CESifo, the International Platform of the Ifo Institute of Economic Research and the Center for Economic Studies of Ludwig-Maximilians University

CESifo Venice Summer Institute

19 - 24 July 2010

"Central Bank Communication, Decision-Making and Governance"

to be held on **23 - 24 July 2010**
on the island of San Servolo in the Bay of Venice, Italy

Deconstructing Alan: A Quantitative Assessment of the Qualitative Aspects of Chairman Greenspan's Communication

Michelle Bligh and Gregory D. Hess

VIU
Venice
International
University

Deconstructing Alan: A Quantitative Assessment of the Qualitative Aspects of Chairman Greenspan's Communications

Michelle Bligh
Claremont Graduate University

Gregory D. Hess*
Claremont McKenna College

Current Draft: March 2010

* Address correspondence to Gregory D. Hess, Robert Day School of Economics and Finance, Claremont McKenna College, Claremont, CA 91711. E-mail: ghess@cmc.edu, tel: (909) 607-3686, fax: (909) 621-8249. We thank seminar participants at the Bank of Japan, the Federal Reserve Banks of Kansas City, San Francisco and St. Louis, the Cass Business School at the City University of London, Oxford University, the Society for Computational Economics Conference in Limassol, Cyprus, and the Central Bank Communication, Decision-Making and Governance Conference at Wilfrid Laurier University for their helpful comments. Justin Eskind and Paul VanDeventer provided superb research assistance, and we also thank Ken Kuttner and the Federal Reserve Bank of San Francisco for data assistance. We would also like to thank Michael Ehrmann, Alberto Montagnoli, Pierre Siklos for their detailed comments. We gratefully acknowledge the Kravis Leadership Institute, the Financial Economics Institute and the Fletcher Jones foundation for partially funding our research.

Deconstructing Alan: A Quantitative Assessment of the

Qualitative Aspects of Chairman Greenspan's Communications

Abstract

A manifestation of the Federal Reserve Board's increased transparency was FOMC Chairman Greenspan's method of communication. The purpose of this paper is to improve our understanding of the qualitative affects of the language embodied in his speeches, testimonies and FOMC statements on financial market variables. This analysis is undertaken using daily data since the middle of 1999, that is the period after which the FOMC provided statements after every FOMC meeting, through the end of January 2006, when Chairman Greenspan stepped down. Using content analysis, we calculate for each communication a measure of its certainty, pessimism, and macroeconomic language. We then include these variables in standard regression to see if these language variables forecasted financial market outcomes. We find that Chairman Greenspan's language did forecast movements in the returns to financial market variables. In addition, these language measures were also helpful at predicting options based measures of financial market volatility. Interestingly, during Chairman Greenspan's tenure, language associated with certainty in FOMC statements and speeches was useful for predicting movements in the federal funds futures markets, while macroeconomic language stands out as having been particularly helpful in forecasting financial market volatility.

JEL Codes: E52, E58, E44

Keywords: Monetary Policy, Communication, Transparency.

1 Introduction

There can be no doubt that for *a considerable period* of time the Federal Open Market Committee (FOMC) has articulated its message at *a measured pace*. This has not always been the case. Indeed, for much of its history the FOMC has been largely uncommunicative, preferring to surround itself with mystery and secrecy as it has implemented monetary policy.

With an eye towards enhanced transparency, Alan Greenspan's tenure as the Chairman of the Federal Reserve Board is associated with a fundamental change in the practice of both the conduct and communication of U.S. monetary policy. Historically, transparency had not been high on any monetary authority's list of priorities. For example, as argued by Rockoff (1990), the imagery of the Wizard of Oz is focused on the debates over a bimetallic currency standard at the end of the 19th century. And the view taken by the book is that those who conduct monetary policy are grandiose wizards, who hide behind smoke and mirrors, and who are ultimately filled with hot air.

In addition, in a widely read book, William Greider (1987) describes the Fed's level of transparency in equally unpleasant terms:

> "The central bank, notwithstanding its claims to rational method, enfolded itself in the same protective trappings that adorned the temple—secrecy, mystique, and an awesome authority that was neither visible nor legible to mere mortals. Like the temple, the Fed did not answer to the people, it spoke for them. Its decrees were cast in a mysterious language people could not understand, but its voice, they knew, was powerful and important. Greider (1987).

The FOMC, however, has made some recent demonstrated progress in articulating its decisions. For example, it actually started announcing decisions in 1994, as prior to 1994 the FOMC did not announce decisions: rather, it allowed market participants to infer its actions from the conduct of open market operations. Systematically, however, the FOMC has begun to improve the

dissemination of its decisions. As of the middle of 1999, for instance, it now provides an approximately 150 word statement after the conclusion of each and every meeting, regularly scheduled or not. Moreover, FOMC members routinely make speeches that are placed on the Federal Reserve Board's web-site as their prepared testimonies to Congress and the Senate. FOMC minutes are provided in a timely manner and Federal Reserve forecasts for key macroeconomic variables are now made available to the public.

Now there are two important questions about Federal Reserve communications. The first is what are the goals of the Federal Reserve's communication? The second is what are the best ways to accomplish these goals? For the time being I will defer discussion of the second question to the end of this paper and concentrate for now on the first one.

Federal Reserve Bank of St. Louis William Poole (2005) points to several issues as necessary preconditions for the FOMC to implement and design an appropriate communication strategy in an environment where it does not have private information about the economy.[1] The first issue is that the central bank must be clear about its objectives. The second is that the market and the central bank have a correct understanding of how the economy works. The third is that unexpected economic outcomes are to be understood as news, that is, information that cannot currently be forecasted.

Consequently, monetary policy communication should lead to an understanding of the strategy for future monetary policy actions. As such, policy should be as informative about future policy as possible and as predictable as possible within the confines of Poole's (2005) three necessary conditions: that the FOMC stick to its objectives, that the FOMC and the market understand the

[1]See Amato, Morris and Shin (2002) for an analysis of central bank communication when the central bank has private information. They point to the problems of providing public information in these types of environments as it may diminish the range of expectations in the market and force the coordination of market expectations on the incorrect outcome.

workings of the economy and the understanding that the actual path of future monetary policy may be affected by events that cannot currently be forecasted.

In the evidence below, we undertake a positive analysis that investigates whether Federal Reserve Board Chairman Greenspan's communications generally accomplished this goal of providing relevant information as well as making policy more predictable. In section 2 we discuss the recent empirical literature on central bank communication. In section 3 we introduce the empirical data we use in our study and discuss our empirical methodology. We present summary statistics and the empirical results in section 4 and conclude in section 5.

2 Literature Review

There have been a number of papers which analyzed Federal Reserve communications from an empirical standpoint.[2] Kohn and Sack (2003) estimate a standard baseline model, as shown below in equation (1), whereby unexpected movements in monetary policy (i.e. the one month Federal Funds Futures rate) and unexpected movements in macroeconomic variables lead to movements in financial variables. Accordingly, they posit that if Federal Reserve communications provide information to the market, then the residual market volatility should be higher on days when there is a communication by the Fed. Indeed, they find a strong component for this in statements and testimony. They also provide results from a variance decomposition where they conclude that this information is conveying information on near-term policy moves but also information on the economic outlook. In complementary work, Grkaynak, Sack and Swanson (2005) provide evidence that FOMC statements also have a strong impact on longer-term Treasury yields.

