

Yesterday's news: Media created emotions in asset markets

Abstract

Using daily data on emotions and facts related news and social media mentions, we study how sentiment, joy, gloom and other feelings affect international stock market returns. We find a statistically significant correlation between the changes in feelings and market indices and several variables to be able to predict short-term returns. Market sensitivity to emotions is larger in emerging countries than in developed markets and especially high in China. The differences in markets' emotional sensitivities can be explained with several cultural, political, economic, market behavior and market participants related variables.

Keywords: sentiment, asset returns, emotions.

JEL Classification: F37, G12, G15

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1. Introduction

Investor sentiment and its relation to asset markets has been under an increasing research interest for the past decades and the current consensus is that the investor sentiment affects significantly to behavior of the asset prices, both at the short (daily) and longer (monthly) run (e.g. Brown and Cliff (2005), Baker and Wurgler (2007), and Da, Engelberg and Gao (2015)). Theoretically, sentiment is often related to changes in demand which lead to excess trading. It is argued that unsophisticated (speculator or noise) traders are more affected by the sentiment and react to it by starting to trade stocks that they assume are most affected by it. Due to limits of arbitrage, more sophisticated (fundamental) investors cannot affect prices in the short run and eventually the whole market might be affected by the noise traders pushing prices away from their fundamental value. For example, when noise traders get a negative (positive) belief shock, they sell (buy) their shares to (from) fundamental investors, causing prices to drop (rise) and increasing volatility. However, as these shocks are mean reverting, on next period there should be a new belief shock and the returns should rebound (DeLong et al. (1990) and Tetlock (2007)).

Figure 1 shows the relationship between scaled ($100=1/1998$) S&P 500 index (red line) and demeaned monthly average of aggregate positive versus negative media (both newspaper and social media) references for the US companies (black line, named as Sentiment). The burst of a Dot-com bubble around 2000-2002 and the Global Financial Crisis between 2008 and 2009 are clearly visible from both of the time series and although the Sentiment-line is more volatile, the general movement in the lines is very similar. This is not surprising since it could be assumed that there are more positive news during the bull markets and negative news in bear market. What is interesting in the figure is that, although the trends of the lines are very alike, the newspaper and social media content seem to precede the turns in S&P 500 indicating that there might be a lead-lag relationship between these two. Hence, the figure shows that the sentiment created by the media could predict the asset market movements.

FIGURE 1 HERE

Measuring sentiment, however, has turned out to be a challenging task and so far, no single accepted measure exists. Typically, empirical research has taken one of the three alternatives in this task. First, studies have used data from surveys such as University of Michigan Consumer Sentiment Index, the UBS/Gallup Index for Investor Optimism or investment newsletter (Brown and Cliff (2005), Lemmon and Portniaguina (2006), and Qiu and Welch (2006)). One problem with survey based measures is their monthly or quarterly frequency which does not allow higher frequency studies¹. Second, surveys are often criticized for being inaccurate because they rarely provide any incentives

¹ There is some discussion on the persistency of the sentiment. Studies using low frequency data (for example Brown and Cliff (2005), Baker and Wurgler (2006) and Chang, Hsieh and Wang (2015)) support the view that sentiment is a persistent variable and reinforces as more and more people are affected by it, increasing its importance over time. While Kaustia and Rantapuska (2016) name transient state of feeling as mood, other studies with daily data (for example Tetlock (2007) and Da et al. (2015)), name their measures as sentiments and concentrate on studying its short-term properties. In this study we use emotions as a general term when referring to feelings related variables and reserve sentiment as a name for one of our aggregate variables.

