MACROECONOMIC ANNOUNCEMENTS, INTRADAY COVARIANCE STRUCTURE AND ASYMMETRY IN THE INTEREST RATE FUTURES RETURNS

DIMITRIOS D. THOMAKOS
TAO WANG*
JINGTAO WU
RUSSELL P. CHUDEREWICZ

The effects of scheduled macroeconomic announcements on the real-time intraday return volatilities, covariances, and correlations between the Eurodollar futures and the U.S. Treasury bond futures markets are studied. These announcements are responsible for most of the observed intraday jumps in

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*Correspondence author, Department of Economics, Queens College and the Graduate Center of the City University of New York, Flushing, New York 11367. Tel: +1-718-997-5445, Fax: +1-718-997-5466, e-mail: tao.wang@qc.cuny.edu

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■ *Dimitrios D. Thomakos is Associate Professor of Economics, Department of Economics, School of Management and Economics, University of Peloponnese, Tripolis Campus 22100, Greece.*

■ *Tao Wang is Assistant Professor of Economics, Department of Economics, Queens College and the Graduate Center of the City University of New York, New York.*

■ *Jingtao Wu is a Ph.D. candidate at the Department of Economics, Iowa State University, Ames, Iowa.*

■ *Russell P. Chuderewicz is Senior Lecturer at the Department of Economics, Penn State University, University Park, Pennysylvania.*

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volatilities, covariances, and correlations. The details of the linkage are intriguing and include announcements timing effect. Further study on intraday asymmetric volatility and correlation-in-volatility indicates that news announcements magnify asymmetric volatility and shed light on why correlations tend to be high when volatilities are high. © 2008 Wiley Periodicals, Inc. Jrl Fut Mark 28:815–844, 2008

INTRODUCTION

It is widely documented that asset return volatilities vary systematically over the trading day and the pattern is highly correlated with the intraday variation of trading volume, bid–ask spreads, and news announcements. Indeed, many studies examine the effect of macroeconomic announcements on volatilities (Ederington & Lee, 1993; Fleming & Remolona, 1999) and on prices (Andersen, Bollerslev, Diebold, & Vega, 2003; Andersen Bollerslev, Diebold, & Vega, 2007; Balduzzi, Elton, & Green, 2001). These studies find that macroeconomic announcements are linked with jumps in conditional means as well as jumps in conditional variances in asset returns.[1] However, there are very few systematic studies on how announcements affect intraday asset returns covariances, and correlations. This is quite surprising given that the estimation and modelling of asset return covariances and correlations are indispensable in asset pricing, portfolio choices, and risk management. One of the reasons that the study of news announcements on intraday return covariances and correlations dynamics is neglected is primarily because standard multivariate time series models of volatilities have proven inadequate when applied to high-frequency returns data (Engle, 2002). In fact, except for that of Christiansen and Ranaldo (2007), the authors are not aware of any other study on estimating intraday covariances and correlations of asset returns.

In this study, high-frequency intraday covariances and correlations are constructed and an empirical examination of price discovery in the futures market is provided. Using a data set consisting of real-time futures prices and macroeconomic announcements, the influence of 23 scheduled macroeconomic news announcements on the volatilities, covariances, and correlations between the two most-traded interest rate futures contracts is examined: the Eurodollar and the U.S. long bond (henceforth T-bond). The implications of news announcements on intraday asymmetric volatility and asymmetric correlation are also investigated.

In constructing high-frequency correlations between asset returns, the literature is followed for estimating realized volatility. Merton (1980) argued that

[1]Andersen and Bollerslev (1998) linked 15 of their 25 largest five-minute deutsche mark–dollar moves to just-released economic news, and Fleming and Remolona (1997) linked all of their 25 largest five-minute U.S. Treasury price changes to just-released news.

integrated volatility can be accurately estimated with sufficiently finely sampled observations for a continuous time diffusion process. Andersen, Bollerslev, Diebold, and Ebens (2001) used high-frequency data to estimate daily realized/integrated volatilities and correlations. However, recent evidence suggests microstructure noise could potentially make the estimation of realized volatility biased. To reduce the potential bias caused by microstructure noise, moving average (MA)-filtered one-minute-squared returns are used to construct five-minute realized variances and covariances. The MA filter has been used by Andersen et al. (2001) and Thomakos and Wang (2003).

This study differs from the previous literature in two areas. First, the focus is primarily on intraday asset return volatilities, covariances, and correlations, as opposed to the price effect or daily volatilities, covariances, and correlations. This focus is maintained because the variances, covariances, and correlations are indispensable in theories of asset pricing and portfolio choices. After all, portfolio diversification has more to do with covariances with the market instead of volatilities. Hence, this study differs significantly from that of Andersen and Bollerslev (1998), Bollerslev, Cai, and Song (2000) and Andersen et al. (2003), who examined news effects purely on asset return volatilities or prices but not on covariances and correlations.

The choice of two interest rate futures here is closely related with recent research on how the federal reserve can affect the long-term interest rates through the federal fund rate. The Fed does not control the long-term interest rates directly, which is the benchmark for many financial instruments, for example, the 30-year mortgage rate. The Fed hopes to exercise significant influence on long-term rates through its conduct on the federal fund rates. Therefore, it is important to understand how the changes in short-term interest rates are eventually related with the changes in the long-term interest rates. Recent studies (Demiralp & Jorda, 2004; Kuttner, 2001; Rudebusch, 1995) on this area examine how monetary policy affects the term structure of interest rates, but do not examine the covariances and correlations among those interest rates.

Second, the issues of asymmetric volatility and asymmetric correlation in an intraday setting are addressed, allowing one to link these two important phenomena in the assets markets to economic fundamentals. Previous studies (Bekaert & Wu, 2000; Black, 1976; Cappiello, Engle, & Sheppard, 2006; Christie, 1982) found an asymmetric response in volatilities of equity returns to good vs. bad news in terms of positive vs. negative lagged returns without explaining the origin of the news. The existing literature (Ang & Chen, 2002; Bae, Karolyi, & Stulz, 2003; Karolyi & Stulz, 1996; Kroner & Ng, 1998) has also found that correlations among assets returns often rise when asset return volatilities rise or when the market is in downturn. These studies, however, typically

examined asymmetric volatility and asymmetric correlation in daily (Andersen et al., 2001; Thomakos & Wang, 2003) or monthly (Bekaert & Wu, 2000) settings.[2] Instead the focus is on intraday asymmetric volatility and asymmetric correlation. This provides an opportunity to understand whether asymmetric volatility and asymmetric correlation are linked to news announcements. To our knowledge, this is the first study that uses economic announcements fundamentals to explain asymmetric volatility and asymmetric correlation.

To preview our results, this study shows that on news days, the volatilities, covariances, and correlations of the two interest rate futures are higher than those on non-news days. The most important news announcement, for the two interest rate futures volatilities and covariances, is the non-farm payroll report while the retail sales announcements affect the intraday correlations the most. The results also imply that the announced unemployment rate plays a significant role in affecting intraday volatilities, covariances, and correlations. The non-farm payroll report and the unemployment rate are released at the same time in the employment situation summary by the Bureau of Labor Statistic (BLS), it appears that this summary by the BLS is the most important in affecting futures return volatilities, covariances, and correlations. All other announcements have a positive influence on the intraday correlations, suggesting that the returns on Eurodollar and T-bond contracts move in the same direction as a result of these announcements. Thus, at least empirically, the correlations between short-term interest rates and long-term interest rates tend to be positive after news announcements.

The results on asymmetric volatility indicate that news announcements magnify the existing asymmetries in the data. Put differently, asymmetries exist in the data on a small scale without macroeconomic news announcements, but asymmetries increase on news days, especially during the five-minute interval when the news announcements are released. The results contrast with previous studies that link asymmetric responses in volatilities to positive vs. negative lagged returns only. They do not explicitly examine the relevance of economic fundamentals captured in news announcements. The results suggest that asymmetric volatility exists especially during the period when there are macroeconomic news announcements.

Whether there are asymmetric effects with regard to the correlations between the Eurodollar and T-bond futures contracts around news announcements times is investigated. First, it is found that after controlling for the influence of volatilities on correlations, news announcements matter. That is, the correlations between these two interest rate contracts are significantly higher

[2]Andersen et al. (2003) examined asymmetric responses of exchange rate returns on news, but not asymmetric volatility.

on news announcements time, even after controlling for volatilities. Second, the existence of asymmetric correlation with regard to volatilities is found. The results suggest that correlation-in-volatility could be due to news announcements that lead to the rise of volatilities as well as correlations.

The rest of the article is organized as follows. The second section describes the construction of the data, volatilities, covariances, and correlations used in the study. The third section provides the empirical results regarding the influence of news announcements on the intraday volatilities, covariances, and correlations along with the speed of adjustment for the volatilities, covariances, and correlations. The fourth section addresses the asymmetric responses of the volatilities and correlations to news announcements. The last section concludes.

THE DATA

In this section the data set and the construction of the variances, covariances, and correlations from the futures price data are described.

Futures Prices and Announcements Data

The U.S. Treasury bond (T-bond) futures contract is traded on the Chicago Board of Trade (CBOT). The Eurodollar futures contract is traded on the International Monetary Market unit of the Chicago Mercantile Exchange (CME).[3] These markets were chosen for two reasons. First, prices are available on a tick-by-tick basis and thus allows construction of a high-frequency time series at the five-minute and the one-minute time intervals. The daily transaction record extends from 8:20 EST until 15:00 EST for the Eurodollar and T-bond futures contracts. There are a total of 80 five-minute returns and 400 one-minute returns, daily, for both futures contracts. The high-frequency data allow one to precisely identify the impact and dynamic effects that news announcements may have on the two futures contracts. Second, both contracts are heavily traded and thus, are arguably very liquid, a desirable feature given the motivation underlying this study. The T-bond contract, which calls for delivery of a U.S. Treasury bond with fifteen or more years to maturity, is the most heavily traded long-term interest rate contract in the world during our sample period. The Eurodollar contract, which specifies cash delivery based on the three-month London interbank offered rate, is the most heavily traded short-term interest rate futures contract. The data are time and sale

[3]During the time period when the data are available, both the CME and CBOT have dual trading systems: trading in the pit and electronic trading, but during different hours. However, the trading volume in the pit dominates that in the electronic trading.

transaction prices, not bid–ask quotes, recorded by exchange personnel who observe the pits and post the most recent price. Our data set begins January 3, 1995, and ends December 31, 1999, for the Eurodollar contract, and begins October 2, 1995, and ends September 30, 1999, for T-bond contract, for a total of 1,258 and 1,003 trading days, respectively.