While Federal Reserve communications, if informative, should move markets, a test of the usefulness of this information is if it can help predict future movements of these financial variables.

[2]Note that Jansen and De Haan (2006) investigate the role that contradictory nature of statements by national central bank presidents and the European Central Bank. Also see the recent survey by Blinder, *et. al.* (2008).

As such, our paper and important work by Ehrmann and Fratzscher (2007a,b) provide investigations into the language of Federal Reserve communications as they help to predict movements in financial markets variables. For instance, Ehrmann and Fratzscher (2007b) compare how markets forecasted future financial markets during periods where the Fed was less transparent as compared to its more recent period of greater transparency. In addition, Ehrmann and Fratzcher (2007a) compares the more individualistic style of communication in the Federal Reserve System as compared to the more collegial communication strategy of the Bank of England.[3]

Critically, however, the work by Ehrmann and Fratzscher summarize the language of the communications by examining press releases by Reuters just minutes after each communication and then "based on our own judgment and reading of the newswire reports" they classify the communications into measures of stronger, unchanged or weaker economic outlooks as well as tighter, no change or easing policy inclinations. While they acknowledge that they cannot "rule out a wrong classification in individual cases" the inherent biases by central bank economists retrospectively determining the intent of a central bank just 5 year hence is obviously problematic for researchers who prefer a more ahistoric analysis of real-time communication.

By contrast, the analysis in this paper provides such an ahistoric real-time analysis of Federal Reserve communication. Rather than use our own judgement to interpret the Federal Reserve's intent from its communications as do Ehrmann and Fratzscher (2007a,b), we allow content analysis to ascertain for each communication the following three characteristics of each communication: certainty, pessimism, and macroeconomic language.[4] Below, we explain both our empirical strategy

[3]Interestingly, they also note and contrast the collegial decision making process of the FOMC to the individualistic decision-making style of the Bank of England.

[4]Boukus and Rosenberg (2006) also take a more automated approach to extracting information from the FOMC minutes for the time period 1987-2005. Their approach uncovers latent characteristic themes across the minutes based on the observed sample, much like in atheoretical principle components analysis. By contrast, our approach scores communications based on *ex ante* constructed components explicitly developed for public policy discourse and based on linguistic theory.

and content analysis, and demonstrate that these qualitative aspects of Chairman Greenspan's communications are statistically and economically important predictive factors of financial market variables.

3 Data and Methods

In the following two subsections, we describe the data and methodology used in our analysis of the quantitative impact of the qualitative factors of official communications by Chairman Greenspan. In sub-section 3.1 we describe the economic data and a baseline specification for predicting movements in standard financial market data. In sub-section 3.2 we describe our use of content analysis to help quantify the effect of Chairman Greenspan's language on financial markets. We also present some summary statistics of the data in this sub-section.

3.1 Economic Data

Recent research has examined the role that FOMC communications (speeches, statements and testimonies by Chairman Greenspan) have played in moving markets. Kohn and Sack (2003) investigate the role that communications have on raising or lowering the volatility of markets, the former being evidence according to the authors that there is 'news' in the communications that is driving the market. Their evidence involves results from the following regression:

$$\Delta r_t = \alpha_0 + \alpha_1 \Delta FF_t^u + \sum_{i=1}^{12} \beta_i NEWS_{it} + \nu_t \tag{1}$$

where Δr_t is the change in one of the financial market return variables under consideration, ΔFF_t^u is the unexpected change in the Federal Funds rate as measured by Kuttner (2001), and $NEWS_{it}$ refers to macroeconomic news. This standard baseline specification indicates that financial variables change in response to unexpected and actual moves in monetary policy as proxied by the Federal Funds rate, as well as news about the macroeconomy. Implicitly, the level of financial variables

should price in the expected path of monetary policy and macroeconomic activity so that changes in financial variables represent unexpected changes or news to these same variables. The residual term, ν_t, allows for omitted factors that move financial market variables.

For the dependent variables, we use the daily changes in various financial variables, as done in Kohn and Sack (2003). We use many of the same variables, including the changes in the Federal Funds futures rate three and six months ahead, $FF(3M)$ and $FF(6M)$, Treasury forward rates zero to one year ahead, $TF(0|1)$, one to two years ahead, $TF(1|2)$, and four to five years ahead, $TF(4|5)$, as well as growth of the S&P 500 and the dollar (US$). All the interest rate data are reported in basis points (that is 100 times the percentage) while the data for the U.S. Dollar and the S&P500 are reported in percentages (i..e, 100 times the change in the natural logs levels of the data). The data in the analysis are similar to those in Kohn and Sack. [5] Descriptive statistics for these variables, and others, are provided in Table 1 and are discussed below.

As we discussed above, the analysis uses a proxy variable for the unexpected component of monetary policy developed in Kuttner (2001) and used in Kohn and Sack (2003). The Federal Funds futures rates are a market based predictor of future policy, though they must be adjusted in order to adequately measure the expected and unexpected component of monetary policy. Two problems must be resolved. First, the settlement price of the contract is the average of the month's overnight Fed funds futures rates, not the rate on the last day of the month. Second, futures contracts are based on the market rate rather than the target Federal Funds rate. The difference of the two can be significant on a day-to-day basis. To correct for these problems, Kuttner (2001) derives the unexpected change in the Federal Funds target rate for date t as:

$$\Delta FF_t^u = \left[\frac{m}{m-t}\right]\left(F_{s,t}^0 - F_{s,t-1}^0\right)$$

[5] Indeed, the Treasury forward rate data were obtained from the Federal Reserve Board's Treasury Forward rate curves.

where the left hand side is the unexpected change in monetary policy (change in the Federal Funds target rate), m is the total number of days in the month, t is the day of the month, F is the spot futures rate on a given day t in month s. If the target rate change is in the last three days of the month, the daily change in the one-month spot futures rate is used to correct the targeting error of day-t and the change in the expectation of future targeting errors. A complete description of this variable is available in Kuttner (2001).

The macroeconomic news variables were from the Money Market Services report. These 12 data series are constructed from the median of the survey of forecasts in the Friday before the data are reported for the first time. The surprise is constructed by subtracting the actual reported number from the most recent survey.[6] The 12 surprise variables are for the advanced estimate of GDP, capacity utilization, consumer confidence, core consumer index, durable goods orders, Institute of Supply Management Index, non-farm payrolls, new home sales, core producer price index, retail sales, unemployment rate, and initial claims for unemployment. To avoid cluttering the paper, individual results on these macroeconomic surprises will not be presented, though we collectively report results for **NEWS** as a p-value for the F-test that all the coefficients on the macroeconomic news variables are jointly equal to zero.

3.2 Content Analysis

To further explore the role of the qualitative factors of Greenspan's language and their quantitative impact on financial markets, we augment equation (1) with language variables constructed from linguistic content analysis:

$$\Delta r_t = \alpha_0 + \alpha_1 \Delta FF_t^u + \alpha_2 \Delta r_{t-1} + \sum_{i=1}^{12} \beta_i NEWS_{it} \tag{2}$$

[6]The data were obtained from Haver Analytics.

$$+\sum_{j=1}^{3}\gamma_j COM_{jt}+\sum_{j=1}^{3}\sum_{k=1}^{3}\phi_{jk}\left[COM_{jt}\times LANG_{kt}\right]+\nu_t$$

There are two four sets of terms that we include on the right side of expression (2). The first two are unrelated to communication, but provide a richer empirical structure. The first is to include a measure of the unexpected change of monetary policy as measured by the unexpected change in the Federal Funds rate, ΔFF_t^u. The second is an auto-regressive term for the market return variable, namely Δr_{t-1}. The third is a set of three dummy variables for the presence of a communication on day t, COM_t. Such communications are FOMC statements (STATE), and speeches (SPEECH) and testimonies (TEST) by Chairman Greenspan.

