries as UAUA return to more normal levels soon after the rumor regarding UAUA was clarified yet the stock price of UAUA took four days to return to its pre-rumor levels.

We suggest the quick rebound of other airline stocks following United Airlines’ statement which clearly outlined it was not re-entering bankruptcy, coupled with the fact the S&P 500 was less than 1% below its pre-event levels during the four days UAUA remained depressed, is evidence that general investor fear regarding the equity market is not driving our results. Nonetheless, we investigate CBOE S&P 500 market volatility index (VIX),

which is commonly referred to as the “investor fear gauge”. As Whaley (2000, p. 12) states “the index is set by investors and expresses their consensus view about expected future stock market volatility. The higher the VIX, the greater the fear.” Figure 2 shows the VIX was at levels close to its prior ten-year average on September 8, 2008 and the four following days, as UAUU remained below its pre-stale-news-release level.<sup>26</sup> This further reinforces that general investor fear does not seem a likely explanation for the delayed response of UAUU.

[Insert Figure 2 About Here]

In Figures 3a and 3b we present the bid-ask spreads and volume of UAUU on September 8, 2008. Our results are based on end of one-minute interval bid-ask quotes and total volume over one-minute intervals. From Figure 3a it is clear that spreads and volume are elevated as trading opens for the day. This is consistent with McInish and Wood (1992) and Foster and Viswanathan (1993) respectively. Both spreads and volumes decline during the morning before surging around the time that the UAUU bankruptcy rumor was publicized by Bloomberg around 10.53 am. The spread of UAUU ended the 1-minute interval commencing 11.00:00 at 4.62%, some 55 times larger than its spread at 10.50:00. UAUU volume surged to a level 44 times larger during this same period. Figure 3b shows that spreads and volume were elevated when trading commenced following the trading halt but quickly declined and returned to pre-rumor levels for the remainder of the day.

[Insert Figure 3a About Here]

[Insert Figure 3b About Here]

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<sup>26</sup> VIX climbed through October 2008 due to the global financial crises, reaching a high of 80.86.

We now turn our attention to the question of determining what is driving the marked increase in spread in the twenty minutes preceding the trading halt. We are unable to apply any of the traditional spread decomposition methods in the literature as these require a much longer time period so we are left to infer the major driver of the spread change using other means.<sup>27</sup> Hasbrouck and Sofianos (1993)<sup>28</sup> find adjustment lags in inventory levels take months rather than minutes so it seems unlikely that changes in inventory risk explain the sharp increase in spread. Lin, Sanger, and Booth (1995) note that order costs tend to be fixed for a particular transaction so “the average order processing cost per share should decrease as trade size increases” (p. 1154). We observe an increase in the average trade size in the minutes leading up to the trading halt, so we conclude a change in order processing costs does not account for the sharp increase in spread.<sup>29</sup> This implies the spread increase following the UAUA bankruptcy rumor is due to an increase in the adverse selection spread component. Dealers were clearly concerned they might be trading with informed investors so they increased their spreads accordingly.

Figures 4a and 4b show that event day volatility for UAUA follows a similar pattern to spread and volume. We measure volatility as the standard deviation of one-minute mid-prices. Volatility is relatively high as trading commences, which is consistent with the pattern documented by Foster and Viswanathan (1993). Volatility then declines before surging soon after the UAUA bankruptcy rumor appears on Bloomberg at 10:53am. After reaching a high in excess of 45%, volatility declines as the bankruptcy rumor is denied and trading is halted. Volatility temporarily increases around 1:50pm, but remains relatively low for the remainder of the event day.

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<sup>27</sup> Glosten and Harris (1988) use transactions over a 14-month period in their model, Stoll (1989) uses transactions over a 1-month period, and Huang and Stoll (1997) use a full calendar year.

<sup>28</sup> See Popsecu and Kumar (2008) footnote 3, for a summary of other literature with similar findings.

<sup>29</sup> The average trade size on September 8 in the period prior to the release of the bankruptcy story on Bloomberg at 10:53 was 192 shares yet the average trade size between this point and the trading halt at 11:06:57 was 288 shares.



[Insert Figure 4a About Here]

[Insert Figure 4b About Here]

The intraday movements in Airline industry (SIC code 4512) volume and bid-ask spreads are presented in Figures 5a and 5b. We generate end of one-minute interval bid-ask quotes and total volume over one-minute intervals for each individual company and then calculate a weighted average for the industry. These results show a similar pattern to those for UAA. In addition to the well-documented standard intraday pattern we see that both volume and bid-ask spreads spike higher as the UAA bankruptcy rumor hits the market around 10.53 a.m. EDT. Average volume increases over 40 times, while average spreads are over 5 times larger approximately ten minutes after the rumor hit the market than they were before. Figure 5b reveals that volumes had returned to normal levels by the time 4512 firms were trading above their opening levels around 12.54 p.m. Bid-ask spreads were also at pre-rumor levels at this point. They then increased slightly during the 1.00 p.m. to 2.00p.m. period, but returned to normal levels for the remainder of the day. We suggest that, taken together, the price, volume, and spread results indicate trading activity in other airline firms returned to normal within the trading day.

[Insert Figure 5a About Here]

[Insert Figure 5b About Here]

In Table 3 we present the spread, volume, and volatility of UAA, airline companies with an SIC code of 4512 (excluding UAA), airline companies with an SIC code of 45XX (excluding UAA and 4512 companies), and the S&P 500 index fund (SPDR) on September 8, 2008 (Day 0) and the days before and after. Daily averages for each variable are calculated

based on end of one-minute interval bid and ask quotes (spread), one-minute volumes, and one-minute mid-price standard deviations. 4512 and 45XX measures are value-weighted based on market capitalizations. The reaction of UAU to the bankruptcy rumor is very strong, with volume approximately 4 times higher than that on surrounding days. Volatility is nearly 2 times higher and spread increased by approximately 50% on event day. 4512 firms have larger spreads, volume, and volatility, on average, on Day 0 due to the run-up around the time of the UAU bankruptcy rumor. However, the increase compared to surrounding days is far less dramatic than for UAU. The event day of September 8, 2009 was not unusual for the SPDR. Neither spreads, volume nor volatility were higher than a number of other days in the [-3,+5] window.

Many authors have pointed out that volume (e.g. Harris and Raviv, 1993) and volatility (Berkman, Dimitrov, Jain, Koch, and Tice, 2009) are proxies for differences in investor opinion. If there is more divergent opinion regarding the value of a stock and its future price path then return volatility and volume are likely to increase. Both UAU volatility and volume decline dramatically on Day 1 returning to levels that are similar to pre-event levels. This seems to indicate that investors in general did not believe UAU to be under-valued. This adds to the puzzle as most theoretical models (e.g. De Long, Shleifer, Summers, and Waldmann, 1990) assume that noise traders operate within financial markets. This introduces risk as De Long et al. (1990, p. 705) note: "If noise traders today are pessimistic about an asset and have driven down its price, an arbitrageur buying this asset must recognize that in the near future noise traders might become even more pessimistic and drive the price down even further. If the arbitrageur has to liquidate before the price recovers, he suffers a loss. Fear of this loss should limit his original arbitrage position." However, if there was a lot of noise trader selling UAU stock in days 1 – 4 and this selling pressure was offsetting the buying of more rational investors who identified the UAU rumor was false,

one would expect a marked increase in volume and in volatility. The fact this did not occur implies investors in general did not perceive UAU A to be undervalued following the correction of the bankruptcy rumor despite it trading at up to 10% below its pre-rumor levels.