The data on the date and time of 23 regularly scheduled macroeconomic announcements are also available. These include 1 weekly announcement (initial unemployment claims), 17 monthly announcements, 4 quarterly announcements, and the federal funds target (FOMC) announcements that are scheduled to occur eight times per year. The announcements data were obtained from the Money Market Service (MMS), a San Francisco-based corporation, which has conducted telephone surveys since 1977. The exact time of the announcements was obtained from the *Wall Street Journal* whenever there was incomplete time data from the MMS. MMS data are frequently used in studies of macroeconomic announcements. Edison (1996), Balduzzi et al. (2001), Andersen et al. (2003) are some of the studies that have used the MMS data. The 23 economic news announcements that are considered are shown in Table I. Over half (16) of the 23 news announcements considered are released at 8:30 A.M. eastern standard time (EST). The industrial production announcements are made at 9:15 A.M. while most of the remaining announcements are made at 10:00 A.M. (EST). The Fed open market committee (FOMC) meeting announcements are made at 2:15 P.M.

Volatilities, Covariances, and Correlations Construction

To investigate the influence of news announcements on the volatilities, covariances, and correlations between the two interest rate futures contracts, the five-minute return series ($r_i^{5-\min}$) from the logarithmic differences between the prices recorded at or immediately before the corresponding five-minute marks is also constructed. The price volatilities as the absolute values of the five-minute returns are also defined. This definition is consistent with Ederington and Lee (1993) and Balduzzi et al. (2001). The covariances as the product of the five-minute returns for the two relevant series (i.e., $Cov_{ij}^{5-\min} = r_i^{5-\min} r_j^{5-\min}$) are also defined. Essentially, the average five-minute returns were treated as approximately zero, since empirically five-minute returns are quite small. This definition has also been used by Andersen et al. (2001) in their construction of daily realized volatilities and covariances.

Intraday correlations can be estimated directly from the intraday data. However, as the frequency increases, the asynchronicity of trades and returns and other market microstructure effects lead to a serious underestimation of

TABLE I
U.S. News Announcements

Announcement	*Obs*[1]	*Source*[2]	*Dates*[3]	*Announcement Time*[4]	*Frequency*
Quarterly announcements					
Employment Cost Index	20	BLS	01/31/95–10/28/99	8:30 A.M.	Quarterly
GDP advance	20	BEA	01/27/95–10/28/99	8:30 A.M.	Quarterly
GDP preliminary[5]	19	BEA	03/01/95–11/24/99	8:30 A.M.	Quarterly
GDP final	20	BEA	03/31/95–12/22/99	8:30 A.M.	Quarterly
Monthly announcements					
Real activity					
Non-farm payroll	60	BLS	01/06/95–12/03/99	8:30 A.M.	Monthly
Retail sales	60	BC	01/13/95–12/14/99	8:30 A.M.	Monthly
Unemployment rate	60	BLS	01/06/95–12/31/99	8:30 A.M.	Monthly
Industrial production	60	FRB	01/05/95–12/30/99	9:15 A.M.	Monthly
Consumption					
Personal income	60	BEA	01/30/95–12/23/99	8:30 A.M.	Monthly
New home sales	59	BC	02/02/95–12/02/99	10:00 A.M.	Monthly
Investment					
Durable goods[6]	60	BC	01/26/95–12/23/99	8:30/9:00/10:00 A.M	Monthly
Business inventory[7]	60	BC	01/18/95–12/15/99	10:00a.m./8:30 A.M.	Monthly
Construction spending	60	BC	01/04/95–12/02/99	10:00 A.M.	Monthly
Factory order	60	BC	01/05/95–12/03/99	10:00 A.M.	Monthly
Net exports					
Trade balance	60	BEA	01/19/95–12/16/99	8:30 A.M.	Monthly
Prices					
CPI	60	BLS	01/11/95–12/14/99	8:30 A.M.	Monthly
PPI	60	BLS	01/10/95–12/10/99	8:30 A.M.	Monthly
Forward-looking					
Housing starts	60	BC	01/20/95–12/16/99	8:30 A.M.	Monthly
Leading indicator[8]	60	CB	02/01/95–12/29/99	8:30/10:00 A.M.	Monthly
Consumer confidence	60	CB	01/31/95–12/28/99	10:00 A.M.	Monthly
NAPM survey	60	NAPM	01/03/95–12/01/99	10:00 A.M.	Monthly
Six-weekly announcements					
FOMC target Fed funds rate	40	FRB	02/01/95–12/21/99	14:15 P.M.	Six-weekly
Weekly announcements					
Initial claims	261	ETA	01/05/95–12/30/99	8:30 A.M.	Weekly

[1]Total number of observations in the announcement sample.
[2]Bureau of Labor Statistics (BLS), Bureau of the Census (BC), Bureau of Economics Analysis (BEA), Federal Reserve Board (FRB), National Association of Purchasing Managers (NAPM), Conference Board (CB), Employment and Training Administration (ETA).
[3]Starting and ending dates of the announcements sample.
[4]Eastern standard time. Daylight saving time starts on the first day of April and ends on the last Sunday of October.
[5]In 03/96, there is a missing value.
[6]Whenever GDP is released on the same day as durable goods orders, the durable goods orders announcement is moved to 10:00 A.M. On 07/96, the durable goods orders announcement was released at 9:00 A.M.
[7]Starting from 01/97, the business inventory announcement was moved from 10:00 A.M. to 8:30 A.M.
[8]Starting from 01/97, the leading indicators announcement was moved from 8:30 A.M. to 10:00 A.M.
[9]The unemployment rate and non-farm payroll announcements are always made at the same date and the same time.

comovements (Epps, 1979). Thus, high-frequency correlations are difficult to estimate (Engle, 2002). In this study, the five-minute correlations are constructed using the method that is similar to the one in constructing daily realized volatility implemented by Andersen et al. (2001) and Thomakos and Wang (2003). The procedure is as follows: to construct five-minute integrated correlations between the Eurodollar and T-bond future contracts, the one-minute return series $(r_i^{1-\min})$ is first calculated for each futures time series from the logarithmic differences between the prices recorded at or immediately before the corresponding one minute marks. Owing to the microstructure bias for the high-frequency data, the one-minute return series is filtered using the MA model with the order of the MA term determined by the respective correlogram for each one-minute return series. Based on the correlograms, an MA(4) model is used for the T-bond futures one-minute return and a MA(3) model for the one-minute Eurodollar futures return.

The realized five-minute volatility for asset i is then constructed as the sum of one-minute MA-filtered-squared returns $\sum_{t=1}^{5}(r_{it}^{1-\min})^2$ while the realized five-minute covariances are constructed as the sum of the product of MA-filtered one-minute return series $\sum_{t=1}^{5} r_{it}^{1-\min} r_{jt}^{1-\min}$. The realized five-minute correlations are calculated as the ratio of the five-minute realized covariances and the product of five-minute realized standard deviations

$$\left(\sum_{t=1}^{5} r_{it}^{1-\min} r_{jt}^{1-\min} \Big/ \left(\sqrt{\sum_{t=1}^{5} (r_{it}^{1-\min})^2} \sqrt{\sum_{t=1}^{5} (r_{jt}^{1-\min})^2} \right) \right)$$

Here, the five-minute sample interval is used following the literature for analyzing news impacts (Andersen et al., 2003; Balduzzi et al., 2001). The small number of observations used in constructing the five-minute realized covariations from the five one-minute returns might reduce the attractiveness of our resulting estimates, from an asymptotic distribution theory point of view, but does not invalidate them.[4] It should be noted that with the fast transmission of news to asset prices as shown later in the study as well as in the literature, most of the news impact happens within the first five to ten minutes, and that is exactly why most studies use the five-minute as the sample interval instead of longer time intervals. All in all, our estimates are reasonable for the task at hand—it is possibly to improve them but only at a cost of reducing the resulting sample for the subsequent analysis that forms the core of the study.

In the following section, the effect of macroeconomic news on the five-minute volatilities, covariances, and correlations structure of the two interest rate futures returns is investigated.

[4]See Barndorff-Nielsen and Shephard (2004) for more on the related asymptotic theory for realized covariation measures.