The second additional set of regressors in equation (2) allows for the quantification of the qualitative factors of these communications using content analysis. As a methodology, content analysis allows the investigator insight into the often symbolical laden connotations employed by leaders themselves in context, making it a valuable tool for researchers specifically interested in leadership as the management of meaning – e.g., see Smircich and Morgan (1982). Given the focus on Chairman Greenspan's language, this suggests that Greenspan's specific choice of words can be particularly telling about his motives, intentions, and underlying assumptions, and may have significant effects on financial markets – see Bligh and Hess (2007). As well, due to the highly visible and politicized nature of Greenspan's position, computerized content analysis has the additional advantage of providing a completely impartial analysis of his leadership based solely on his public policy communications.

For each form of communication, the entire text was read into the DICTION Program which is a content analysis program that keeps track of a number of key features of language that conform to key lists of words constructed by linguists. There are 251 communications in our sample made up of 58 FOMC statements, 58 Testimony's before Congress or the Senate and 135 Speeches

during the time period May 18, 1999 to January 31, 2006. This period was chosen because May 18, 1999 is the date at which all FOMC meetings were followed with a statement. We then perform content analysis on all these communications and score the messages based on the following criteria: **CERTAINTY**, **PESSIMISM**, and **MACRO** (these dictionaries are detailed below). Each of these 3 characteristics of speech, for each of the 3 types of communications, is treated separately in the regression, so that there are 9 additional explanatory variables that quantify the content of Chairman Greenspan's communications.

We chose DICTION 5.0 (Hart, 2000) for our analysis, a computerized content analysis program specifically designed for public policy discourse. DICTION has been used to study semantics in a variety of social discourse arenas such as politics and communication, and more recently has been used in business applications such as evaluating annual reports and press releases about earnings forecasts – see Bligh, Kohles and Meindl (2004), Davis, Piger and Sedor (2007), and the references therein. Because we wanted the measure of the Chairman's speech to be generic and impartial, DICTION was a natural choice due to its explicit development for political discourse and careful attention to linguistic theory.[7] To our knowledge, DICTION is the only existing content analysis program that has been specifically designed for public policy dialogue, and that is expressly concerned with the types of words frequently encountered in American public discourse. Thus, it seemed particularly appropriate for the analysis of policy communications made by Chairman Greenspan.

There are obvious advantages and disadvantages to using computerized content analysis. Let's start with some drawbacks. First, the sterility of analysis that may preclude creative insights or innovative breakthroughs (e.g., the recent use by the FOMC of the expression 'a considerable period'); Second, it is based on the assumption that higher frequency usages of a word or phrase

[7]See Hart (1984,1987,2001) for a more thorough discussion of the development of DICTION.

mean that concept is more meaningful or important than infrequently utilized words or phrases; and finally, it does not account for the fact that words are divorced from their original contexts – again, see Bligh, Kohles, and Meindl (2004).

With respect to the advantages, first and foremost, content analysis is highly systematic and reliable. This aspect of the analysis should not be undervalued: language for monetary policy purposes does not live in a context separately from all other types of language. Explicitly, the term 'a considerable period' actually means what it says. As such, it should conform to the same standards and analysis as other types of communication. In addition, due to its microscopic nature, DICTION is ideal for uncovering aspects of language that may be missed by the human eye. Third, all of the dictionaries contain individual words only, and homographs are explicitly treated by the program through statistical weighting procedures to partially correct for context – see Hart (2000).

By default, DICTION uses numerous dictionaries, containing over 10,000 search words, to analyze a given communication. In order to keep our analysis as simple as possible, we construct three composite variables from 7 of these dictionaries that are likely to be of interest with respect to monetary policy making: these composite variables are **CERTAINTY** and **PESSIMISM**. While Supplemental Appendix A provides a formal definition of these variables and Supplemental Appendix B provides a few examples, a brief description here of the variables is clearly warranted. **CERTAINTY** refers to words that indicate resoluteness, inflexibility, and completeness. **PESSIMISM** is language that endorses or highlights blame or hardship.

We also made two important adjustments to the data. First, a problem with examining individual words is that they can be preceded by a negation that completely reverses the meaning of the individual word. For instance, the common term by Chairman Greenspan of 'There can be no doubt' is clearly impacted by the presence of a negation. As such, we do remove any words from

CERTAINTY and **PESSIMISM** that are preceded by the word 'no' or 'not'.[8] Second, we created an additional composite variable to more closely follow the extent to which macroeconomic terms are present in the Chairman's communications. We constructed this list of words by accumulating the dictionary of terms provided at the end of the popular intermediate macroeconomic textbooks Abel and Bernanke (2005), Delong (2002) and Mankiw (2003). We label this variable **MACRO**.

While specification (2) provides an empirical relationship that allows us to see whether the qualitative components of Chairman Greenspan's communications help to predict market returns, it is also important to see if monetary policy language also systematically predicts changes in credit quality spreads and market volatility. To be more precise, in expression (3) we estimate the relationship between changes in credit quality spreads, Δcq_t, and monetary policy language as follows.

$$\Delta cq_t = \alpha_0 + \alpha_1 \Delta FF_t^u + \alpha_2 \Delta r_{t-1} + \sum_{i=1}^{12} \beta_i NEWS_{it} \tag{3}$$
$$+ \sum_{j=1}^{3} \gamma_j COM_{jt} + \sum_{j=1}^{3} \sum_{k=1}^{3} \phi_{jk} \left[COM_{jt} \times LANG_{kt} \right] + \nu_t$$

Specification (3) is identical to expression (2), with the exception that the dependent variable is now the change in a standard credit quality spread. We measure credit quality using the following four interest rate spreads: first, the TED(1M) spread, which is the difference between the one month LIBOR rate less the one month Treasury bill rate; second, the spread between the one month commercial paper rate for financial firms and the one month Treasury Bill rate, CPTB-F(1M); third, the spread between the one month commercial paper rate for non-financial firms and the one month Treasury Bill rate, CPTB-NF(1M); lastly, we measure credit quality as the spread between the corporate bond rate for debt rated BAA less that for AAA rated debt, BOND(10Y).

[8] Our method can be explained as follows: if a **PESSIMISM** or **CERTAINTY** word is preceded by a 'not' or a 'no', we reduce the overall count of this category by one as it connotes the opposite the opposite meaning to the word and it does not have a neutral meaning.