[Insert Table 3 About Here]

Cohen and Frazzini (2008) document predictability across economically linked firms. Company specific news appears to be quickly incorporated into stock prices, but the stock prices of supplier firms are slow to react to important customer firm news. We find no Regulation SFAS 131 disclosures for firms deriving 10% or more of their yearly sales or profits from UAU A. Airline supplier firms appear to have a diverse customer base. We then search the websites of all Airline supplier industry firms (SIC codes 3720, 3721, 3724, and 3728) for mention of UAU A being an important customer. It is clear these firms will have a weaker supplier link to UAU A than the customer – supplier links considered by Cohen and Frazzini (2008). However, it is possible that these companies will still react to the UAU A rumor given investors will be aware of their relationship with UAU A. We find three companies (AAR Corporation<sup>30</sup>, Genesis Lease Limited<sup>31</sup>, and Rockwell Collins Incorporated<sup>32</sup>) with clear mentions of UAU A as an important customer.

Figures 6a and 6b show the reaction of a “supplier index” of these three firms to the UAU A bankruptcy rumor.<sup>33</sup> Cohen and Frazzini (2008) find a value-relevant event, such as an earnings downgrade, results in an immediate reaction in the stock price of the firm in question, but the stock price of economically-linked supplier firms takes time to reflect this news. In Figure 6a we see that UAU A suppliers quickly declined 3% from opening levels as

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<sup>30</sup> [http://www.aarcorp.com/about/aar\\_factsheet.pdf](http://www.aarcorp.com/about/aar_factsheet.pdf)

<sup>31</sup> <http://www.genesislease.com/summary.cfm>

<sup>32</sup> [http://www.rockwellcollins.com/horizons/pdf-archives/Horizons\\_Vol\\_13\\_Issue-1\\_2008.pdf](http://www.rockwellcollins.com/horizons/pdf-archives/Horizons_Vol_13_Issue-1_2008.pdf)

<sup>33</sup> We calculate an equally-weighted index to give a clearer presentation of the joint reaction as Rockwell Collins is 89% of the total market capitalization of these firms.

the market began to react to the UAUA bankruptcy rumor. We suggest it not surprising that UAUA supplier firms reacted much quicker than the supplier firms considered in the Cohen and Frazzini (2008) study. The UAUA rumor received widespread coverage in popular financial news sources so there would have been more widespread knowledge of it among investors in UAUA supplier firms than an event like a customer firm earnings downgrade.

Figure 6b shows supplier companies rebounded once it was clear the rumor was false, closing the day less than 0.4% lower, on average, than their opening levels. This compares to the in excess of 11% decline by United Airlines. While consistent with our industry results, this result is puzzling from a gradual information diffusion / investor inattention perspective. The news that the United Airlines bankruptcy rumor was false is certainly relevant for UAUA supplier firms given their reaction to the initial rumor, so it is not surprising they quickly rebounded and closed just 0.4% down on the day, in line with the broader market. However, the lack of rebound by United Airlines is inconsistent with both the gradual information diffusion and investor inattention hypotheses, as both of these imply the firm most directly affected by news should react more quickly than less related firms.

[Insert Figure 6a About Here]

[Insert Figure 6b About Here]

We present granger causality analysis for UAUA and supplier firm returns in Table 4. These are based on the null hypothesis that UAUA price movements do not granger cause the price movement in UAUA supplier firms. All results are generated using Granger causality F-test between UAUA and its supplier firm's 1-minute quote midpoint returns. These results show that UAUA returns granger cause the returns of United Airline supplier firms on the event day prior to the trading halt. The null hypothesis of no granger causality is strongly rejected

with a F-statistic of 63.09. UAU A returns also granger cause supplier firm returns on the event day following the halt, but they do not granger cause returns on days following the halt, based on 5% significance levels. The Table 4 results are consistent with Figures 6a and 6b. The UAU A bankruptcy rumor is clearly responsible for the price decline of supplier firms on event day. Supplier firms then rebound while the price of UAU A remains depressed for four days.

[Insert Table 4 About Here]

## **5. Conclusions**

An internet search in September 2008 led to an old story about the 2002 bankruptcy of United Airlines being released as new news. The stock price of United Airlines promptly fell 73% and over \$3.1 billion was wiped of the market value of other airline stocks and United Airlines suppliers. This is not the first instance of stale news affecting stock prices, but, to the best of our knowledge, the United Airlines episode is the first instance of stale news affecting prices for an extended period in spite of the stale news release being retracted in a very public way.

The stock prices, volume, and bid-ask spreads of airline industry companies and United Airline suppliers quickly rebounded once it was clear the 2008 bankruptcy story was stale news, but the price of United Airlines remained depressed for four days. This is puzzling on a number of fronts. Firstly, unlike many instance of “inefficient pricing” in the literature, none of the well-documented limits to arbitrage seem to apply in our setting. Investors wishing to exploit the apparent mispricing in the stock price of United Airlines needed to simply purchase its stock. This raises the possibility that there are other

impediments to arbitrage that have not been discussed in the literature. An alternative explanation is that irrational investor sentiment is responsible for the delayed reaction of the United Airlines stock price, although it is not clear why this did not prevail beyond four days. Secondly, the United Airlines rumor episode is puzzling from the perspective of the gradual information diffusion and investor inattention hypotheses. These suggest that firms that news pertains to should react quickly, while firms less directly related may react with a lag. Our evidence suggests the opposite occurred on this high profile occasion.

## References

- Berkman, Henk., Dimitrov, Valentin., Jain, Prem C., Koch, Paul D. and Tice, Sheri. (2009). Sell on the news: Differences of opinion, short-sales constraints, and returns around earnings announcements. *Journal of Financial Economics* – forthcoming.
- Busse, Jeffrey and Green, T. Clifford. (2002). Market efficiency in real time. *Journal of Financial Economics*, 65, 415-437.
- Carvalho, Carlos, Klagge, Nicholas, and Moench, Emanuel. (2009). The persistent effects of a false news shock. SSRN working paper. <http://ssrn.com/abstract=1408169>
- Chan, Kalok., Hameed, Allaudeen., and Lau, Sie Ting. (2003). What if trading location is different from business location? Evidence from the Jardine Group. *Journal of Finance*, 58(3), 1221-1246
- Chordia, Tarun, Roll, Richard, and Subrahmanyam, Avanidhar. (2005). Evidence on the speed of convergence to market efficiency. *Journal of Financial Economics*, 76, 271-292.
- Cohen, Lauren and Frazzini, Andrea. (2008). Economic links and predictable returns. *Journal of Finance*, 63(4), 1977-2011.
- Dammon, Robert, Dunn, Kenneth, and Spatt, Chester. (1993). The relative pricing of high-yield debt: The case of RJR Nabisco Holdings Capital Corporation. *American Economic Review*, 83(5), 1090-1111.
- De Long, J. Bradford., Shleifer, Andrei, Summers, Lawrence H. and Waldmann, Robert J. (1990). Noise trader risk in financial markets. *The Journal of Political Economy*, 98(4), 703-738
- Fama, Eugene. (1991). Efficient capital market II. *Journal of Finance*, 46(5), 1575-1617.
- Fang, Lily and Peress, Joel. (2009). Media coverage and the cross-section of stock returns. *Journal of Finance*, 64(5), 2023-205.
- Foster, F. Douglas and Viswanathan, S. (1993). Variations in trading volume, return volatility, and trading costs: Evidence on recent price formation models. *Journal of Finance*, 48(1), 187-211.
- Glosten, Lawrence R. and Harris, Lawrence E. (1988). Estimating the components of the bid-ask spread. *Journal of Financial Economics*, 21, 123-142.
- Harris, Milton and Raviv, Artur. (1993). Differences of opinion make a horse race. *Review of Financial Studies*, 6(3), 473-506
- Hasbrouck, Joel. and Sofianos, George (1993). The trades of market makers: An empirical analysis of NYSE specialists. *Journal of Finance*, 48(5), 1565-1593.