NEWS ANNOUNCEMENTS EFFECTS ON VOLATILITIES, COVARIANCES, AND CORRELATIONS

Intraday Patterns of Volatilities, Covariances, and Correlations

Figure 1 depicts the intraday patterns of the five-minute absolute returns of the two futures contracts on news announcements days vs. non-announcements days. Casual observation of Figure 1 supports the well-documented U-shaped intraday patterns (Ederington & Lee, 1993). In particular, the intraday absolute returns of the two futures contracts spike upward during

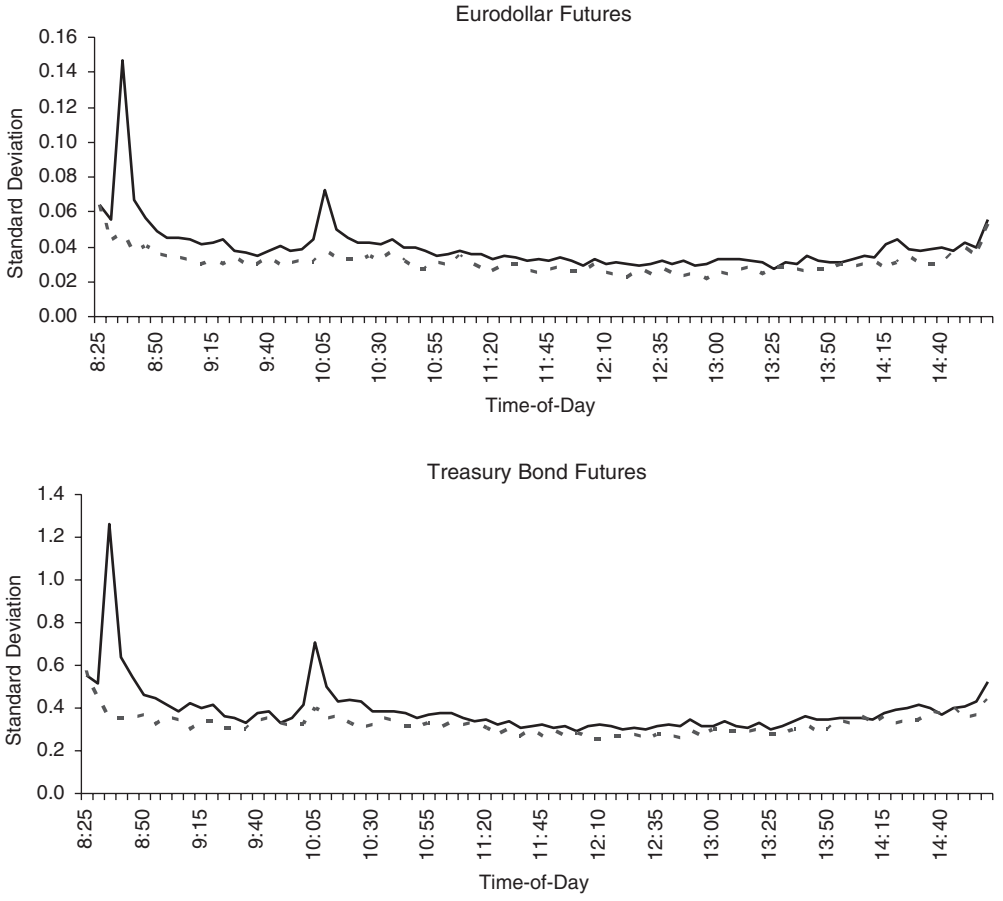

FIGURE 1

Intraday return volatilities on announcement and non-announcement days. Standard deviations of five-minute returns are reported for days with at least one of the 25 announcements listed in Table I (solid line) and days with none of these announcements (dashed line). The reported standard deviations are 10^3 times the calculated values and the times shown are interval ending times (ET).

announcements days at the 8:30–8:35 A.M. time period as well as, to a lesser extent, during the 10:00–10:05 A.M. time interval. On non-announcements days (broken line), the volatilities of the futures contracts appear to be U-shaped but on a much smaller scale. Comparing the two futures interest rate returns, T-bond returns are ten times as volatile as Eurodollar returns, consistent with the empirical facts that long-term bonds are much more volatile than the short-term bonds.

The impact of news announcements on intraday covariances and correlations is now considered. The top panel in Figure 2 shows the corresponding

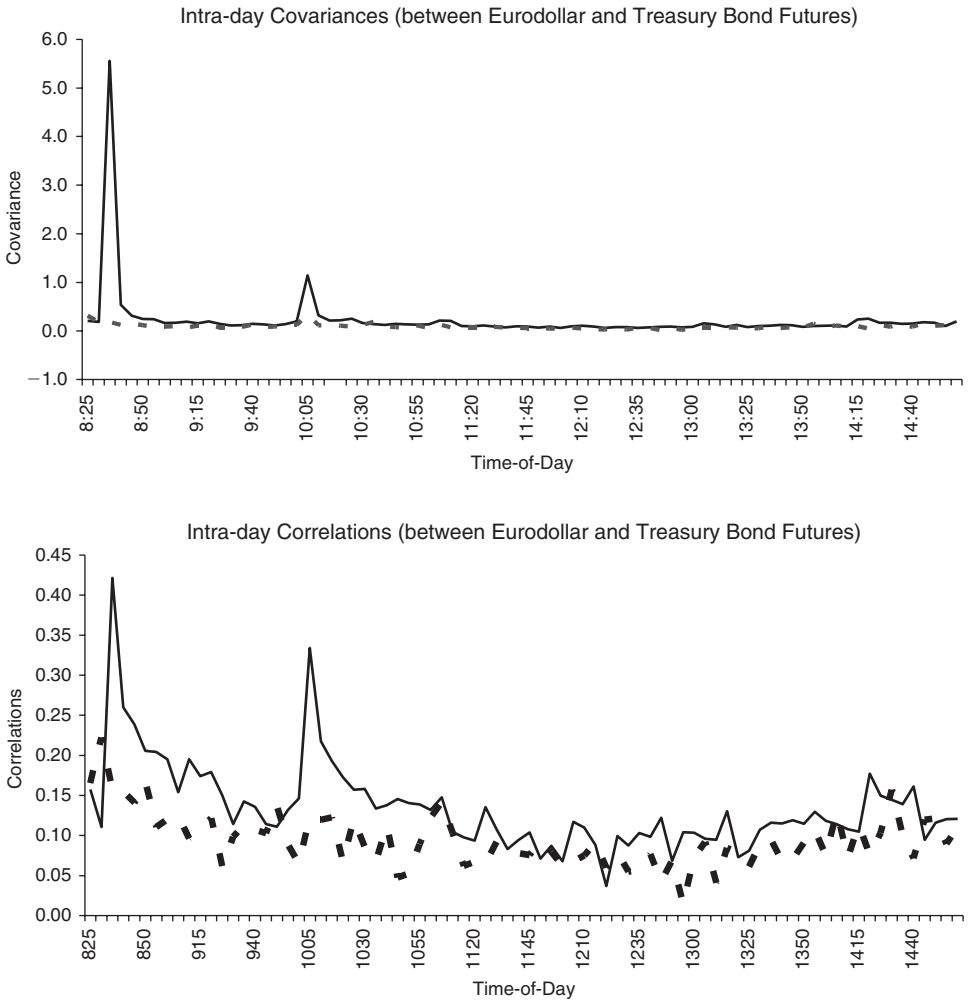

FIGURE 2

Intraday return covariances/correlations on announcement and non-announcement days. Covariances/correlations of five-minute returns are reported for days with at least one of the 25 announcements listed in Table I (solid line) and days with none of these announcements (dashed line). The reported covariances are 10^7 times the calculated values and the times shown are interval ending times (ET).

result for the intraday covariances. The results are similar to those in Figure 1 and suggest that intraday covariances respond in a similar fashion in response to news announcements. During non-announcements days, the covariances between the Eurodollar and T-bonds appear to be not U-shaped and relatively stable throughout the day. However, by carefully examining the data, the intraday covariances during non-announcements days are indeed U-shaped. The graph gives a false impression because the impact of news announcements on covariances is so large that covariances during non-announcements days all appear small.

The bottom panel in Figure 2 depicts the analogous results regarding the influence of news announcements on the five-minute realized Eurodollar–Treasury bonds correlations. The correlations appear to react in a systematic way to news announcements, as the spikes during news announcements days resemble those offered in the volatilities and the covariances figures.

Figures 1 and 2 suggest that the releases of macroeconomic news induce common movements in the interest rate futures market, which strengthen the correlations. This result is consistent with that in Christiansen (2000) who examined the effect of major news announcements news on the daily covariance structure of government bond returns. Still, even after adjusting for the news impact, the intraday patterns of standard deviations, covariances, and correlations still exhibit the U-shaped properties. This calendar effect is consistent with that in Andersen and Bollerslev (1998) on the Deutsche Mark–Dollar volatility.

Contemporaneous News Impacts

Volatilities

In order to obtain a clearer picture of the impact of announcements on volatilities, covariances, and correlations, the regression specification of Balduzzi et al. (2001) and Andersen et al. (2003) is followed. Let F_i denote the median of the MMS forecast survey and A_i denote the released value of the news announcement i. Then the standardized surprise measure is $S_i = (A_i - F_i)/\sigma_i$, where σ_i is the standard deviation of the news surprise for news i. The regression takes the following form:

$$Y_{it} = \alpha + \beta_i |S_{it}| + \sum_{j=1}^{J} \beta_j |S_{jt}| + \varepsilon_t \tag{1}$$

where Y_{it} represents the volatilities, covariances, or correlations at selected times. S_{it} represents the standardized surprise for news i at time t, and S_{jt} denotes the jth announcement concurrent with announcement i, where J is the total number of concurrent announcements.

The focus is on the five-minute interval immediately after the announcements. For example, for the 8:30–8:35 five-minute time interval, the sixteen announcements surprises are included and the significance of the coefficients and the fit as measured by the value of the R^2 is examined. For the 10:00–10:05 time interval, the 10:00 announcements as well as the announcements surprises at 8:30 are included if there are 8:30 announcements on that day. As each explanatory variable is standardized, the magnitude of the coefficients can be used as an indication of the relative importance of news announcements.

Table II provides the results with volatilities of the two futures, covariances, and correlations as the dependent variables. For the Eurodollar standard deviation, it shows that 8:30 announcements are more significant relative to the 9:15 and 10:00 announcements.[5] The R^2 value is 0.437 for the 8:30–8:35 time interval. In terms of the order of magnitude, the non-farm payroll announcements dominate, followed by the retail sales surprise and the employment cost index. The Fed announcements at 14:15 are also quite significant. The R^2 value for that regression is approximately 0.228.

The results for the T-bonds futures volatility indicate that 11 of the 16 8:30 announcements have positive and statistically significant impact, lead by, in terms of the magnitude of the coefficients, the retail sales, the employment cost index, and the non-farm payroll. The R^2 value is at 0.384. Compared with the results on Eurodollar futures volatilities, nearly all the estimated coefficients are larger, indicating that bonds futures are more volatile with regard to news announcements.