Finally, our specification relating financial market volatility, ΔV_t, and monetary policy language adopts the following specifications:

$$\Delta V_t = \alpha_0 + \alpha_1 \left(\Delta FF_t^u\right)^2 + \alpha_2 \Delta V_{t-1} + \sum_{i=1}^{12} \beta_i NEWS_{it} + \sum_{i=1}^{12} \delta_i NEWS_{it}^2 \tag{4}$$
$$+ \sum_{j=1}^{3} \gamma_j COM_{jt} + \sum_{j=1}^{3} \sum_{k=1}^{3} \phi_{jk} \left[COM_{jt} \times LANG_{kt}\right] + \nu_t$$

Specification (4) is similar to that in expressions (2) and (3), except that financial market volatility is affected by the volatility of unexpected Federal Funds rate changes, and the level and volatility of macroeconomic news.[9] We measure financial market volatility using options based market measures of volatility for equities and government securities: VIX(1M) and MOVE(1M,3M and 6M). VIX(1M) is the Chicago Board of Option's volatility index conveyed by S&P 500 stock index option prices over a 1 month period, while MOVE(1M) (Merrill Lynch's Option Volatility Estimate) is an index that tracks how much traders expect Treasuries maturing in two to 30 years to fluctuate in a month. Correspondingly, we also define MOVE(3M) and MOVE(6M) for implied volatility at the 3 and 6 month horizons.

4 Empirical Results

This section is separated into two sub-sections. The first examines the stylized facts of our data. The second provides estimates of the effect on monetary policy language on financial market returns and financial market volatility, as described in empirical equations (2) and (4).

[9] Our findings are not affected by the inclusion of both these linear and squared NEWS variables. In addition to the variables included in (2), specification (4) also includes dummy variables for whether the FOMC meeting was scheduled or not, and Monday, Friday and first day of the month affects. Again, the inclusion of these additional variables does not affect the results.

4.1 Empirical Regularities

The top part of Table 1 provides summary statistics for the dependent and language variables that we will be investigating. Again the interest rate variables are reported as business daily basis point changes. There are a few items worth noting in this table. First, interest rate variables were flat or declined during this period – recall that the FOMC's first experiment with an extended policy of near zero interest rates took place during this time period. Second, generally speaking, longer term interest rates demonstrate more volatility than shorter term interest rates. Third, credit quality spreads also declined during this time period, in part owing to the Federal Reserve's expansionary policy and the economy's strong economic performance throughout all but the first part of the sample. Finally, the dollar and the stock market have been relatively flat during this period, with the stock market showing substantial volatility.[10]

The bottom part of Table 1 provides some summary statistics for the content analysis data of Chairman Greenspan's communications. Note that the data are presented so that it indicates the number of words per 100 in a particular communication.[11] If a communication does not take place for that day, then its language components are all equal to zero. Each row indicates a particular component of language, e.g. **CERTAINTY** for a particular form of communication (SPEECH). There are two important factors worth noting in Table 1. First, statements have, on average, more **MACRO** language. This may in fact be due to the fact that since statements are so short, **MACRO** language can be a useful way to parsimoniously convey information. Second, there is more heterogeneity about **CERTAINTY** in testimonies. Of course, because testimonies are less constrained by time and provide more background materials, this may allow for the greater variety

[10]Note that the time period covered in this analysis includes the aftermath of the terrorist attack on the United States on September 11th, 2001. Removing from the data sample the time period after this incident until the end of the 2001 does not affect the results presented below.

[11]For example, if there are 10 **MACRO** words out of a 500 word communication, **MACRO** would be coded as 2.0 ($100 \times (10/500)$) for that particular day for that particular form of communication.

of information that they communicate about the level of certainty in the environment.

Table 2 also demonstrates a number of key features of how the volatility of the underlying financial data series change when there is either macroeconomic news on a given day, or some form of communication by the Chairman. Each row represents a financial data series while each column presents the standard deviation of the data over alternative sub-samples of the data. ALL, NO COM NO NEWS, NEWS and COMM refer to whether the statistic is calculated over the full sample, for just days when there is neither communication nor news, only for days when one of the 12 news variables were reported, or only for days when there was a Speech or Testimony by Greenspan, or an FOMC statement, respectively. STATE, SPEECH and TEST refer to days when there was either a Speech, Testimony by Greenspan, or an FOMC statement, respectively. Test results are also presented to answer whether one can reject the null hypothesis that the standard deviation of the data sub-sample differs from that when there is neither news nor communication (i.e. NO COM NO NEWS). Note that for the financial market returns, we measure volatility by the standard deviation of the series. By contrast, for market volatility measures such as VIX and MOVE, we measure volatility by the change in the level of the variable.

There are four interesting results demonstrated in Table 2. First, on days where macroeconomic news is released, financial markets are generally more volatile for the shorter term interest rate data. In short, macroeconomic news moves financial markets – days of macroeconomic news typically have significantly higher interest rate volatility in the Federal Funds and Treasury forward markets as well as the credit quality spreads as compared to days when there is neither news nor communication. Second, there is one strong exception to the first observations: namely, direct measures of financial market volatility derived from options markets – VIX and MOVE(1M, 3M and 6M) – actually are unchanged or decline on days of economic news or communication. Third,

days where there was a communication by Federal Reserve Chairman Greenspan show an almost identical pattern of volatility changes as compared to that given on days of NEWS, with the exception of the credit quality spread variables (i.e. the columns labeled 'NEWS' and 'COM' have similar patterns of statistical significance). As such, one can infer that NEWS and communication each embody similar attributes as evidenced by their affect in a wide variety of financial markets. Fourth, the different modes of communication – that is statements, speeches and testimonies– each have wide ranging affects on financial markets.

4.2 Regression Analysis

While we discussed the stylized facts in Tables 1 and 2, in this section we discuss results from our estimates of expression (2). These key results are presented in Table 3 where we report the estimated parameters of the key language variables for each of the seven dependent variables that measure financial market returns. Please note that at the bottom of each table there is a list of variables where we report the associated p-value from the F-test that the coefficients on the collection of variables is statistically significantly different from zero. We report evidence on the collective impact of NEWS, all LANGUAGE as well as the separate testimonies, speeches and statements.

There are a number of key findings in Table 3.[12] First, controlling for unexpected movements in the Federal Funds rate is important, as they are predictors of changes in Federal Funds futures rates at the three month and six months. Moreover, NEWS is statistically significant across all the financial markets considered in Table 3. Second, the qualitative aspects of language are statistically significant at or below the .1 level for 3 and 6 month changes in the Federal Funds futures market, and the growth of the value of the dollar. Third, the language in statements appear to have a

[12]The estimated standard errors have been bootstrapped using 1000 replications. The results are similar using clustering methods and other robust estimation methods.

broad amount of predictive ability for financial market variables. In particular, statements with more **CERTAINTY** language are consistent with increases in Federal Funds futures rates, while statements with more **MACRO** language are associated with a rise in the value of the US dollar. Fourth, speeches with more **PESSIMISM** are associated with declines in the S&P500 and the 3 month Federal Funds futures market. Fifth, Testimonies have no statistically significant impact on same day movements in financial variables except on the US dollar. Overall then, **CERTAINTY** language seems to have the greatest statistical impact on raising shorter term interest rates futures, while **PESSIMISM** language tends to lower the value of the dollar, the stock market and near term Federal Funds futures.

The findings in Table 3 that point to the role of enhanced levels of CERTAINTY in FOMC statements and speeches during Alan Greenspan's tenure are consistent with our earlier findings in Bligh and Hess (2007).[13] Indeed, in our prior work, we find strong evidence that in periods of economic strength (weakness) that the language from the Federal Reserve has higher (lower) levels of certainty. Based on these combined findings, it appears that in times of strength (weakness) in U.S. economic activity, the FOMC under Greenspan spoke with a voice that connoted more (less) certainty, which the markets took to be a sign that future FOMC moves would lead to future tightening (loosening) of monetary policy.