- Hong, Harrison, Torous, Walter, and Valkanov, Rossen. (2007). Do industries lead stock markets? *Journal of Financial Economics*, 83, 367-396.
- Huberman, Gur and Regev, Tomer. (2001). Contagious speculation and a cure for cancer: A nonevent that made stock prices soar. *Journal of Finance*, 56(1), 387-396.
- Huang, Lixin and Liu, Hong. (2007). Rational inattention and portfolio selection. *Journal of Finance*, 62(4), 1999-2040.
- Huang, Roger D. and Stoll, Hans R. (1997). The components of the bid-ask spread: A general approach. *Review of Financial Studies*, 10(4), 995-1034
- Jensen, Michael. (1978). Some anomalous evidence regarding market efficiency. *Journal of Financial Economics*, 6, 95-101.
- Kaplanski, Guy and Levy, Haim. (2009). Sentiment and stock prices: The case of airline disasters. *Journal of Financial Economics* – forthcoming.
- Lamont, Owen and Thaler, Richard. (2003). Can the market add and subtract? Mispricing in tech stock carve-outs. *Journal of Political Economy*, 111(2), 227-268.
- Lee, Charles, Shleifer, Andrei, and Richard Thaler. (1991). Investor sentiment and the closed-end fund puzzle. *Journal of Finance*, 46(1), 75-109.
- LeRoy, Stephen. (2004). Rational exuberance. *Journal of Economic Literature*, 42, 783-804.
- Lesmond, David., Schill, Michael, and Zhou, Chungshen. (2004). The illusory nature of momentum profits. *Journal of Financial Economics*, 71(2), 349-380.
- Lin, Ji-Chai., Sanger, Gary C., and Booth, G. Geoffrey. (1995). Trade size and components of the bid-ask spread. *Review of Financial Studies*, 8(4), 1153-1183.
- McInish, Thomas H. and Wood, Robert A. (1992). An analysis of intraday patterns in bid/ask spreads for NYSE stocks. *Journal of Finance*, 47(2), 753-764
- Maiello, Michael. (2004). *Buy the rumor, sell the fact: 85 investment maxims and what they really mean*. McGraw-Hill, New York.
- Peterson, Warren A. and Noel P. Gist. (1951). Rumor and public opinion. *The American Journal of Sociology*, 57(2), 159-167.
- Popsecu and Kumar (2008). An ex-ante measure of the probability of informed trading. SSRN Working Paper: <http://ssrn.com/abstract=891717>
- Stoll, Hans R. (1989). Inferring the components of the bid-ask spread: Theory and empirical tests. *Journal of Finance*, 44(1), 115-134.
- Tetlock, Paul C., (2008). *All the news that's fit to reprint: Do investors overreact to stale information?* Columbia University working paper.



- Tetlock, Paul C. (2009). *Does public financial news resolve asymmetric information?* Columbia University working paper.
- Tetlock, Paul C. (2007). Giving content to investor sentiment: The role of media in the stock market, *Journal of Finance*, 62, 1139–1168.
- Tetlock, Paul C., Maytal Saar-Tsechansky, and Sofus Macskassy (2008). More than words: Quantifying language to measure firms' fundamentals, *Journal of Finance*, 63, 1437–1467.
- Vega, Clara. (2006). Stock price reaction to public and private information, *Journal of Financial Economics*, 82, 103–133.
- Whaley, Robert E. (2000). The investor fear gauge. Explication of the CBOE VIX. *Journal of Portfolio Management*, Spring, 12-17.

**Table 1: Summary of UAU Chapter 11 Bankruptcy Protection**

<b>Date</b>	<b>Time (EDT)</b>	<b>Event</b>
<b>9-Dec-2002</b>	-	UAL Corporation files for Chapter 11 federal bankruptcy protection
	-	Chicago Tribune publishes bankruptcy story
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<b>1-Feb-2002</b>		UAL Corporation emerges from Chapter 11 bankruptcy protection
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<b>7-Sep-2008</b>	1:00:34 am	Archived Chicago Tribune article received a single visit via the Sun-Sentinel's website
	1:36:57 am	Google Webcrawler located copy of UAL story (undated) and became searchable on Google News with current date
	1:39:59 am	First referral to Sun-Sentinel website via Google News
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<b>8-Sep-2008</b>	10:53 am	Bloomberg news reports story
	11:06 am	UAUA denies bankruptcy claims
	11:06:57 am	Trading halt
	---	UAUA issues formal statement denying bankruptcy rumors
	12:30 pm	Trading resumed on UAU stock

**Table 2: Granger Causality of UAUA and Airline Industry**

Day	Period	UAUA does not Granger cause 4512 F-statistic	UAUA does not Granger cause 45XX p-value	UAUA does not Granger cause 4512 F-statistic	UAUA does not Granger cause 45XX p-value
-3	Full day	1.85	0.10	4.09	0.00
-2	Full day	1.06	0.38	1.60	0.16
-1	Full day	1.94	0.09	1.87	0.10
0	Before halt	93.71	0.00	16.08	0.00
0	After halt	1.87	0.10	3.08	0.01
1	Full day	1.53	0.18	2.05	0.07
2	Full day	1.27	0.28	5.79	0.00
3	Full day	3.10	0.01	4.16	0.00
4	Full day	1.44	0.21	1.37	0.24
5	Full day	1.25	0.28	0.62	0.69

Notes: Granger causality test results for the null hypothesis that United Airline returns do not granger cause industry 4512 returns and industry 45XX returns. Granger causality F-statistics test the hypothesis that all coefficients of lagged UAUA returns are jointly equal to zero.

**Table 3: Spread, Volume, and Volatility Around Event Day**

Day		-3	-2	-1	0	1	2	3	4	5
UAUA	Spread	0.0960	0.0962	0.1006	0.1534	0.1047	0.1209	0.1307	0.1135	0.1056
	Volume	23,455	16,857	15,222	65,365	16,166	15,845	11,192	11,416	23,950
	Volatility	0.0094	0.0094	0.0086	0.0190	0.0111	0.0116	0.0119	0.0116	0.0128
4512	Spread	0.2622	0.2907	0.2847	0.3238	0.3127	0.2732	0.2781	0.2673	0.2896
	Volume	4,118	3,350	3,246	6,755	3,389	3,389	3,922	3,406	4,837
	Volatility	0.0353	0.0349	0.0366	0.0484	0.0423	0.0403	0.0424	0.0387	0.0446
45XX	Spread	0.1330	0.1404	0.1461	0.1548	0.1366	0.1406	0.1504	0.1455	0.1674
	Volume	2,399	2,735	2,253	3,378	3,379	4,669	3,402	2,871	4,287
	Volatility	0.0148	0.0157	0.0174	0.0183	0.0171	0.0176	0.0180	0.0182	0.0204
SPDR	Spread	0.0079	0.0080	0.0083	0.0080	0.0081	0.0082	0.0083	0.0082	0.0086
	Volume	622,545	836,832	656,868	866,623	882,354	693,048	853,301	679,060	1,088,260
	Volatility	0.0008	0.0008	0.0008	0.0010	0.0010	0.0009	0.0010	0.0010	0.0012