Covariances

The influence of news announcements on the covariances and correlations between the two interest rate futures contracts is examined. For the theoretical relation between short-term interest rates and long-term interest rates, according to the expectations hypothesis on the term-structure of interest rates, long-term interest rates are related to short-term rates through market expectations of future short-term rates. In the simplest version of the expectations theory, long-term interest rates are equal to an average of current and expected future

[5]A potential issue with the results in Table II is the power of the tests at conventional levels of significance: results with large sample sizes can reject the null hypothesis even when the hypothesis is correct if the level of significance is not adjusted downwards. Connolly (1989) has a useful discussion on this issue and provides some prior literature and remedies from a Bayesian perspective. Our results, however, are less prone to the above problem. Most of the coefficient estimates in Table II have *t*-ratios in excess of 3 or 4 and the corresponding *P*-values are close to zero. The authors are thus not particularly concerned with conventional levels of significance even if they are at the 1% level.

TABLE II
Responses to News Surprises

	Volatility (ED)	*Volatility (US)*	*Covariances*	*Correlations*
8:30 A.M. announcements				
Business inventory	0.036 (0.035)	0.762(0.333)**	3.603(2.371)	0.034(0.102)
CPI	0.110(0.034)***	1.463(0.406)	8.712(3.315)***	0.281(0.053)***
Durable goods	0.196(0.056)***	1.174(0.382)***	11.266(6.427)*	0.303(0.088)***
Employment Cost Index	0.240(0.105)**	2.954(0.807)***	30.009(17.756)*	0.333(0.080)***
GDP advance	0.128(0.061)**	1.293(0.490)***	6.095(5.093)	0.274(0.057)***
GDP preliminary	0.039(0.019)**	0.328(0.104)***	0.748(0.451)*	0.343(0.080)***
GDP final	−0.005(0.025)	0.004(0.123)	−0.209(0.642)	0.118(0.081)
Housing starts	0.058(0.024)**	0.473(0.153)***	0.801(0.625)	0.269(0.060)***
Initial claims	0.005(0.007)	−0.039(0.035)	−0.660(0.523)	0.059(0.037)
Leading indicators	0.087(0.062)	0.238(0.232)	0.785(0.598)	−0.005(0.098)
Non-farm payroll	0.429(0.123)***	2.461(0.848)***	38.981(17.988)**	0.192(0.083)**
Personal income	−0.009(0.009)	−0.221(0.131)*	−2.002(1.802)	0.068(0.066)
PPI	0.182(0.034)***	1.256(0.356)***	7.055(3.125)**	0.399(0.058)***
Retail sales	0.310(0.070)***	3.008(0.737)***	15.373(6.853)**	0.759(0.094)***
Trade balance	0.005(0.013)	0.084(0.138)	0.115(0.545)	0.042(0.060)
Unemployment	0.177(0.103)*	1.589(0.826)*	14.550(17.904)	0.302(0.051)***
No. of observations	1,253	996	996	981
Adjusted R^2	0.437	0.384	0.311	0.147
9:15 A.M. announcements				
Industrial production	0.074(0.026)***	0.495(0.183)***	0.977(0.456)**	0.290(0.070)***
No. of observations	1,258	1,002	1,002	985
Adjusted R^2	0.063	0.055	0.071	0.018
10:00 A.M. announcements				
Business inventory	0.022(0.025)	0.189(0.138)	0.271(0.344)	0.125(0.125)
Durable goods	−0.029(0.026)	−0.076(0.304)	−0.649(0.502)	0.379(0.104)***
Leading indicators	−0.012(0.017)	−0.006(0.216)	−1.007(1.054)	0.071(0.126)
Consumer confidence	0.066(0.024)***	0.617(0.228)***	2.540(1.498)*	0.297(0.052)***
Construction spending	−0.003(0.021)	0.040(0.223)	−2.742(2.371)	0.163(0.058)***
Factory orders	0.033(0.026)	0.402(0.266)	2.156(2.051)	0.195(0.054)***
NAPM	0.206(0.037)***	2.066(0.473)***	14.450(7.299)**	0.402(0.058)***
New home sales	0.090(0.027)***	0.621(0.192)***	1.685(0.550)***	0.318(0.052)***
No. of observations	1,258	1,003	1,003	985
Adjusted R^2	0.234	0.268	0.222	0.096
14:15 P.M. announcements				
FOMC	0.218(0.124)*	0.229(0.034)***	0.357(0.702)	0.103(0.072)
No. of observations	1,200	956	955	952
Adjusted R^2	0.228	0.008	0.001	0.002

Note. Coefficients of news surprises in the regression $Y_{it} = \alpha + \beta_i|S_{it}| + \sum_{j=1}^{J}\beta_j|S_{jt}| + \varepsilon_t$ are reported. Y_{it} represents the volatility, covariance, or correlation at selected times. S_{it} represents the news surprise of interest. S_{jt} denotes the jth announcement surprise concurrent with announcement i. J is the number of concurrent announcements. Robust standard errors in parentheses.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

short-term interest rates. If the changes in the current short-term interest rate (in one direction) are greater in absolute value than the sum of changes in the expected future short-term rates (in the other direction), then the correlations between the current short-term rates and long-term interest rates would be

positive. However, if the changes in the current rates are smaller in absolute value, then the correlations between the short and long-term rates would be negative.

Table II also provides the regression results for the covariances between the Eurodollar and T-bond futures contracts. During the 8:30–8:35 time period, seven of the announcements are significant, led by the non-farm payroll announcements with a coefficient of 38.98. The other significant announcements are the employment cost index, retail sales, and the unemployment rate surprises. As non-farm payroll and unemployment rates announcements are made in the same employment situation report, this suggests that the employment situation report news is the most significant with regard to the covariances. The R^2 value for the 8:30–8:35 time interval is 0.311.

For the correlations between the two interest rate futures contracts, during the 8:30–8:35 time period, ten announcements are statistically significant with the R^2 equalling 0.147. The most significant announcement is retail sales, followed by the Producer Price Index (PPI) announcement surprises. These results clearly indicate comovements between the returns of the Eurodollar and long bond futures contracts as a result of these news announcements.

Overall, all the statistically significant coefficients are positive, indicating that with regard to news announcements, the short-term interest rate and the long-term interest rate move in the same direction during the first five minutes of trading after the announcements. This suggests empirically, after news announcements, changes in the current short-term rate (in one direction) are greater in absolute value than the sum of changes in the expected future short rates (in the other direction). As a result, short rates and long rates move in the same direction.

Speed of Adjustment

In this section, the dynamic responses of the two interest rate series to news announcements are investigated. In terms of volatility persistence, Ederington and Lee (1993) found volatilities to be "considerably" higher than normal for roughly 15 minutes and slightly more volatile for several hours following news announcements. Anderson et al (2003), focusing exclusively on foreign exchange contracts, found that the optimal lag structure regarding the impact of news on volatilities is one hour (12 lags at five-minute intervals). This issue can be approached in two ways. First, following Ederington and Lee (1993) and Fleming and Remolona (1999), the volatilities/covariances/correlations on news announcements days vs. days without news announcements are compared. Second, dynamic regressions focussing on the significance of leads and lags of the news announcements dummies is estimated. Employing the second

approach allows one to identify and assess the impact of specific news announcements on the dynamic response of the volatilities, covariances, and correlations under investigation.

Timing and anticipatory effects

As a starting point, a graphical depiction of the dynamic response to news announcements of the volatilities, covariances, and correlations of the two futures contracts is offered. Figure 3 provides the dynamic responses of the two volatilities to news announcements. The first spike (in each panel) at 8:35

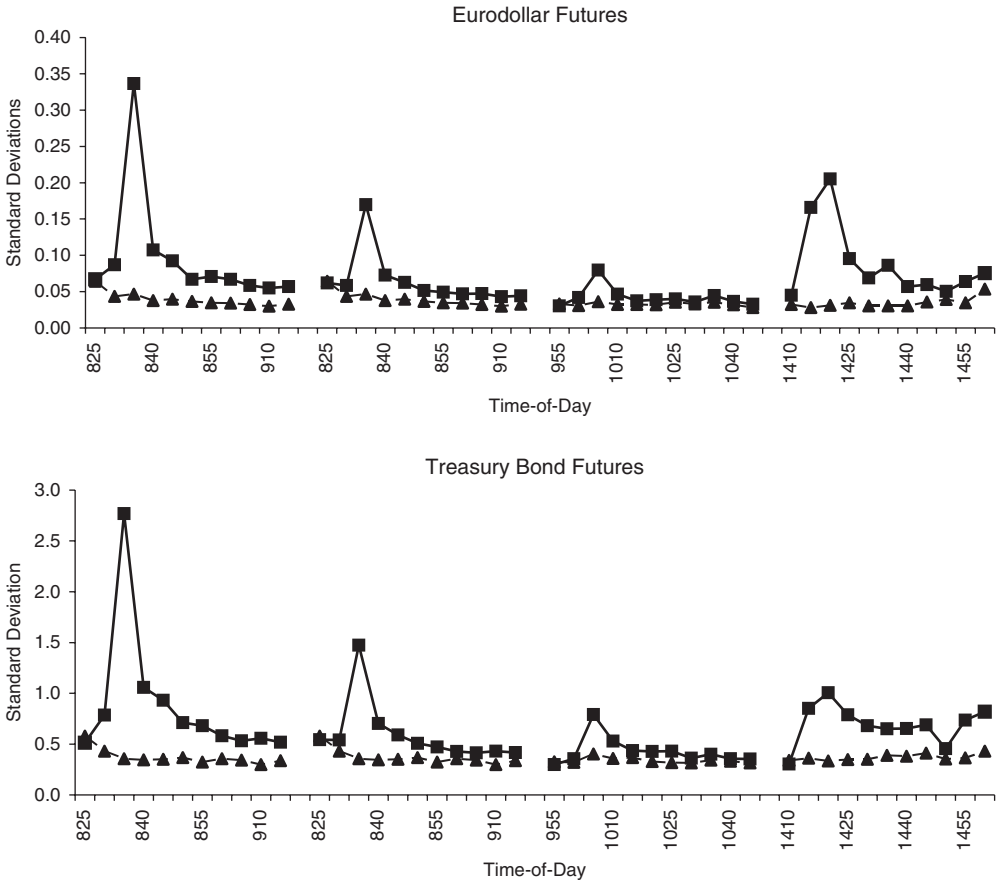

FIGURE 3

Intraday five-minute return standard deviations on announcement and non-announcement days around news announcement times. Standard deviations of five-minute returns are reported for days with at least one of the followings (from left to right on the graph): major 8:30 announcements (defined as CPI, PPI, and unemployment rate), 8:30 announcements, 10:00 announcements, and 14:15 FOMC announcement (solid lines) and days with none of these announcements (dashed lines). The reported standard deviations are 10^3 times the calculated values and the times shown are interval ending times (ET).

considers what is referred to as the major news announcements and plots the volatilities on news days vs. non-news days where the news days are defined to be days in which the non-farm payroll, PPI, and CPI announcements are made.[6] The second 8:35 spike is the result defining news days in which any of the 8:30 news announcements were made.