Table 4 provides estimates for the change in credit quality spreads, cq_t, as modeled in equation (3). The results from this specification suggest that the change in credit quality spreads is much less responsive to news and Chairman Greenspan's communication as compared to the results for change in interest rate provided in Table 3. Indeed, all the results for p-values listed at

[13]To gauge the size of this effect, let's consider the effect from moving to the highest to the lowest level of **CERTAINTY** in an FOMC Statement on movements in the short term Federal Funds futures markets. Note that Table 1 indicates that the movement from the lowest to the highest level of **CERTAINTY** in a Statement is approximately 8, while the effect this variable on the short term Federal Funds futures is about 1. Hence, the effect of enhanced **CERTAINTY** could move this market by at most 8 basis points, which is about one-third the value of a 25 basis point move.

the bottom of Table 4 indicate that neither individually or collectively does macroeconomic news or Greenspan's communications predictably move these credit quality spreads. For sake of comparison, the R^2 in Table 4 is approximately .035, as compared to over .25 for several specifications in Table 3. One interesting finding, however, is that an increase in the CERTAINTY language in the STATEMENT tends to lower the credit quality spread, as measured by the TED spread and both commercial paper spreads. Overall, this indicates that a rise in certainty in the language of the FOMC statements could provide some reassurance to the private sector.

To provide a final component to our analysis, the results in Table 5 provide a broader understanding as to how Chairman Greenspan's communication and language predict the volatility in the movements in financial variables.[14] Recall from the regression specification (4) that ΔV_t is a measure of volatility measured using volatility indices from market based options.

The results in Table 5 provide a number of interesting findings. First, measures of the squared unexpected Federal Funds rate changes and **NEWS** measures are not significantly associated with the measures of financial market volatility.[15] Second, as demonstrated by the p-values reported at the bottom part of the table, the language variables are significant predictors of volatility in the Treasury Forward rates for less than one year – i.e., MOVE(1M), MOVE(3M) and MOVE(6M). Third, **MACRO** language is consistently a significant variable in explaining changes in the MOVE volatility indices. Typically, for the MOVE indices, **MACRO** language in speeches and statements are significant. Hence, broadly speaking, the Chairman's testimonies appear to be unusually influential in forecasting movement in the financial market volatility, and this is primarily

[14]Note that volatility is useful for another reason – for example, let's say that Greenspan's comments were either pessimistic about inflation or output. Depending on what he was pessimistic about, this would push interest rate expectations and futures and forward rates in different directions. These would be difficult to capture in a simple regression. However, articulated pessimism by Greenspan, regardless of what he was pessimistic about, would increase movement in financial variables which would increase observed volatility. Hence, volatility may be better at capturing the effects of monetary policy language on financial market variables.

[15]Note that if remove the linear terms for **NEWS** in the regressions, the remaining variables for **NEWS** do become significant.

due to the significance of **MACRO** language.

5 Conclusion

The positive evidence suggests that the language in monetary policy communications by Chairman Greenspan were informative and aided in the improved predictability of financial market variables. These effects have been demonstrated to be statistically significant. In all, we find that macroeconomic news and macroeconomic language in the Chairman's speeches and statements moved financial markets. An important question remains, however, as to whether the Federal Reserve System has fully exploited the net gains from communication.

Generally speaking, an argument can be put forth that the Federal Reserve System under Chairman Greenspan may have improved upon yet still under-utilized its ability to beneficially communicate to the markets and broader public. For example, as indicated by the evidence, FOMC statements and speeches by Chairman Greenspan appear to have had an important impact on the direction of short term expectations about policy as well as on options based measures of financial volatility. Macroeconomic language, in particular, also appeared to be important for lowering the volatility in financial markets which suggests that the markets turn to the Federal Reserve for macroeconomic explanations and analysis. In all, the Federal Reserve's attempts post-Greenspan to improve the range and contents of its language and communications affirms that it felt that communication in earlier periods, such as the one examined in this study, were both useful and could be improved upon.

Finally, though complex and at times difficult to put in context, one should not trivialize the FOMC's or the Chairman's language of communication (tempting though it may be). As discussed in Bligh and Hess (2006), monetary policy communication requires an outsized level of subtlety. The economic terrain is best described by tradeoffs and uncertainty, which necessitates that a successful

communication policy be nuanced. But nuanced information need not be limited information. One legacy of Alan Greenspan's chairmanship has been to firmly remind us that communication matters. The follow up for the Federal Reserve to consider is how to make communication matter even more.

6 References

Abel, Andew B. and Benjamin S. Bernanke (2005). Macroeconomics (5th edition), Addison Wesley, Boston, MA.

Amato, Joseph, Stephen Morris and H.S. Shin (2002). "Communication and Monetary Policy." *Oxford Review of Economic Policy* 18(4), 495-503.

Bligh, Michelle C. and Gregory D. Hess (2007). "Leading Cautiously: Alan Greenspan, Rhetorical Leadership, and Monetary Policy" *Leadership Quarterly*, 18(2), 87-104.

Bligh, Michelle C., Jeffrey C. Kohles and James R. Meindl (2004). "Charisma Under Crisis: Presidential Leadership, Rhetoric, and Media Responses Before and After the September 11th Terrorist Attacks," *Leadership Quarterly* 15(2), 211-239.

Blinder, Alan S., Michael Ehrmann, Marcel Fratzscher, Jakob De Hann, and David-Jan Jansen (2008). "Central Bank Communication and Monetary Policy: A Survey of Theory and Evidence," *Journal of Economic Literature* 46(4), 910-945.

Boukus, Ellyn, and Joshua V. Rosenberg (2006). "The Information Content of FOMC Minutes," *Federal Reserve Bank of New York*, mimeo.

Davis, Angela K., Jeremy Piger, and Lisa M. Sedor (2007). "Beyond the Numbers: Managers' Use of Optimistic and Pessimistic Tone in Earnings Press Releases," *University of Oregon*, mimeo.

Delong, J.B. (2002). Macroeconomics (updated edition), McGraw-Hill, New York, NY.

Ehrmann, Michael and Marcel Fratzscher (2007a). "Communication and Decision-Making by Central Bank Committees: Different Strategies, Same Effectiveness?" *Journal of Money, Credit and Banking*, 39(2-3), 509-541..

Ehrmann, Michael and Marcel Fratzscher (2007b). "Transparency, Disclosure and the Federal Reserve," *International Journal of Central Banking*, 3(1) 179-225.

Greider, William (1987). Secrets of the Temple: How the Federal Reserve Runs the Country, Simon and Schuster, New York, NY.

Grkaynak, Refet S., Brian Sack and Eric T. Swanson (2005). "Do Transparency, Disclosure and the Federal Reserve?" *International Journal of Central Banking*, 1(1) 55-93.

Hart, R. P. (2000). DICTION 5.0: The Text-Analysis Program. Thousand Oaks, CA: Scolari/Sage Publications.

Jansen, David-Jan and Jakob de Haan (2006). "Look Who's Talking: ECB Communications During the First Years of EMU," *International Journal of Finance and Economics* 11(3), 219-228.