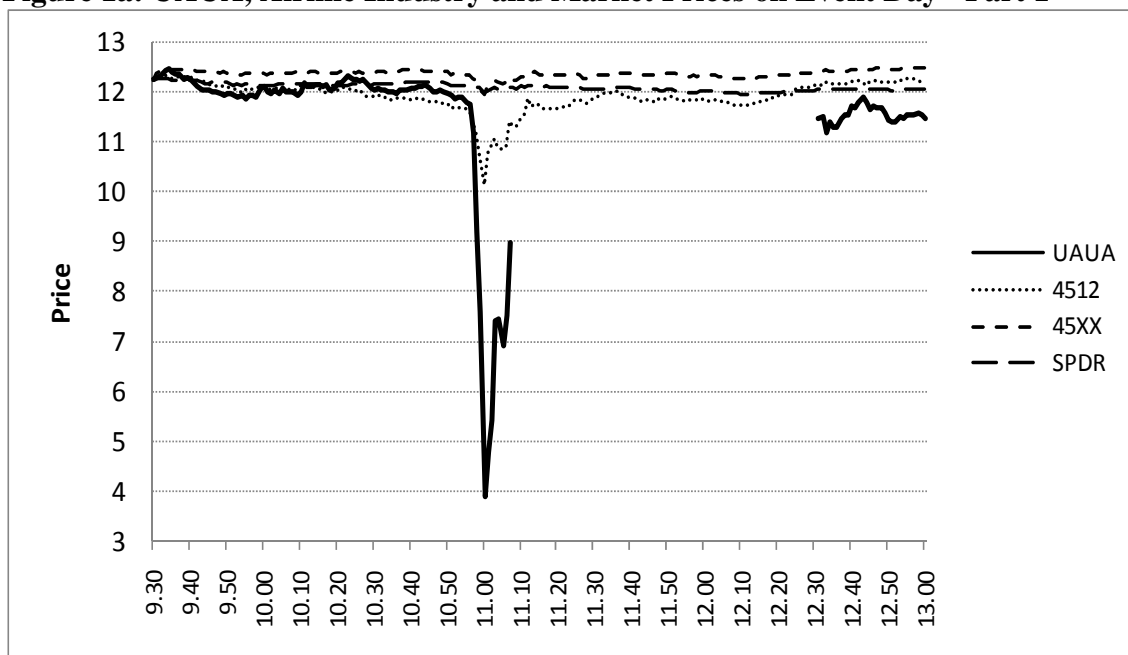
Notes: Average daily spread, volume, and volatility of United Airlines, airline companies with an SIC code of 4512 (excluding UAUA), airline companies with an SIC code of 45XX (excluding UAUA and 4512), and the S&P 500 index fund (SPDR) around the UAUA rumor event day of September 8, 2009. Daily averages are calculated based on end of one-minute interval bid and ask quotes for spread, volume over one-minute intervals, and one-minute mid-price standard deviations.

**Table 4: Granger Causality of UAUA and UAUA Supplier Firms**

Day	Period	UAUA does not Granger cause Supplier Firms F-statistic	P-value
-3	Full day	1.85	0.10
-2	Full day	1.06	0.38
-1	Full day	1.94	0.09
0	Before halt	93.71	0.00
0	After halt	1.87	0.10
1	Full day	1.53	0.18
2	Full day	1.27	0.28
3	Full day	3.10	0.01
4	Full day	1.44	0.21
5	Full day	1.25	0.28

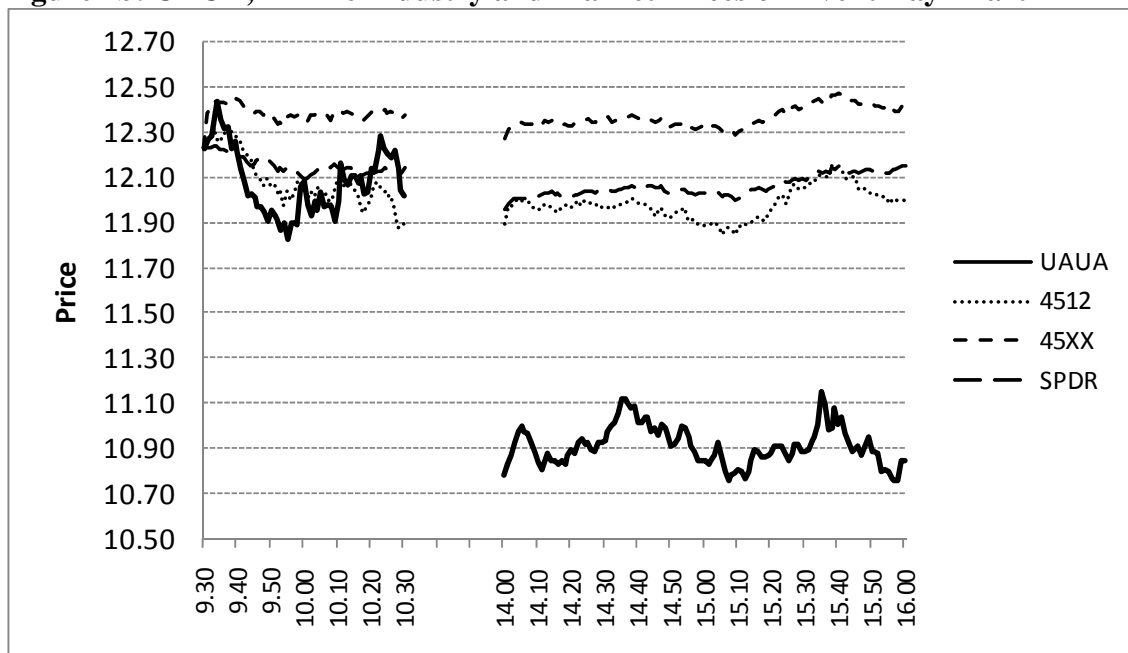
Notes: Granger causality test results for the null hypothesis that United Airline returns do not granger cause United Airline supplier firm returns. Granger causality F-statistics test the hypothesis that all coefficients of lagged UAUA returns are jointly equal to zero.

**Figure 1a: UAU, Airline Industry and Market Prices on Event Day - Part 1**



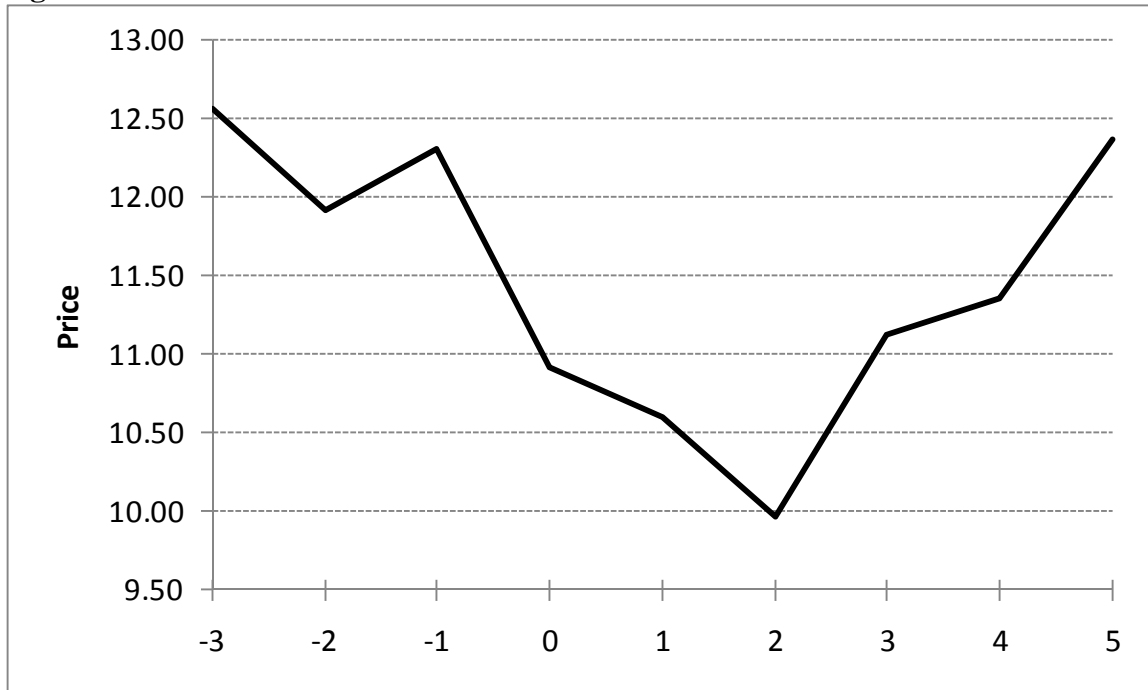
Notes: Price movements of United Airlines, airline companies with an SIC code of 4512 (excluding UAU), airline companies with an SIC code of 45XX (excluding UAU and 4512 companies), and the S&P 500 index fund (SPDR) on September 8, 2008. Value-weighted indices are created and indexed to the UAU opening price. End of one-minute interval quote mid-prices are used. UAU trading was halted at 11:06:57 am and resumed at 12:30:00 pm.