In terms of ratio tests, the volatilities, covariances, and correlations for news announcements days and non-announcements days at each five-minute interval from ten minutes before the announcement time until 45 minutes after the announcements or the end of the trading day (FOMC announcements) are compared. The results for the 8:30 announcements are in Table III[7] For the 8:30 news announcements vs. no-news announcements, both volatilities are significantly higher at 8:35 with the influence of the news announcements lasting, for the most part, at least 45 minutes after the announcements are made. Interestingly, volatilities are also significantly higher for the 8:25–8:30 period, implying what is referred to as anticipatory effects (Panels A and B of Table III).

For the 10:00 news announcements, casual observation of Figure 3 suggests that there is a significant influence on both volatilities, but not nearly the magnitude relative to the 8:30 announcements.

The FOMC announcement in Figure 3 is quite impressive which results in a significant and persistent rise in volatilities across both interest rate futures contracts. First, the volatilities of both futures contracts rise (significantly) five minutes before the FOMC announcements, implying anticipatory effects. For the T-bond, the influence of the FOMC announcements persists until the end of the trading day. For Eurodollar volatilities, the pattern of persistence is similar in that the ratio, the volatilities on news days divided by the volatilities on non-news days are greater than one until the end of the trading day.

Figure 4 provides the covariances and correlations results between Eurodollar and T-bond futures contracts. The covariances results (top panel) appear to be similar to the previous volatility results. According to the ratio tests in Table III, the covariances on announcements days (8:30) are significantly higher, relative to non-announcements days, for at least 45 minutes after the major announcements are made. For the 10:00 announcements, the results for the covariances between the Eurodollar and T-bond are a little weaker. Graphically, the spike in the covariances during news days is much smaller than the other news periods, and statistically, the significance of the difference only lasts for 25 minutes after the news announcements. The FOMC

[6]Non-farm payrolls, PPI, and CPI are chosen to be consistent with the literature (Fleming & Remolona, 1999).

[7]All other results are available upon request.

TABLE III

Volatility, Covariance, and Correlation Persistence Following 8:30 A.M. Announcements

	Five-minute											*1-minute*					
	825	*830*	*835*	*840*	*845*	*850*	*855*	*900*	*905*	*910*	*915*	*829*	*830*	*831*	*832*	*833*	*834*
Panel A: Volatility (Eurodollar futures)																	
Anno. Day	0.062	0.058	0.170	0.073	0.063	0.051	0.049	0.047	0.047	0.043	0.044	0.033	0.045	0.165	0.073	0.057	0.042
Non-Anno. day	0.064	0.044	0.047	0.038	0.040	0.037	0.034	0.034	0.032	0.030	0.033	0.026	0.020	0.023	0.023	0.024	0.021
Ratio (*A*/*N*)	0.967	1.341	3.648	1.923	1.577	1.409	1.426	1.370	1.475	1.441	1.353	1.278	2.280	7.292	3.159	2.408	1.955
P-value	0.354	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000
Panel B: Volatility (Treasury Bond Futures)																	
Anno. Day	0.543	0.543	1.475	0.705	0.592	0.509	0.472	0.430	0.415	0.431	0.418	0.240	0.340	1.330	0.652	0.493	0.431
Non-Anno. day	0.580	0.433	0.356	0.346	0.353	0.367	0.324	0.359	0.344	0.300	0.337	0.207	0.203	0.197	0.180	0.204	0.188
Ratio (*A*/*N*)	0.937	1.254	4.139	2.037	1.679	1.386	1.455	1.198	1.208	1.437	1.240	1.159	1.675	6.737	3.610	2.422	2.296
P-value	0.220	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000
Panel C: Covariances (Between Eurodollar and Treasury Bond Futures)																	
Anno. Day	0.232	0.186	6.833	0.641	0.371	0.297	0.286	0.186	0.209	0.204	0.166	0.007	0.053	5.323	0.709	0.265	0.178
Non-Anno. day	0.310	0.188	0.172	0.121	0.156	0.122	0.088	0.088	0.092	0.065	0.113	0.027	0.015	0.022	0.015	0.014	0.014
Ratio (*A*/*N*)	0.751	0.990	39.624	5.280	2.380	2.429	3.252	2.103	2.262	3.133	1.472	0.276	3.512	239.340	46.013	18.349	12.511
P-value	0.545	0.925	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.076	0.105	0.163	0.000	0.000	0.000	0.000
Panel D: Correlations (Between Eurodollar and Treasury Bond Futures)																	
Anno. Day	0.155	0.105	0.488	0.295	0.271	0.244	0.234	0.214	0.173	0.192	0.187						
Non-Anno. day	0.165	0.222	0.156	0.155	0.141	0.167	0.111	0.120	0.124	0.097	0.110						
Ratio (*A*/*N*)	0.936	0.471	3.136	1.907	1.927	1.458	2.113	1.779	1.393	1.988	1.706						
P-value	0.713	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.034	0.024	0.009						

Note.

1. Announcement days are defined as days with at least one of the 8:30 A.M. announcements.
2. Non-announcements days are defined as days when none of our twenty-five announcements occur.
3. Ratio is the value of announcement days to the values of non-announcement days.
4. *P*-value is the empirical level of significance, based on newey-white standard error with 6 lags, on the slope coefficient in the regression. $y_{it} = \alpha_{0i} + \alpha_{1t} D_{it} + e_{it}$ where D_{it} is the dummy variable which has value of 1 for the days with announcements and 0 otherwise.

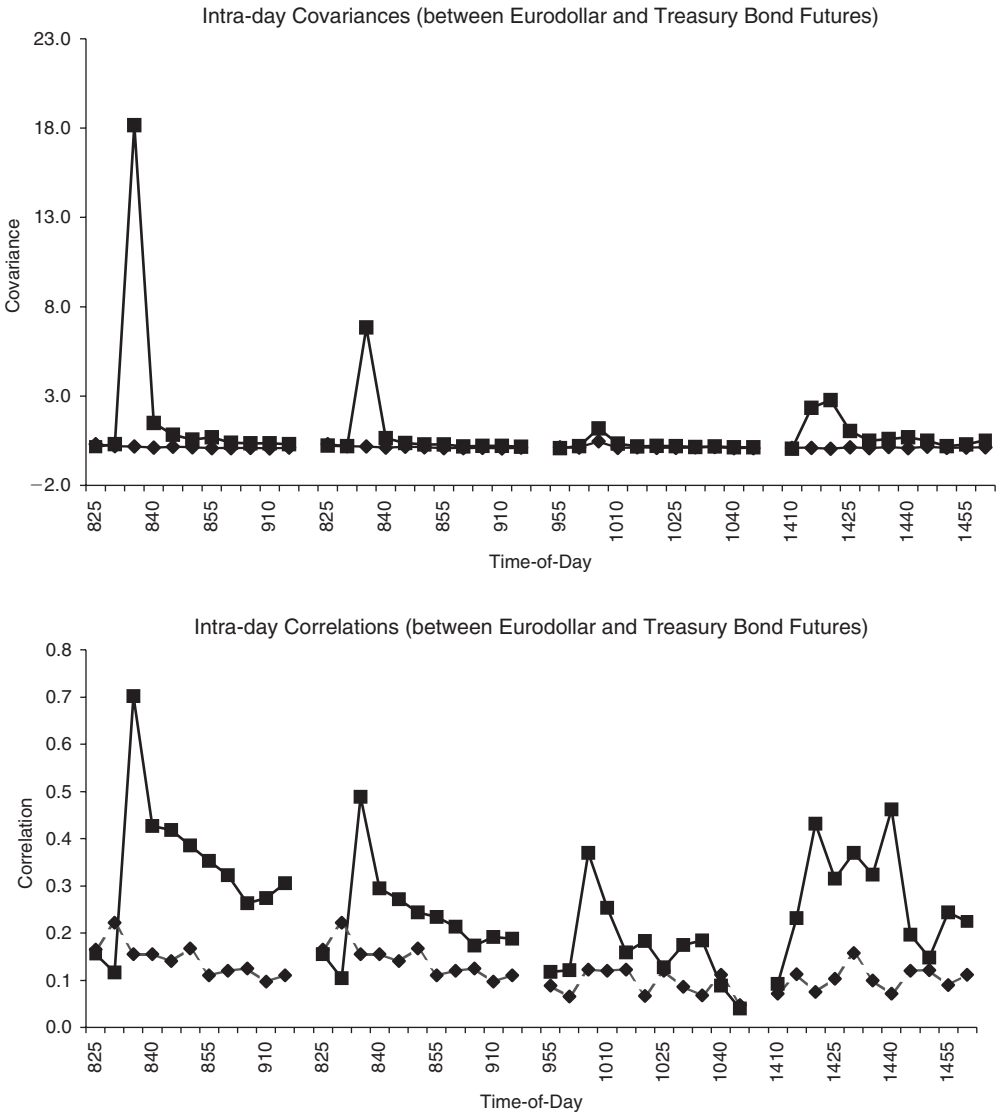

FIGURE 4

Intraday five-minute return covariances and correlations between Eurodollar and treasury bond futures on announcement and non-announcement days around news announcement times. Covariances and correlations of five-minute returns are reported for days with at least one of the followings (from left to right on the graph): major 8:30 announcements (defined as CPI, PPI, and unemployment rate), 8:30 announcements, 10:00 announcements and 14:15 FOMC announcement (solid lines), and days with none of these announcements (dashed lines). The reported covariances are 10^7 times the calculated values and the times shown are interval ending times (ET).

announcements results in an upward spike in the covariances between the two series at the time of the announcements; however, the influence of the announcements is not statistically significant until 10 minutes after those announcements.