Kohn, Donald L. and Brian P. Sack (2004). "Central Bank Talk: Does it Matter and Why?" in Macroecnomics, Monetary Policy, and Financial Stability, 175-206, Ottowa: Bank of Canada.

Kuttner, Kenneth (2001). "Monetary Policy Surprises and Interest Rates: Evidence from the Fed Funds Futures Market," *Journal of Monetary Economics* 47, 523-544.

Mankiw, N.G. (2003). Macroeconomics (5th edition), Worth Publishers, New York, NY.

Poole, William (2005). "How Should the Fed Communicate?" Speech given to the *Center for Economic Policy Studies*, Princeton University, April 2, 2005. Available at: $http://www.stlouisfed.org/news/speeches/2005/4_02_05.htm$

Rockoff, Hugh (1990). "The 'Wizard of Oz' as a Monetary Allegory," *Journal of Political Economy*, volume 98(4), 739-760.

Smircich, L. and G. Morgan (1982). "Leadership: The Management of Meaning." *Journal of Applied Behavioral Science*, 18, 257-273.

Table 1: Sample Statistics (May 18th, 1999 to January 31, 2006)

VARIABLE	COMM	MEAN	ST. DEV.	MIN	MEDIAN	MAX	NOBS
ΔFF^u		−0.067	1.812	−42.500	0.000	15.000	1682
$\Delta FF(3M)$		−0.021	3.496	−35.000	0.000	26.000	1682
$\Delta FF(6M)$		−0.011	4.536	−37.000	0.000	30.000	1682
$\Delta TFW(0\|1)$		−0.029	5.010	−53.520	0.105	22.540	1682
$\Delta TFW(1\|2)$		−0.066	7.798	−50.030	−0.140	36.800	1682
$\Delta TFW(4\|5)$		−0.087	6.858	−24.030	−0.535	31.030	1682
$\Delta ln(US\$)$		−0.013	0.462	−3.716	−0.002	5.032	1682
$\Delta ln(S\&P)$		−0.003	1.181	−6.005	0.018	5.574	1682
$\Delta TED(1M)$		−0.017	7.107	−81.725	0.088	63.675	1682
$\Delta CPTB - F(1M)$		−0.014	7.396	−87.600	0.000	49.300	1682
$\Delta CPTB - NF(1M)$		−0.017	7.486	−77.600	0.000	50.321	1682
$\Delta BOND(10Y)$		0.009	1.895	−9.999	0.000	41.002	1682
$\Delta VIX(1M)$		−0.009	1.239	−5.570	−0.060	9.920	1682
$\Delta MOVE(1M)$		−0.016	4.256	−17.570	−0.085	34.640	1682
$\Delta MOVE(3M)$		0.004	2.465	−11.750	0.000	13.820	1682
$\Delta MOVE(6M)$		0.004	1.940	−11.880	0.000	15.980	1682
$CERTAINTY$	ST	8.188	1.618	3.808	8.443	11.416	58
$PESSIMISM$	ST	1.289	0.686	0.000	1.122	3.686	58
$MACRO$	ST	5.053	1.039	1.974	5.122	7.051	58
$CERTAINTY$	SP	8.028	2.064	3.388	7.666	15.460	135
$PESSIMISM$	SP	1.167	0.790	0.000	0.994	3.374	135
$MACRO$	SP	2.651	1.222	0.225	2.516	5.723	135
$CERTAINTY$	TE	8.104	3.238	2.618	7.744	27.733	58
$PESSIMISM$	TE	1.149	0.653	0.148	1.076	2.900	58
$MACRO$	TE	3.013	0.946	0.606	3.116	5.211	58

Notes: Data are for business days from May 18th, 1999 to January 31, 2006. There are 251 communications sample made up of 58 FOMC statements, 58 Testimony's before Congress or the Senate and 135 Speeches during this time period. $\Delta FF(3M)$ and $\Delta FF(6M)$ are the change (Δ)in the Federal Funds futures rate three and six months ahead, respectively, $\Delta TFWD(0|1)$, $\Delta TFWD(1|2)$, $\Delta TFWD(4|5)$ are the change Treasury forward rates (zero to one years ahead, one to two years ahead, and four to five years ahead), $\Delta ln(Dollar)$ is the log growth rate of trade weighted dollar, and $\Delta ln(S\&P)$ is the log growth rate of the S&P500. Following the same convention, TED(1M) is the difference between the one month LIBOR rate and the one month Treasury bill rate, and CPTB-F(1M) and CPTB-NF(1M) are the spread between the one month commercial paper rate, financial and non-financial, and the one month Treasury Bill rate, and BOND(10Y) is the spread between the corporate bond rate for debt rated BAA less that for AAA rated 10 year debt. VIX(1M) is the Chicago Board of Option's volatility index conveyed by S&P 500 stock index option prices, while MOVE(1M) (Merrill Option Volatility Estimate) is an index that tracks how much traders expect Treasuries maturing in two to 30 years to fluctuate in a month. MOVE(3M) and MOVE(6M) are similarly defined. All the interest rate data are reported in basis points (that is 100 times the percentage) while the data for the Dollar, and the S&P500 are in percentages. Language variables, **CERTAINTY**, **PESSIMISM** and **MACRO** are discussed in the text. NOBS is the number of observations.

Table 2: Market Movement of Financial Variables Across News and Communications

Variable			NO NEWS					
	V	ALL	NO COM	NEWS	COM	STATE	SPEECH	TEST
$\Delta FF(3M)$	σ	3.496	1.872	4.284^{c}	4.182^{c}	7.451^{c}	2.263^{c}	2.752^{c}
$\Delta FF(6M)$	σ	4.536	3.305	5.355^{c}	5.150^{c}	7.391^{c}	3.891^{c}	4.952^{c}
$\Delta TFW(0-1)$	σ	5.010	4.275	5.637^{c}	5.227^{c}	6.496^{c}	4.513	5.371^{c}
$\Delta TFW(1-2)$	σ	7.798	6.716	8.786^{c}	8.014^{c}	8.778^{c}	7.078	9.308^{c}
$\Delta TFW(4-5)$	σ	6.858	6.229	7.503^{c}	6.908^{b}	6.799	6.281	8.384^{c}
$\Delta ln(DOLLAR)$	σ	0.462	0.478	0.462	0.381^{c}	0.322^{c}	0.379^{c}	0.427
$\Delta ln(S\&P)$	σ	1.181	1.192	1.175	1.217	1.443^{b}	1.204	0.941^{b}
$\Delta TED(1M)$	σ	7.107	6.903	7.285	6.254^{b}	7.560	6.086^{a}	5.200^{c}
$\Delta CPTB-F(1M)$	σ	7.397	6.662	7.906^{c}	6.929	9.519^{c}	6.226	5.259^{b}
$\Delta CPTB-NF(1M)$	σ	7.487	7.028	7.742^{c}	7.192	9.530^{c}	6.542	5.741^{a}
$\Delta BOND(10Y)$	σ	1.895	1.598	2.107^{c}	1.938^{c}	2.493^{c}	1.732	1.734
$\Delta VIX(1M)$	μ	−0.009	0.122	−0.113^{c}	−0.081^{b}	−0.340^{c}	−0.076^{a}	0.165
$\Delta MOVE(1M)$	μ	−0.016	0.265	−0.084	−0.860	−2.584^{c}	−0.445^{a}	−0.100
$\Delta MOVE(3M)$	μ	0.004	0.003	0.033	−0.085	0.074	−0.051	−0.326
$\Delta MOVE(6M)$	μ	0.004	−0.017	0.042	−0.062	0.009	−0.079	−0.093