**Figure 1b: UAU, Airline Industry and Market Prices on Event Day - Part 2**



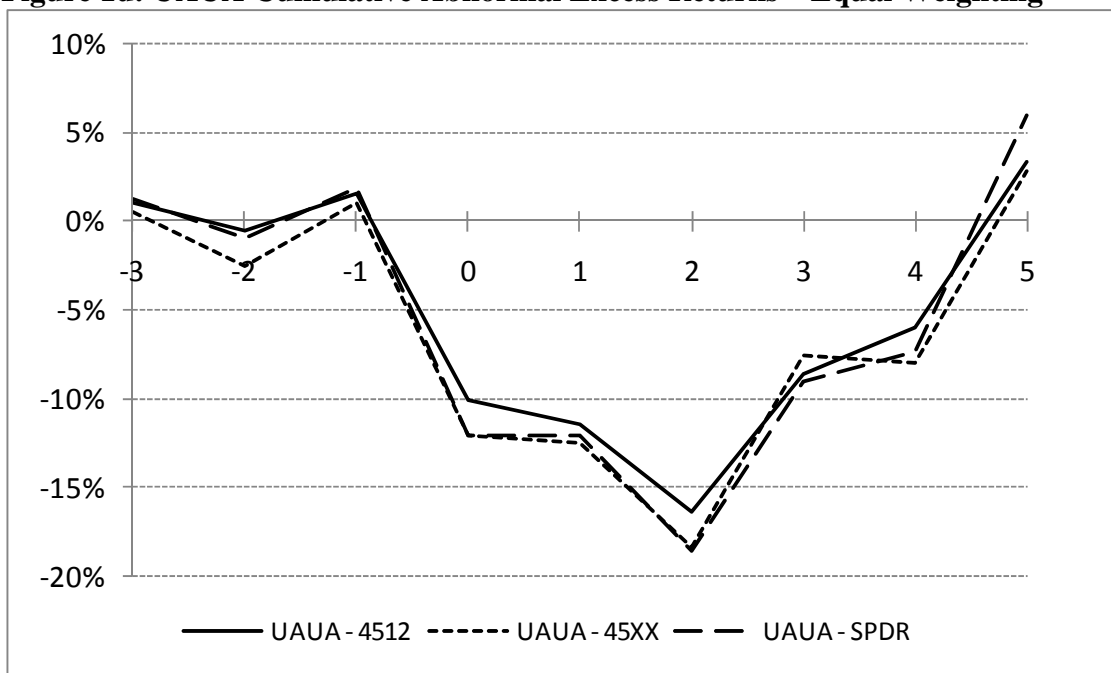
Notes: Price movements of United Airlines, airline companies with an SIC code of 4512 (excluding UAU), airline companies with an SIC code of 45XX (excluding UAU and 4512 companies), and the S&P 500 index fund (SPDR) on September 8, 2008. Value-weighted indices are created and indexed to the UAU opening price. End of one-minute interval quote mid-prices are used. UAU trading was halted at 11:06:57 am and resumed at 12:30:00 pm. The data between 10:30:00 am and 2:00:00pm are cut to allow a more appropriate scale to for the closing levels.

**Figure 1c: UAU Price**



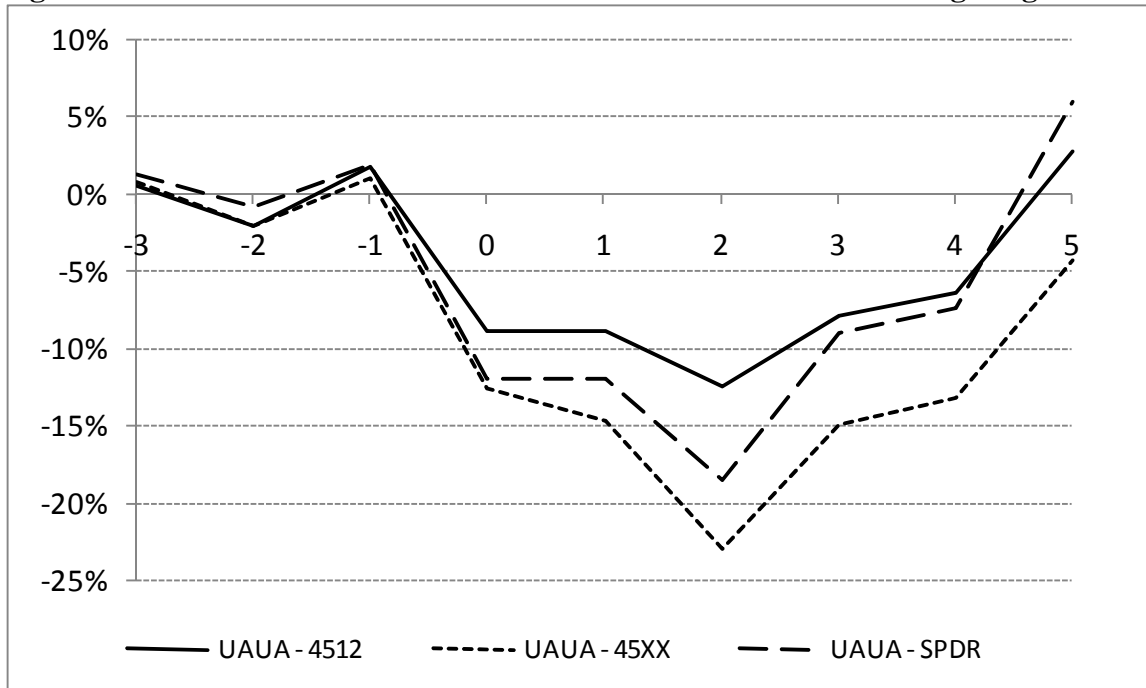
Notes: UAU daily close prices.

**Figure 1d: UAU Cumulative Abnormal Excess Returns – Equal Weighting**



Notes: Cumulative abnormal excess returns are calculated for UAU using SIC code 4512 industry returns (excluding UAU), industry 45XX (excluding 4512 companies), and the S&P 500 index fund (SPDR) as the benchmark. Daily close prices and equal weights are used in each instance.

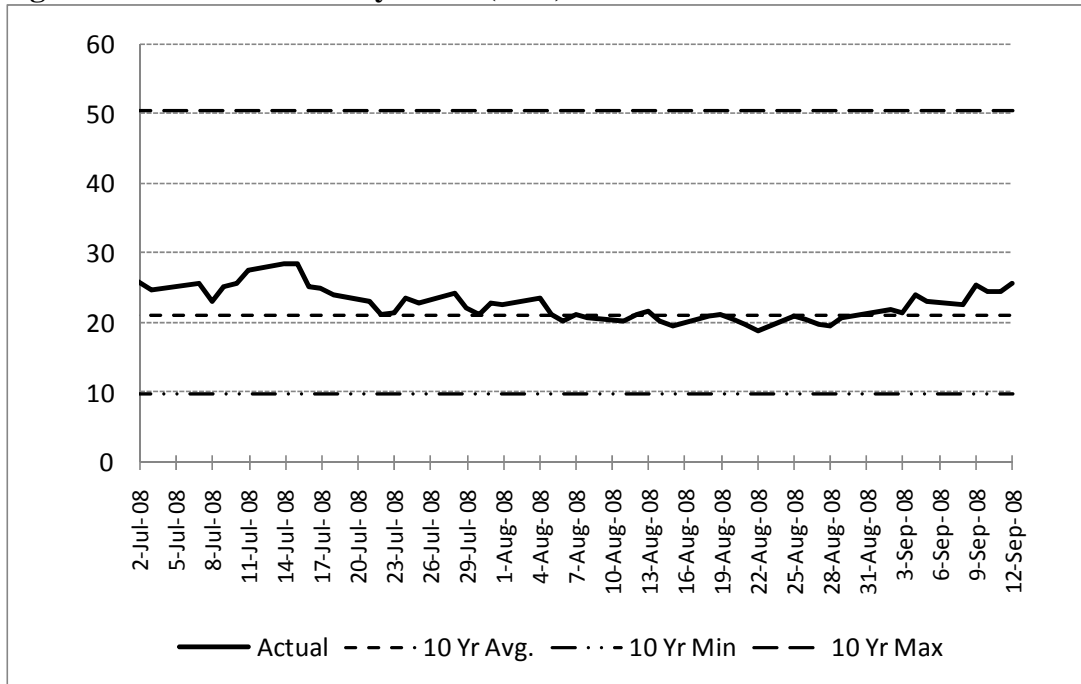
**Figure 1e: UAUU Cumulative Abnormal Excess Returns – Value Weighting**