The bottom panel of Figure 4 indicates that the correlations between the two interest rate contracts reacts in a systematic pattern to news announcements, similar to the results above. For the 8:30 news announcements, there appears to be anticipatory effects in that the correlations between the two interest rate series falls before the announcements; however, the result is not statistically significant. The impact of the 8:30 news announcements, persist for at least 45 minutes as shown in Table III. The 10:00 news announcements are much less persistent, with the statistical difference between the two series (announcements vs. non-announcements days) fading within 10 minutes of the news announcements. The influence of the FOMC announcements persists statistically for 25 minutes. Interestingly, the peak of the Fed influence occurs during the 14:35–14:40 time period, a full 20–25 minutes after the announcements.

In summary, the timing of announcements appears to be important. From the figures as well as the ratio test results, it is clear that news released at 8:30 tends to have greater impact than those released at 10:00 not only in terms of impact magnitude but in terms of persistence as well. The fact that "announcements timing matters" supports the interpretation of our earlier-reported empirical results in Table II that earlier announcements at 8:30 tend to be more statistically significant and have larger impact.

Regression results: which announcements matter

In this section, the persistence and cumulative impact of news announcements via regression analysis are examined. The objective is to investigate how long announcements effects persist. To this end, a series of regressions in which the dependent variables (volatilities, covariances, or correlations) evolve through time is estimated. For example, to investigate whether or not the non-farm payroll announcements have dynamic influence on T-bond volatilities, a regression with T-bond volatilities five minutes after the announcements as the dependent variable and the 8:30 non-farm payroll announcements surprise as the independent variable are run. The dependent variable to the 10 minutes is then updated after the announcements and the same regression is run. The dependent variable is continually updated up until 40 minutes (8 five-minute intervals) after the news announcements. This procedure is followed for each news announcement and those news announcements are ranked according to their cumulative influence. The regressions use the same specification as in Equation (1).

Volatilities: For ease of interpretation, the results are provided graphically (the complete regression results are available upon request). The top panel of Figure 5 depicts the evolution of the estimated coefficients of the top four news

announcements that influence Eurodollar volatilities. The top four announcements are the retail sales, non-farm payroll, unemployment rate, and NAPM, respectively. The other announcements, other than the four offered in the top panel of Figure 5, in terms of their cumulative effects, are the FOMC, employment cost index, PPI, and durable goods orders announcements, respectively.

The bottom panel of Figure 5 contains the results for the volatilities of the T-bond. The top four announcements, according to their cumulative influence, are the retail sales, non-farm payroll, unemployment rate, and NAPM, the same as those for the Eurodollar futures.

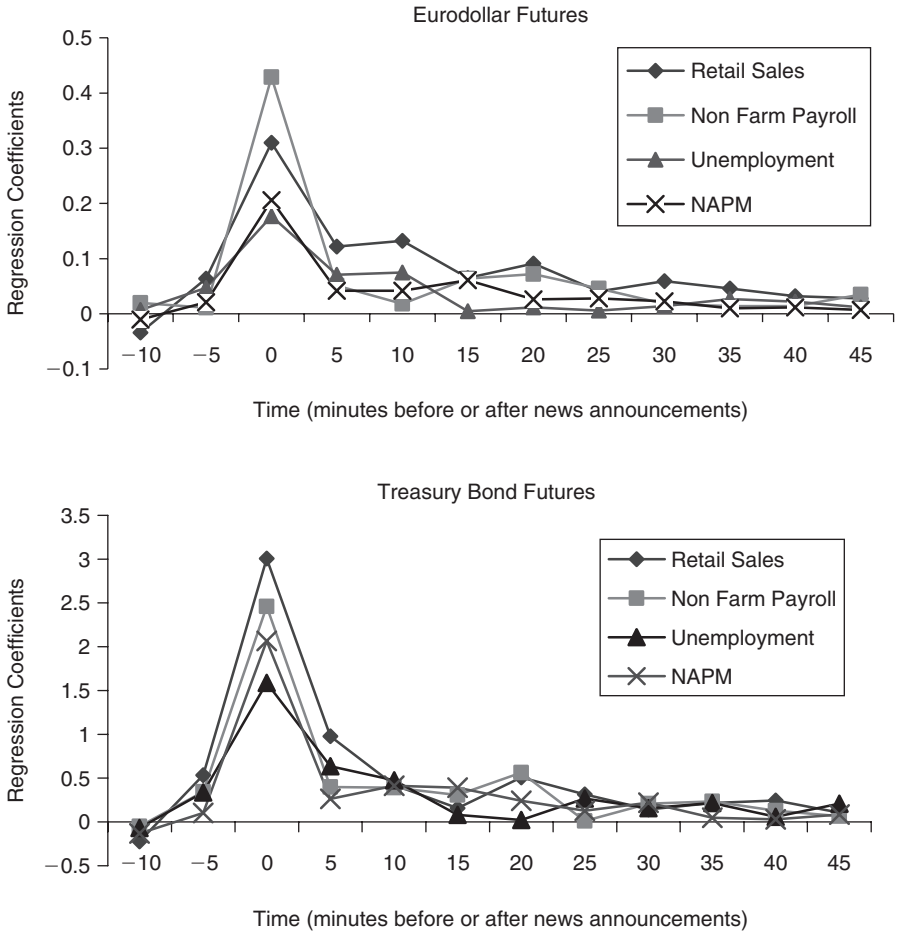

FIGURE 5
Regression coefficients of dynamic regression. The graphs show the regression coefficients of the news surprise variables that have the most cumulative effects (measured by the sum of regression coefficients) over time intervals before and after news announcements on Eurodollar and T-bond return volatitlities.

Covariances and correlations between Eurodollar and T-bond: The covariances and correlations results between the Eurodollar and T-bond futures contracts are provided in Figure 6. In the top panel the dynamic results of the top four news announcements are provided, in terms of their cumulative influence, on the covariances between the Eurodollar and the T-bond. The top four announcements are non-farm payroll, employment cost index, retail sales, and the unemployment rates, respectively. The correlation results are provided in the bottom panel of Figure 6. Casual observation of Figure 6 suggests that the effect of these announcements persists on the correlation between the

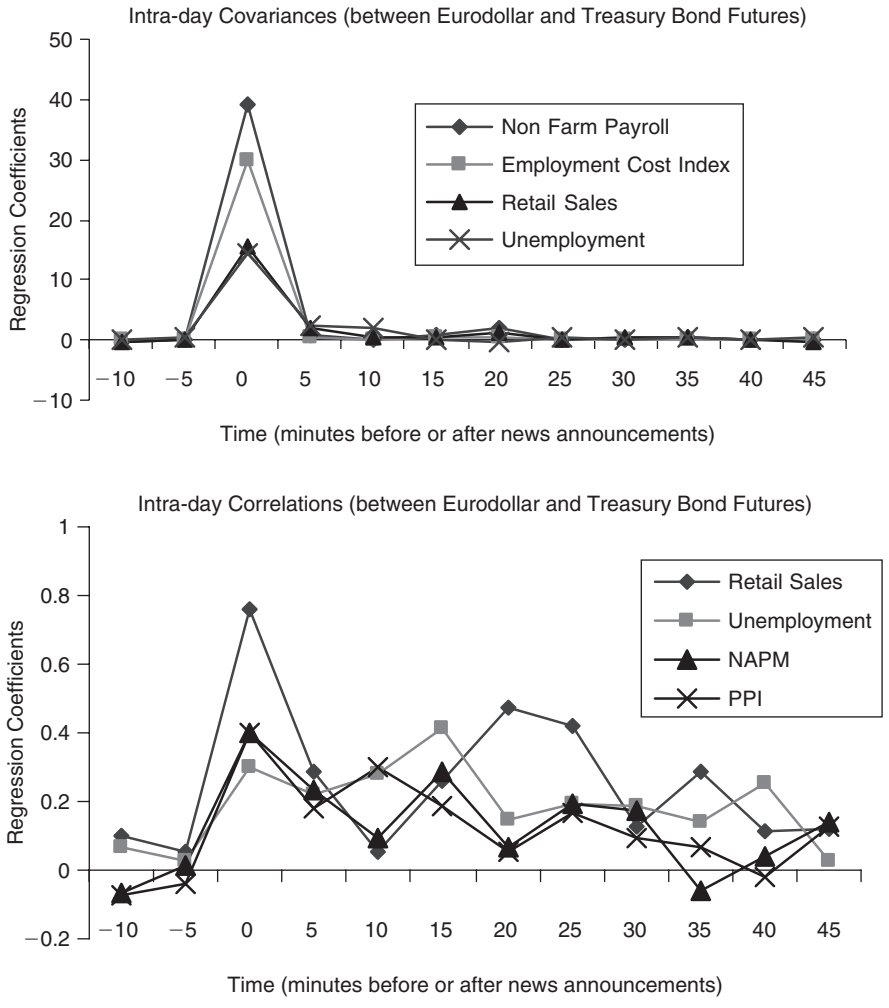

FIGURE 6
Regression coefficients of dynamic regression. The graphs show the regression coefficients of the news surprise variables that have the most cumulative effects (measured by the sum of regression coefficients) over time intervals before and after news announcements.

returns on Eurodollar and long bonds. The top four announcements, in terms of their cumulative effect are the retail sales, unemployment rate, NAPM, and PPI announcements, respectively.