Notes: See Table 1. The column labeled 'V' indicates the measure of volatility – standard deviation (σ) or mean (μ). The standard deviations and means are of the actual data. ALL, NO COM NO NEWS, NEWS and COMM refer to whether the statistic is calculated over the full sample, for just days when there is neither communication nor news, one of the 12 news variables were reported, only for days when there was a Speech or Testimony by Greenspan, or an FOMC statement. STATE, SPEECH and TEST refer to days when there was either a Speech, Testimony by Greenspan, or an FOMC statement, respectively. The superscripts a,b, and c indicate the .10, .05 and .01 level of statistical significance at which one can reject the null hypothesis that the standard deviation of the data sample differs from that when there is neither news nor communication. The p-values are derived from tests that are robust to heteroskedasticity of unknown form.

$$\Delta r_t = \alpha_0 + \alpha_1 \Delta FF_t^u + \alpha_2 \Delta r_{t-1} + \sum_{i=1}^{12} \beta_i NEWS_{it}$$
$$+ \sum_{j=1}^{3} \gamma_j COM_{jt} + \sum_{j=1}^{3} \sum_{k=1}^{3} \phi_{jk} \left[COM_{jt} \times LANG_{kt} \right] + \nu_t$$

Table 3: Regression Results for Market Based Rates of Return

	Type	$\Delta FF(3M)$	$\Delta FF(6M)$	$\Delta TF(0\|1)$	$\Delta TF(1\|2)$	$\Delta TF(4\|5)$	$\Delta ln(US\$)$	$\Delta ln(SP)$
ΔFF_t^U		0.756[c]	0.569[c]	0.494[b]	0.301	0.056	−0.008	−0.09
		[0.111]	[0.161]	[0.216]	[0.340]	[0.171]	[0.013]	[0.042]
Δr_{t-1}		0.118[c]	0.094[c]	0.034	0.016	0.056[b]	−0.019	−0.023
		[0.035]	[0.027]	[0.027]	[0.026]	[0.025]	[0.026]	[0.033]
CERT.	*ST*	0.817[c]	1.344[c]	0.940[a]	0.603	0.457	0.024	0.003
		[0.311]	[0.510]	[0.537]	[0.890]	[0.661]	[0.030]	[0.132]
PESS.	*ST*	−0.463	−1.211	−1.125	−1.953	−1.804	−0.073	−0.484
		[0.775]	[1.164]	[1.085]	[1.617]	[1.274]	[0.066]	[0.345]
MACRO	*ST*	0.362	0.973	0.831	0.519	0.199	0.078[a]	−0.120
		[0.323]	[0.676]	[0.803]	[1.097]	[0.832]	[0.041]	[0.120]
CERT.	*SP*	0.156[b]	0.200	0.312[b]	0.244	0.030	−0.029	−0.016
		[0.069]	[0.134]	[0.158]	[0.262]	[0.215]	[0.015]	[0.039]
PESS.	*SP*	−0.433[a]	−0.358	−0.481	−0.226	0.187	−0.003	−0.321[b]
		[0.236]	[0.412]	[0.517]	[0.815]	[0.711]	[0.039]	[0.155]
MACRO	*SP*	0.155	0.147	0.113	−0.152	−0.220	−0.033	−0.002
		[0.139]	[0.224]	[0.313]	[0.514]	[0.473]	[0.029]	[0.078]
CERT.	*TE*	0.029	0.129	−0.014	−0.269	−0.342	−0.030	0.073
		[0.207]	[0.314]	[0.370]	[0.707]	[0.845]	[0.028]	[0.068]
PESS.	*TE*	−0.768	−1.352	−1.619	−1.937	−0.614	−0.227[c]	−0.105
		[0.569]	[1.093]	[1.059]	[1.832]	[1.695]	[0.083]	[0.161]
MACRO	*TE*	0.183	−0.046	−0.017	0.350	−0.350	−0.014	0.140
		[0.394]	[0.666]	[0.755]	[1.298]	[1.379]	[0.052]	[0.137]
NOBS		1682	1682	1682	1682	1682	1682	1682
R^2		.249	.262	.111	.094	.061	.031	.036
NEWS		.000	.000	.000	.000	.000	.000	.028
LANG		.012	.017	.103	.795	.932	.003	.261
ST		.007	.001	.052	.400	.436	.017	.261
SP		.051	.418	.174	.807	.968	.128	.179
TE		.567	.671	.427	.645	.895	.032	.478
CERT.		.007	.023	.072	.671	.880	.155	.730
PESS.		.147	.346	.282	.457	.540	.041	.075
MACRO		.450	.462	.762	.939	.951	.182	.575

Notes: See Tables 1 and 2. Regressions also include a constant, lagged dependent variable and macroeconomic news variables. $\overline{R}^2$ is adjusted R-squared. ST, SP and TE refer to STATEMENT, SPEECH and TESTIMONY. There are 12 macroeconomic surprise variables, 3 communication variables and 3 language variables per type of communication. The bottom panel presents p-values for the F-tests that the collection of variables indicated in each row are jointly equal to zero.

$$\Delta cq_t = \alpha_0 + \alpha_1 \Delta FF_t^u + \alpha_2 \Delta cq_{t-1} + \sum_{i=1}^{12} \beta_i NEWS_{it}$$
$$+ \sum_{j=1}^{3} \gamma_j COM_{jt} + \sum_{j=1}^{3} \sum_{k=1}^{3} \phi_{jk} \left[COM_{jt} \times LANG_{kt} \right] + \nu_t$$

Table 4: Regression Results for Market Based Credit Quality Spreads

	Type	$\Delta TED(1M)$	$\Delta CPTB-F(1M)$	$\Delta CPTB-NF(1M)$	$\Delta BOND(10Y)$
ΔFF_t^U		$-0.545^{\mathbf{a}}$	$-0.652^{\mathbf{a}}$	-0.424	-0.045
		[0.297]	[0.362]	[0.383]	[0.055]
Δcp_{t-1}		0.053	-0.007	-0.003	-0.019
		[0.052]	[0.052]	[0.048]	[0.036]
$CERTAINTY$	ST	$-1.273^{\mathbf{b}}$	$-1.428^{\mathbf{a}}$	$-1.774^{\mathbf{b}}$	-0.068
		[0.643]	[0.868]	[0.837]	[0.281]
$PESSIMISM$	ST	-1.368	-2.734	$-3.319^{\mathbf{a}}$	0.602
		[1.513]	[1.984]	[1.988]	[0.367]
$MACRO$	ST	0.021	-0.004	-0.138	-0.290
		[0.879]	[1.043]	[1.009]	[0.215]
$CERTAINTY$	SP	-0.262	-0.287	-0.265	-0.065
		[0.218]	[0.224]	[0.237]	[0.065]
$PESSIMISM$	SP	0.190	0.258	0.268	0.020
		[0.542]	[0.611]	[0.626]	[0.246]
$MACRO$	SP	-0.248	-0.317	-0.749	-0.083
		[0.424]	[0.454]	[0.475]	[0.113]
$CERTAINTY$	TE	0.213	0.120	0.082	0.014
		[0.308]	[0.322]	[0.353]	[0.092]
$PESSIMISM$	TE	0.802	0.338	-0.167	-0.592
		[1.406]	[1.345]	[1.566]	[0.378]
$MACRO$	TE	-0.637	-0.950	-0.665	-0.092
		[0.672]	[0.693]	[0.851]	[0.219]
$NOBS$		1682	1682	1682	1682
R^2		0.037	0.033	0.038	0.026
$NEWS$		0.774	0.559	0.962	0.119
$LANGUAGE$		0.557	0.523	0.269	0.256
ST		0.262	0.351	0.159	0.264
SP		0.483	0.423	0.196	0.532
TE		0.732	0.574	0.847	0.212
$CERTAINTY$		0.116	0.217	0.113	0.788
$PESSIMISM$		0.738	0.524	0.399	0.160
$MACRO$		0.740	0.487	0.359	0.464