Notes: Cumulative abnormal excess returns are calculated for UAUU using SIC code 4512 industry returns (excluding UAUU), industry 45XX (excluding 4512 companies), and the S&P 500 index fund (SPDR) as the benchmark. Daily close prices and value weighting are used in each instance.

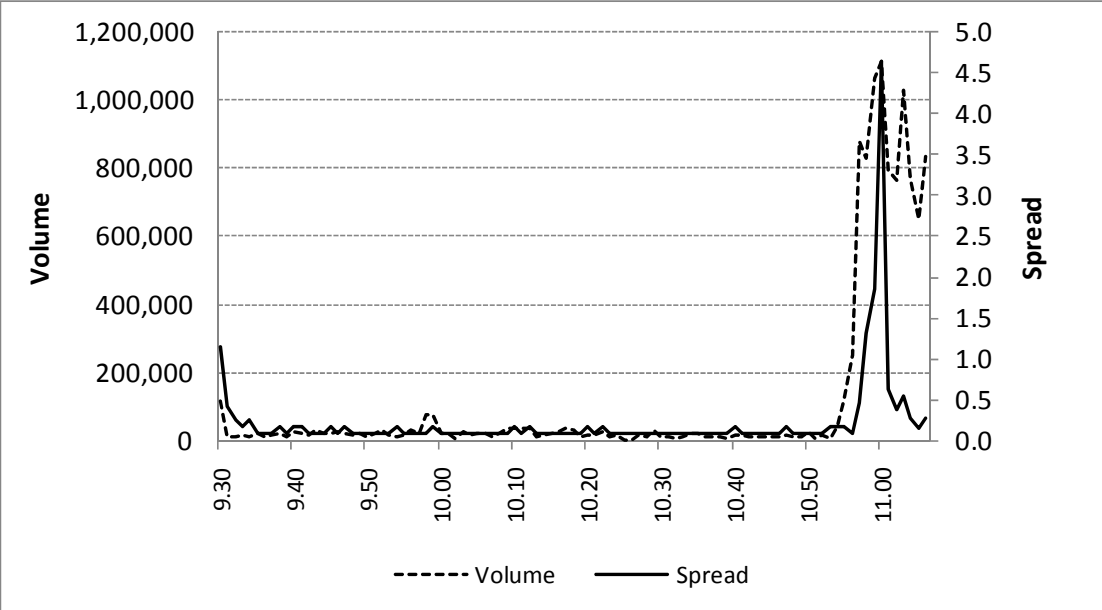


**Figure 2: S&P 500 Volatility Index (VIX)**



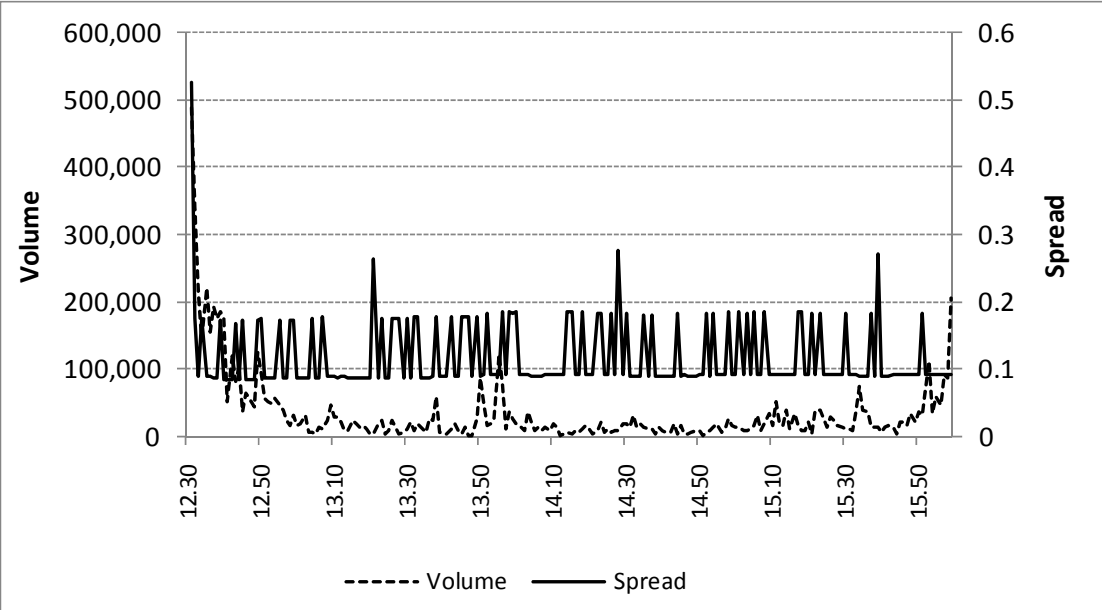
Notes: S&P 500 Volatility Index (VIX) for the two months prior to event month and the month of September 2008 up to the last day UAWA remained below its pre-stale-news-release levels (September 12). The long-term average, minimum, and maximum VIX for the ten years prior to 1 July 2008 are also included. Data are sourced from Global Financial Data (GFD).

**Figure 3a: UAU Bid-Ask Spread and Volume on Event Day Prior to Halt**



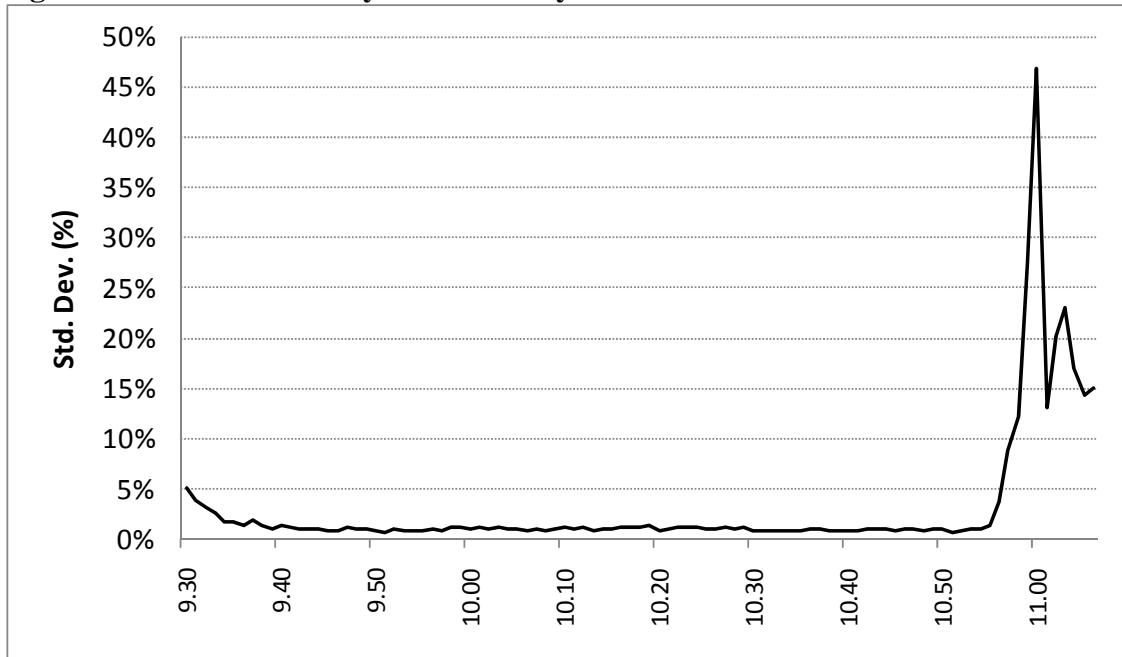
Notes: Volume and bid-ask spreads for United Airlines on September 8, 2008 prior to the trading halt at 11:06:57. End of one-minute interval bid and ask quotes are used for the spread. Volume is the total volume over one-minute intervals.