Overall, the results suggest that the employment situation summary with both the non-farm payroll and the unemployment rate announcements is the most important report among all news announcements. The retail sales announcements appear to be important as well.

ASYMMETRIC RESPONSES OF VOLATILITIES AND CORRELATIONS TO NEWS

Many key economic and financial questions depend upon the perceived commonality in volatility movements across asset markets. The existing literature emphasizes the following two empirical facts. First, there is asymmetry between equity return and volatilities (i.e., positive returns have a smaller impact on future volatilities than do negative returns of the same absolute magnitude). There are two main explanations for the asymmetry: (1) the leverage effect (Black, 1976; Christie, 1982) and (2) the volatility feedback story (Campbell & Hentschel, 1992). Asymmetric volatility tends to be stronger for the aggregate equity market as compared with individual stocks (Andersen et al., 2001; Bekeart & Wu, 2000), and the evidence on asymmetric volatility is much weaker for futures markets (Thomakos & Wang, 2003).

Second, correlations tend to be high when the corresponding volatilities are high. The correlations structure of asset returns, particularly stock returns, is asymmetric (i.e., correlations tend to decrease with the absolute size of the threshold for positive returns, but tends to increase with the absolute size of the threshold for negative returns). The result is that the probability of having large losses simultaneously on two assets (or markets) is much larger than would be suggested under the assumption of multivariate normality. Empirically, Kroner and Ng (1998), employing different multivariate ARCH models, found statistically significant asymmetries in the conditional covariances matrices for weekly returns on a pair of well-diversified small and large stock portfolios. Ang and Chen (2002) demonstrated significant asymmetries in the correlations between the market and various industry, size, and book-to-market sorted portfolios. Hong, Tu, and Zhou (2007) developed statistical tests to examine the existence of asymmetric correlation. For international market correlations, Lin, Engle, and Ito (1994), Longin and Solnik (1995), and Karolyi and Stulz (1996) found that international equity market correlations were larger in periods of volatile markets (large absolute returns), and argued that this effect was more prominent in bear markets. Longin and Solnik (2001), however, found that international equity market correlations are not related to

market volatilities, but are related to the market trend. They further showed that correlations increase in bear markets but not in bull markets.

Surprisingly, there are few studies examining (1) the impact of *actual real* time news on asymmetric volatility and (2) the relationship between correlations and volatilities. More importantly, it is still not clear why correlations are high when the corresponding volatilities are high. Engle and Ng (1993) described a news impact curve with asymmetric volatility response to good and bad "news" with lagged returns instrumenting economic news. Andersen et al. (2003) used actual macroeconomic economic announcements to examine the asymmetric response of volatilities to news announcements in the foreign exchange market, but do not examine the effect of news on asymmetric volatility and lagged returns per se. In what follows, the effect of macroeconomic news on asymmetric volatility is examined and the relationship between correlations and volatilities of the two futures contracts is investigated. First, asymmetric volatility is dealt with.

News Magnifies Asymmetric Volatility

To examine the possible asymmetric effects on the five-minute standard deviations of two futures returns, the following equation, during 8:30–8:35 and 10:00–10:05, two five-minute intervals, by least squares is estimated:

$$sd_{tj} = \alpha_j + \beta_j r_{t-1,j} + \delta_j r_{t-1,j} I(r_{t-1,j} < 0) + u_{tj} \tag{2}$$

where $I(\cdot)$ is the indicator function, j stands for one of the two futures contracts, sd_{tj} is the five-minute standard deviation at time t, and $r_{t-1,j}$ is the lagged return. The specification is consistent with the literature on the effects of lagged returns and is similar to that in Duffee (1995), Engle and Ng (1993), and Nelson (1991), but differs from the literature in that the relationship is examined using high-frequency data. To the authors' knowledge, this is the first attempt at measuring asymmetric volatility with intraday data.[8] The coefficient on the interaction term, δ_j, captures any asymmetries. If asymmetries are indeed present, one would expect δ_j to be negative and larger, in absolute magnitude, than the return coefficient, β_j.

The focus is on the effects of news announcements on asymmetric volatility by examining the volatility-return relation for the 8:30–8:35 and 10:00–10:05 time periods. Each five-minute sample is split into two groups: the news group defined as the five-minute observations that have news announcements and the no-news group, the time intervals without news announcements. The regression results are presented in Table IV. First, there is strong evidence

[8]Andersen et al. (2001) and Thomakos and Wang (2003) examined daily asymmetric volatility constructed from high-frequency data but not on five-minute volatility per se.

TABLE IV
Asymmetric Volatility and News Announcements

	Eurodollar		*Treasury Bonds*	
	News	*No News*	*News*	*No News*
8:30 A.M.–8:35 A.M.				
δ_j	0.1177	0.0386	0.9551	0.3314
	(0.0115)***	(0.0030)***	(0.1075)***	(0.0281)***
β_j	0.8319	0.1781	1.0487	0.1345
	(0.2219)***	(0.0707)***	(0.2339)***	(0.0969)
δ_j	−1.7934	−0.3662	−1.8771	−0.1460
	(0.3469)***	(0.1003)***	(0.4337)***	(0.1258)
$\overline{R}^2$	0.0587	0.0291	0.0622	0.0119
N	650	608	512	488
10:00 A.M.–10:05 A.M.				
α_j	0.0669	0.0345	0.8155	0.3521
	(0.0097)***	(0.0049)***	(0.1241)***	(0.0355)***
β_j	0.2729	0.1601	-0.1151	0.1170
	(0.1670)*	(0.0825)*	(0.2121)	(0.0493)**
δ_j	−0.6145	−0.1546	0.1404	−0.3371
	(0.3062)**	(0.1318)	(0.3937)	(0.1312)**
$\overline{R}^2$	0.0335	0.0051	0.0014	0.0100
N	145	463	119	371

Note.
1. Least-squares coefficient estimates for the regression:

$$sd_{tj} = \alpha_j + \beta_j r_{t-1,j} + \delta_j r_{t-1,j} I(r_{t-1,j} < 0) + u_{tj}$$

where sd_{tj} is the five-minute standard deviation of the jth contract, $I(\cdot)$ is the indicator function, and $r_{t-1,j}$ is the lag of the return of the jth contract. Standard errors (corrected for heteoscedasticity) are in the parentheses.
2. News represents the five-minute sample when there are news announcements. No news represents the five-minute sample when there is no news announcements.
3. ***, ** and * indicate significance at the 1, 5, and 10% level, respectively. N is the number of observations.

on asymmetric volatility for both futures markets. Except for the 10:00–10:05 T-bond news sample, the δ_js are all negative. The results for the 8:30–8:35 time period are very attractive and support asymmetric volatility given that all the δ_js are all statistical significant and larger in absolute magnitude than the return coefficient β_j. For the Eurodollar and T-bond contracts, the relevant comparisons are (δ_j) −1.7934 vs. (β_j) 0.8319 and (δ_j)−1.8771 vs. (β_j)1.0487, respectively. Second, there is strong evidence that α_j, β_j, δ_j are all greater in absolute value when there are news announcements as compared with when there are no news announcements. As a result, asymmetry, measured as the difference between the absolute value of δ_j and β_j ($|\delta_j| - \beta_j$), is larger when there are news announcements. This is true for both the 8:30–8:35 time period and the 10:00–10:05 time period. For example, the $\delta_j s$, the asymmetry coefficients for the 8:30–8:35 time interval, are greater in absolute value in the news sample as compared with the no-news sample: −1.7934 vs. −0.3662 (for Eurodollar)

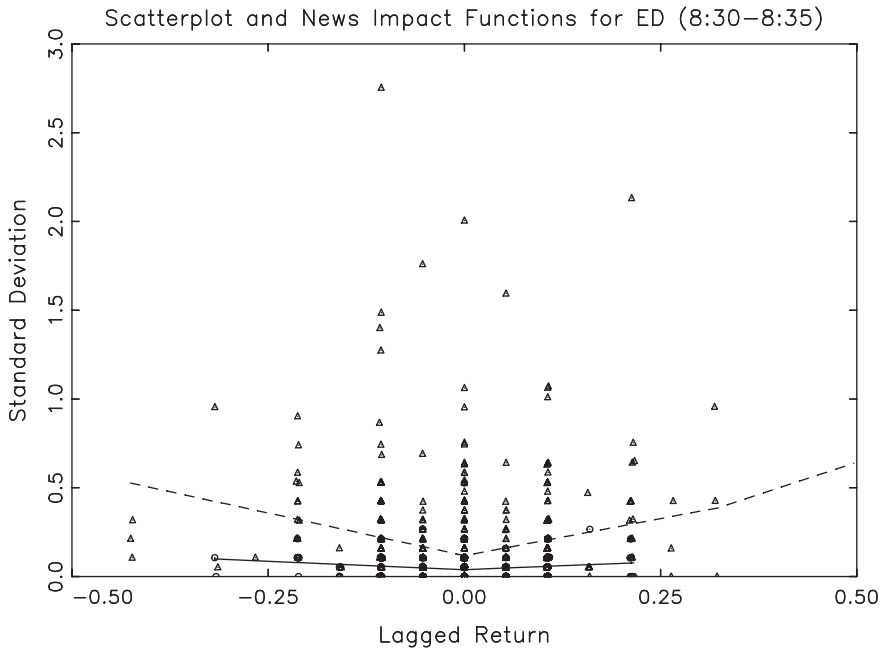

FIGURE 7
News impact functions from 8:30 A.M. to 8:35 A.M. (Eurodollar) The reported lagged returns and standard deviations are 10^3 times the calculated values. The dotted line and the solid line represent the fitted line from the regression on the news sample and on the no-news sample, respectively. Triangles represent the news sample and circles represent the no-news sample.

and −1.8771 vs. −0.1460 (for T-bond). Third, α_j, β_j, and δ_j are nearly all greater in absolute values for the 8:30–8:35 time interval than the 10:00–10:05 time interval whether there is news or not. Lastly, adjusted R^2s are higher in the news sample than the no-news sample.[9]

The news impact function for the two volatilities series is plotted in Figures 7 and 8. The figures show that the news impact lines are more steep when there are news announcements.