Notes: See Tables 1-3. Dependent Variables are the volatility measures labeled at the top of each column.

$$\Delta V_t = \alpha_0 + \alpha_1 \left(\Delta FF_t^u\right)^2 + \alpha_2 \Delta V_{t-1} + \sum_{i=1}^{12} \beta_i NEWS_{it} + \sum_{i=1}^{12} \delta_i NEWS_{it}^2$$

$$+ \sum_{j=1}^{3} \gamma_j COM_{jt} + \sum_{j=1}^{3} \sum_{k=1}^{3} \phi_{jk} \left[COM_{jt} \times LANG_{kt}\right] + \nu_t$$

Table 5: Regression Results for Options Based Measures of Financial Market Volatility

		$\Delta VIX(1M)$	$\Delta MOVE(1M)$	$\Delta MOVE(3M)$	$\Delta MOVE(6M)$
$(\Delta FF_t^U)^2$		-0.010	0.007	0.007	0.008
		[0.007]	[0.013]	[0.011]	[0.008]
ΔV_{t-1}		-0.027	0.031	$0.108^{\mathbf{c}}$	$0.111^{\mathbf{b}}$
		[0.035]	[0.030]	[0.035]	[0.043]
$CERTAINTY$	ST	-0.131	0.094	0.307	0.207
		[0.104]	[0.425]	[0.231]	[0.154]
$PESSIMISM$	ST	0.104	-0.875	0.144	0.293
		[0.208]	[0.965]	[0.438]	[0.311]
$MACRO$	ST	$0.183^{\mathbf{a}}$	-0.728	$-0.692^{\mathbf{b}}$	$-0.363^{\mathbf{a}}$
		[0.109]	[0.706]	[0.297]	[0.213]
$CERTAINTY$	SP	-0.005	-0.028	-0.007	-0.049
		[0.043]	[0.143]	[0.083]	[0.066]
$PESSIMISM$	SP	0.113	0.559	$0.485^{\mathbf{a}}$	$0.347^{\mathbf{a}}$
		[0.137]	[0.469]	[0.257]	[0.195]
$MACRO$	SP	0.047	$-0.570^{\mathbf{b}}$	$-0.356^{\mathbf{b}}$	$-0.314^{\mathbf{b}}$
		[0.0810]	[0.267]	[0.169]	[0.125]
$CERTAINTY$	TE	-0.077	-0.452	-0.187	$-0.281^{\mathbf{a}}$
		[0.068]	[0.331]	[0.181]	[0.169]
$PESSIMISM$	TE	0.127	-0.448	0.934	0.535
		[0.191]	[0.957]	[0.653]	[0.440]
$MACRO$	TE	-0.123	$-1.583^{\mathbf{b}}$	0.257	0.201
		[0.137]	[0.664]	[0.367]	[0.238]
$NOBS$		1682	1682	1682	1682
R^2		.103	.102	.035	.035
$NEWS$		.288	.002	.749	.961
$LANG$		.586	.103	.015	.012
ST		.260	.499	.040	.081
SP		.715	.140	.098	.034
TE		.557	.067	.127	.129
$CERTAINTY$		.415	.585	.430	.152
$PESSIMISM$		.712	.496	.126	.137
$MACRO$		.253	.012	.014	.025

Notes: See Tables 1-4. Dependent Variables are the volatility measures labeled at the top of each column.

APPENDIX A
Diction Dictionaries and Composite Dictionaries

Dictionary	Description	Sample Words
Certainty =	**Language indicating resoluteness, inflexibility, and completeness as well as a tendency to speak ex cathedra.**	**Tenacity + Leveling + Concreteness + Insistence – Ambivalence**
Tenacity	Includes all uses of the verb "to be", definitive verb forms and their variants, and associated contractions. These verbs connote confidence and totality.	Is, am, will, shall, has, must do, he'll, they've, ain't
+ Leveling	Words used to ignore individual differences and to build a sense of completeness and assurance.	Everybody, anyone, each, fully, always, completely, inevitably, consistently, unconditional, consummate, absolute
+ Concreteness	A dictionary of words denoting tangibility and materiality, including physical structures, modes of transportation, articles of clothing, household animals, etc.	Airplane, ship, bicycle, stomach, eyes, lips, slacks, pants, shirt, cat, insects, horse, wine grain, sugar, oil, silk, sand, courthouse, temple, store
– Ambivalence	Words expressing hesitation or uncertainty, implying an inability or unwillingness to commit to what is being said.	Allegedly, perhaps, might, almost, approximate, vague, baffled, puzzling, hesitate, could, would, guess, suppose, seems
Pessimism =	**Language endorsing or highlighting the negative entailments of some person, group, concept, or event.**	**Blame + Hardship**
Blame	Terms designating social inappropriateness and evil, as well as unfortunate circumstances.	Mean, naïve, sloppy, stupid, fascist, repugnant, malicious, bankrupt, rash, morbid, weary, nervous, painful, detrimental, cruel
+ Hardship	Natural disasters, hostile actions, censurable human behavior, unsavory political outcomes, and human fears.	Earthquake, starvation, killers, bankruptcy, enemies, vices, infidelity, despots, betrayal, injustices, exploitation, grief, death
Macroeconomics	**The dictionary of terms provided at the end of the popular intermediate macroeconomic textbooks by Professors Abel and Bernanke (2004), Delong (2002), and Mankiw (2004).**	Unemployment, inflation, natural rate, aggregate demand, cash flow, competition, depreciation, dividends, exports, foreign trade, gross national product, interest, leading indicators, microeconomics, nominal appreciation, price index

Note. To offset the potential problem of negation affecting the meaning of a **CERTAINTY** or **PESSIMISM** word, such words that were preceded by "no" or "not" were subtracted from each of these dictionary's word totals.

APPENDIX B
Computerized Coding of Sample Statement Passages

Construct	Computerized Coding
Certainty	"The evidence accumulated over the intermeeting period indicates that output is continuing to expand at a solid pace and labor market conditions have improved." (06/30/04)
Pessimism	"Heightened uncertainty and concerns about a deterioration in business conditions both here and abroad are damping economic activity." (11/06/01)
Macro	"Consumer and business confidence has eroded further, exacerbated by rising energy costs that continue to drain consumer purchasing power and press on business profit margins." (01/31/01)