**Figure 3b: UAU Bid-Ask Spread and Volume on Event Day Following Halt**



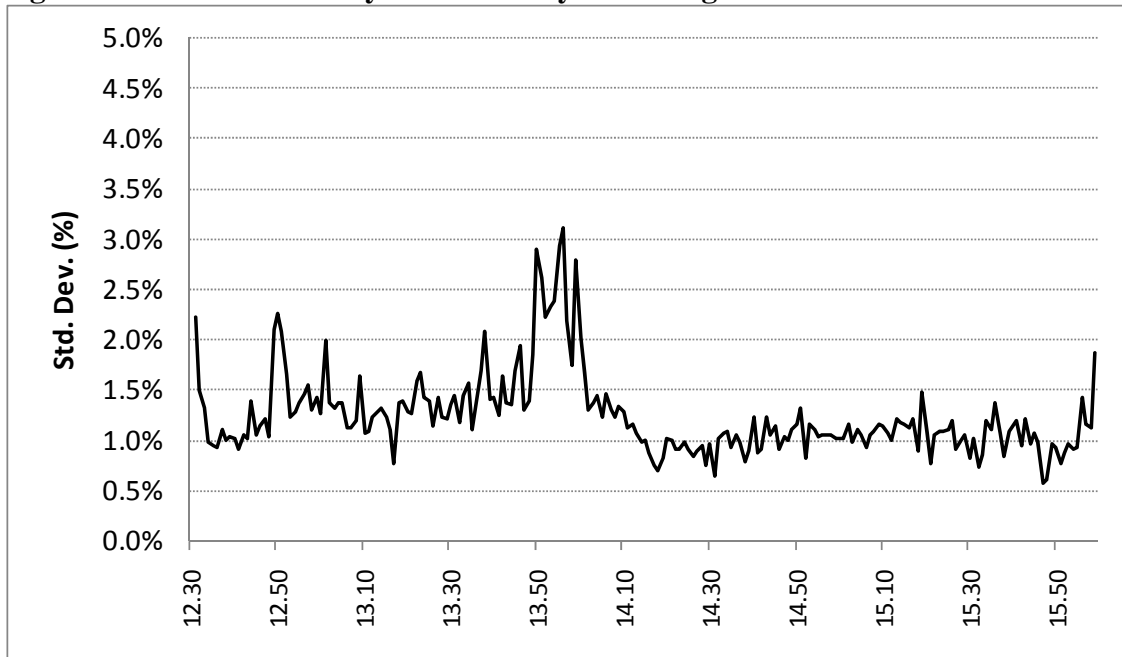
Notes: Volume and bid-ask spreads for United Airlines on September 8, 2008 following the resumption of trading at 12:30:00. End of one-minute interval bid and ask quotes are used for the spread. Volume is the total volume over one-minute intervals.

**Figure 4a: UUA Volatility on Event Day Prior to Halt**



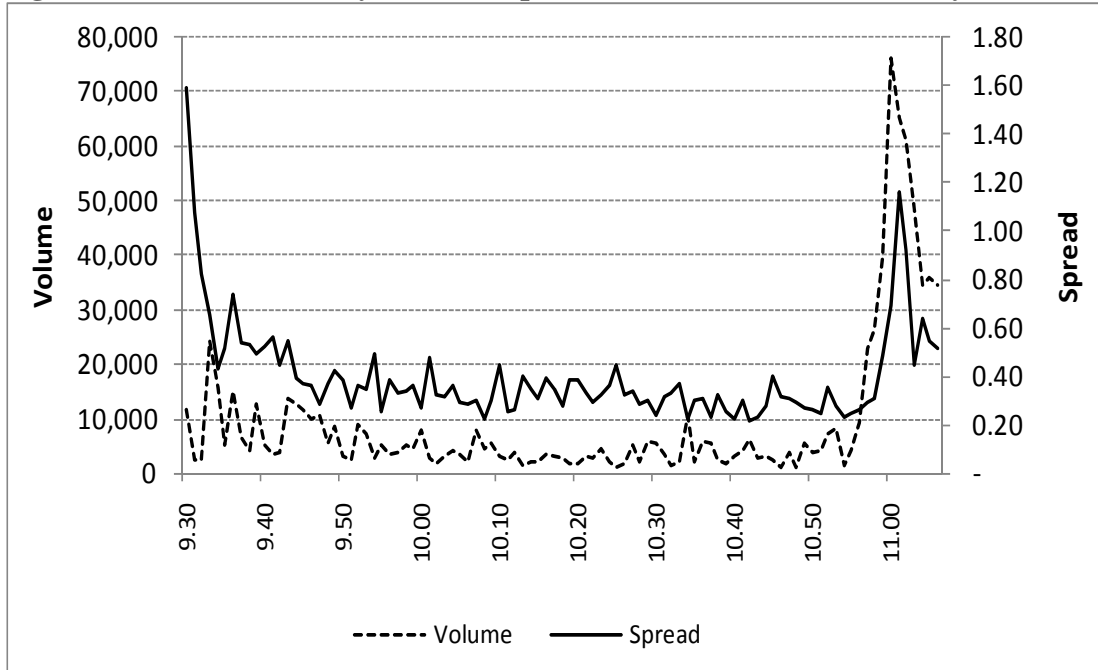
Notes: Volatility for United Airlines on September 8, 2008 prior to the trading halt at 11:06:57. The standard deviation is measured using one-minute mid-prices.

**Figure 4b: UUA Volatility on Event Day Following Halt**



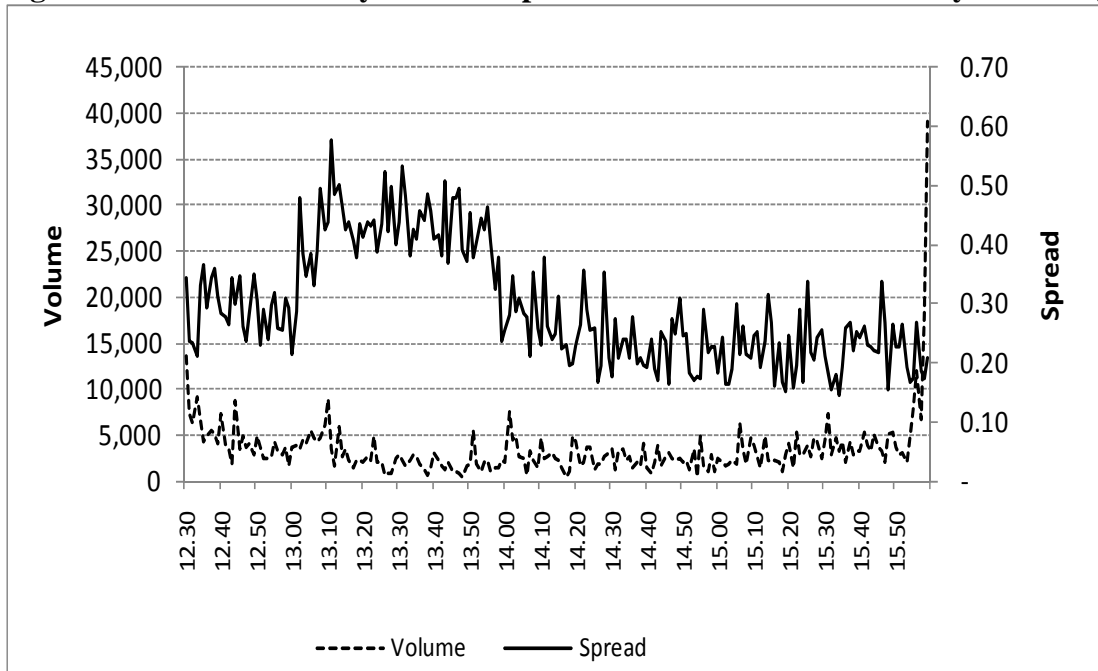
Notes: Volatility for United Airlines on September 8, 2008 following the resumption of trading at 12:30:00. The standard deviation is measured using one-minute mid-prices.