To summarize, the existence of macroeconomic announcements magnifies the response of volatilities to lagged returns. When there are announcements, volatilities and the lagged return relationship are stronger for both positive news and negative news, but even stronger for negative news. Therefore, macroeconomic announcements magnify both volatilities and asymmetric volatility. Furthermore, 8:30 announcements influence the intraday volatility pattern more than the 10:00 A.M. announcements, consistent with the results in the previous section.

[9]The realized five-minute standard deviations are used as dependent variables and the results are similar.

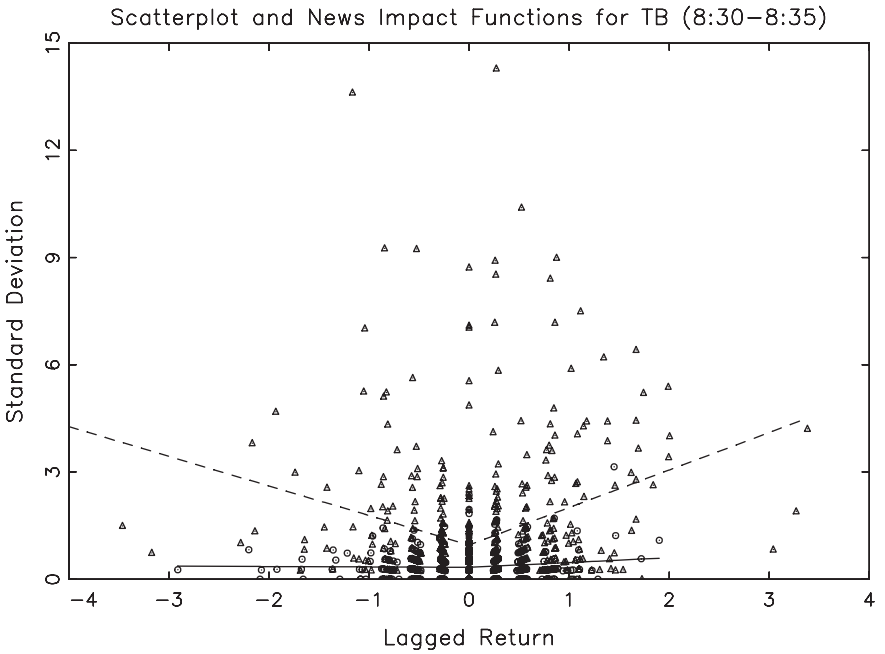

FIGURE 8
News impact functions from 8:30 A.M. to 8:35 A.M. (T-bonds). The reported lagged returns and standard deviations are 10^3 times the calculated values. The dotted line and the solid line represent the fitted line from the regression on the news sample and on the no-news sample, respectively. Triangles represent the news sample and circles represent the no-news sample.

News and Asymmetric Correlation

For the correlation–volatility relationship, the correlations between the Eurodollar and T-bonds futures returns are examined and the following equation is estimated:

$$corr_{t,ij} = \alpha_{ij} + \beta_{ij}(sd_{t-1,i} + sd_{t-1,j}) + \gamma_{ij}(sd_{t-1,i} + sd_{t-1,j})I(r_{t-1,i} \cdot r_{t-1,j} > 0)$$

$$+\delta_{ij}(sd_{t-1,i} + sd_{t-1,j})I(r_{t-1,i} < 0, r_{t-1,j} < 0) + u_{t,ij}. \quad (4)$$

This methodology is consistent with the literature on the asymmetric covariances or correlations for returns on stock portfolios (Ang & Chen, 2002; Kroner & Ng, 1998) as well as Dow Jones stock returns (Andersen et al., 2001). In terms of the equation above, β_{ij} captures the impact of the past volatilities on the correlations, γ_{ij} measures the additional influence when the past returns are of the same sign, and the overall impact of the past volatilities, if both of the returns are negative, is measured by $\beta_{ij} + \gamma_{ij} + \delta_{ij}$. The current setup, therefore, allows for a direct test of asymmetry based on the t-statistics for δ_{ij}.

To compare the news effects on asymmetric correlation, the equation for the following five-minute intervals: 8:30–8:35, 10:00–10:05, and 14:15–14:20 is examined. The five-minute sample is split into two groups: the news group and the no-news group. As shown in Table V via the α coefficient, the correlations between Eurodollar and T-bonds futures are higher when there are news announcements as compared with the no news case. This is true for all the five-minute intervals: the α_{ij}s are 0.4378 vs. 0.1550, 0.3750 vs. 0.0999, and 0.4393 vs. 0.1202 for the news versus no-news sample for the 8:30–8:35, 10:00–10:05, and 14:15–14:20 time intervals, respectively. However, α_{ij} is the only coefficient that is statistically significant consistently for all the samples. Both the β_{ij} and γ_{ij} coefficients are generally not significant statistically. As for the asymmetry coefficient, δ_{ij}, it is statistically significant at the 1% level for the 10:00–10:05 and 14:15–14:20 time intervals. They are −0.4759 and 0.3726, respectively, which give conflicting results on asymmetry. This result is consistent with that of Longin and Solnik (2001), who found that international equity market correlations are not related to market volatilities. The evidence shown here suggests that correlations are high because there is news, which also contributes to high volatilities at the same time.

TABLE V
Asymmetric Correlation and News Announcements

	Correlations Between Eurodollar and Treasury Bonds					
	8:30–8:35		*10:00–10:05*		*14:15–14:20*	
	News	*No News*	*News*	*No News*	*News*	*No News*
α_{ij}	0.4378 (0.0306)***	0.1550 (0.0324)***	0.3750 (0.0650)***	0.0999 (0.0332)***	0.4393 (0.1472)***	0.1202 (0.0312)***
β_{ij}	0.0547 (0.0621)	−0.0536 (0.0775)	0.0447 (0.1710)	0.0807 (0.0970)	−0.1568 (0.0658)**	−0.0963 (0.0852)
γ_{ij}	0.0821 (0.0583)	0.1335 (0.0868)	0.1534 (0.1656)	−0.0356 (0.1061)	0.0318 (0.0675)	0.1269 (0.1067)
δ_{ij}	−0.0459 (0.0543)	0.0014 (0.0842)	−0.4759 (0.1683)***	−0.0047 (0.1133)	0.3726 (0.0928)***	0.0368 (0.1223)
$\overline{R}^2_{ij}$	0.0202	0.0096	0.0581	0.0022	0.2681	0.0066
N	502	483	119	364	19	454

Note. 1. Least-squares coefficient estimates for the regression. Standard errors are in the parentheses:

$$corr_{t,ij} = \alpha_{ij} + \beta_{ij} w_{t-1,ij} + \gamma_{ij} w_{t-1,ij} I^1_{t-1,ij} + \delta_{ij} w_{t-1,ij} I^2_{t-1,ij} + u_{t,ij} \quad (3)$$

where $corr_{t,ij}$ is the five-minute realized correlation, $w_{t-1,ij} = sd_{t-1,i} + sd_{t-1,j}$, and where $I^1_{t-1,ij} = I(r_{t-1,i} \cdot r_{t-1,j} > 0)$ and $I^2_{t-1,ij} = I(r_{t-1,i} < 0, r_{t-1,j} < 0)$ are two indicator functions.

2. White heteroscedasticity consistent standard errors in parentheses.

3. News represent the five-minute sample when there are news announcements. No news represent the five-minute sample when there is no news announcements.

4. ***, ** and * indicate significance at the 1, 5, and 10% level, respectively. *N* is the number of observations

CONCLUSION

This article studies the effects of scheduled macroeconomic announcements on the intraday price volatilities, covariances, and correlations between the Eurodollar futures and the U.S. Treasury bond futures, two of the most traded interest rate futures. This study finds that news announcements are responsible for most of the observed intraday jumps in volatilities, covariances, and correlations. The results of the study also show how the covariances structure of asset returns reacts to macroeconomic announcements news. In particular, it is found that intraday correlations react positively to news announcements, but return to normal after a short period of time. It was also found that the announcements timing matters. News that is released at 8:30 tends to have greater impact than those released at 10:00. The results shed new light on the "comovement" phenomenon identified by Barberis, Schleifer, and Wurgler (2005). Barberis et al. (2005) proposed three explanations for comovements among financial assets, fundamental-based, category-based, and habitat-based. Although macroeconomic announcements tend to magnify the comovement between the two interest rate futures, this kind of comovement seems to be more consistent with the fundamental-based explanation as well as "category-based" explanation.

The results on intraday asymmetric volatility and correlation-in-volatility are particularly interesting. The results indicate that asymmetric volatility exists in high-frequency data, news announcements magnify asymmetric volatility, and correlation-in-volatility could be a spurious relationship due to the existence of news announcements. The results on asymmetric volatility are consistent with the volatility feedback hypothesis: as the timing of macroeconomic announcements is predetermined, it raises the uncertainty for the market at that particular time. If volatilities represent risk, the expected increase in volatilities at announcements time should dampen the returns five minutes before the announcements time. As a result, the expected news announcements magnify asymmetric volatility. With regard to future research, it would be interesting to incorporate the news-based high-frequency asymmetric volatility in the estimation of daily volatilities as proposed in Bollerslev, Kretschmer, Pigorsch, and Tauchen (2008).

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