**Figure 5a: Airline Industry Bid-Ask Spread and Volume on Event Day Prior to Halt**



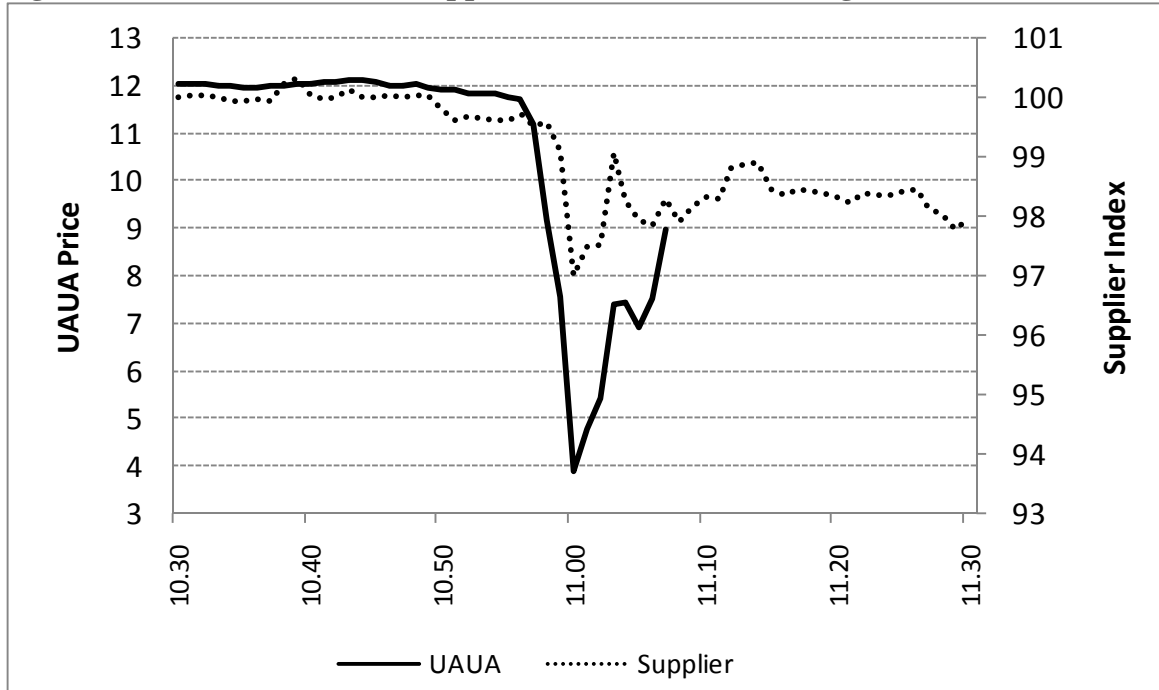
Notes: Volume and bid-ask spreads for Airline Industry firms (SIC code 4512) on September 8, 2008 prior to the trading halt at 11:06:57. End of one-minute interval bid and ask quotes are used for the spread. Volume is the total volume over one-minute intervals. Results are generated for each company and a value-weighted average is presented.

**Figure 5b: Airline Industry Bid-Ask Spread and Volume on Event Day Following Halt**



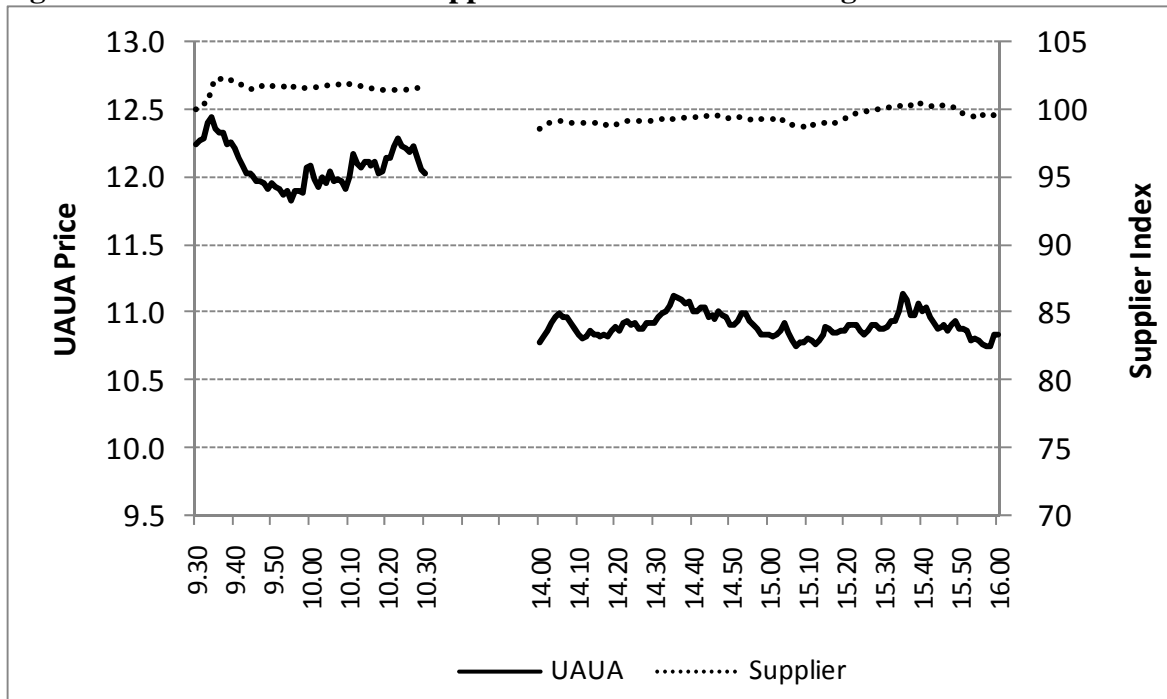
Notes: Volume and bid-ask spreads for Airline Industry firms (SIC code 4512) following the resumption of trading at 12:30:00. End of one-minute interval bid and ask quotes are used for the spread. Volume is the total volume over one-minute intervals. Results are generated for each company and a value-weighted average is presented.

**Figure 6a: UAU A and UAU A Supplier Prices Around Trading Halt - Part 1**



Notes: Price movements of United Airlines and United Airline supplier firms on September 8, 2008. An equal-weighted index is created for UAU A suppliers and indexed to an opening level of 100. End of one-minute interval quote mid-prices are used. UAU A trading was halted at 11:06:57 am and resumed at 12:30:00 pm.

**Figure 6b: UAU A and UAU A Supplier Prices Around Trading Halt - Part 2**



Notes: Price movements of United Airlines and United Airline supplier firms on September 8, 2008. An equal-weighted index is created for UAU A suppliers and indexed to an opening level of 100. End of one-minute interval quote mid-prices are used. The data between 10:30:00 am and 2:00:00pm are cut to allow a more appropriate scale to for the closing levels.