for subjects to consider their answers carefully or even truthfully. Third, due to their measurement costs, surveys are always based on a limited sample set which does not necessarily reflect the opinions, feelings and sentiment of general population. Thus in order to validate the quality of the survey based measures, they should be compared to the observed behavior of individuals or public. The second alternative for sentiment measures has been estimating them from market information such as mutual fund flows, trading volume or option implied volatilities (Baker and Wurgler, 2007). These measures are easy to obtain and available also at higher frequencies, but as they are measured from market outcomes, they also capture several other issues than the investor sentiment and thus using them to study market equilibrium is questionable. Third, the most recent strand of sentiment measures relies on word recognition techniques. Tetlock (2007) and Tetlock, Saar-Tsechansky and Macskassy (2008) were the first to use textual analysis to study media's influence to asset market by using textual analysis to identify sentiment related words and provide evidence of its ability to predict market prices, trading volume and earnings. Da et al. (2015) form an investor sentiment measure based on household internet searches. They recognize state of the economy and sentiment related words (such as "recession", "default" and "gold prices") from several millions of US households internet searches and aggregate them to form a Financial and Economic Attitudes Revealed by Search (FEARS) index for a daily frequency. The measure formed in this way is able to avoid several of the above mentioned problems of the other measurements as it should be able to capture the true high frequency behavior of individuals with a reasonable large sample set. These last two examples are also the measurement styles where our emotional measures are based on.

So far the search based measures have only concentrated on one specific market and only aim to study one particular measure. For example, Da et al. (2015) examine only the US market and Tetlock (2007) uses only one news source for his sentiment measure and consider only the content of the words, not their tone. However, as the human behavior is not limited only to positive and negative sentiments, it is important to study also other forms of emotions and their relationship to fact based measures. We utilize daily data from Thomson Reuters Marketpsych Indices (TRMI hereafter) to measure sentiment and several other media created emotions and facts related variables for several major stock markets and study the effects of emotions for their stock returns. Instead of talking about sentiments, we use more general term, emotions, which is able to capture better the multifaceted feelings we are concentrating on this study. Moreover, due to differences in market environments, their development stages, participants and cultural issues, emotions might play a larger role in some markets than in others. For example, it could be assumed that if the markets are dominated by sophisticated institutional investors who make rational investment decisions, the role for emotions is smaller while the unsophisticated noise traders could make their decisions more based on their gut feelings. The aim of this study is to shed light on these both issues. First, it studies several emotions related measures and second, it examines their differences in international financial markets.

The contributions of the study are the following. We introduce news and social media based daily sentiment measure and its components for a number of global markets. Using the measure, we examine the relationship between stock returns and emotional variables for 15 major markets from Europe, Asia-Pacific and Americas i.e. we study more international stock markets and more emotional variables than any other study, to our knowledge, before us. This allows us to study the daily correlations and prediction abilities of several variables in panel data framework as well as the country level differences with time series regressions. Using the differences in the emotion

sensitivities as dependent variables, we are also able to study their determinants i.e. what makes markets more sensitive to emotion related variables.

The study is divided into two parts. In the first part, we pool all the data together and use panel regressions to study the relationship between emotional variables and stock returns in an international environment. In the second part, we examine the same relationship but this time with time series and for each market separately. Also, in this part we examine the determinants of higher emotional exposure with a panel data setting. Results from panel data estimations show that several emotions related variables are able to both explain and predict future returns. This high statistical and economic significance applies to aggregate variables (Sentiment, EmotionVsFact and MarketRisk) as well as to several positive (Optimism, Joy and Trust) and negative (Fear, Gloom, Anger and Uncertainty) emotions. When the estimations are performed separately for each country, we observe some heterogeneity in the sensitivities to media content and that the emerging markets have larger coefficients than developed countries. There are also two interesting findings from the time series estimations. First, China has clearly the largest TRMI coefficients indicating that its market has substantially larger exposure to emotional related variables than the other markets. Second, the market in the USA behaves contrary to other markets and has an opposite sign in several cases for TRMI variables than the rest of the markets. Due to these differences, we also study the determinants of sentiment sensitivity and find that several cultural, political, economic, market behavior and market participants related variables affect significantly to it.

The remainder of the paper is organized as follows. In section 2, we introduce our data and especially the TRMI variables and the estimation model. In section 3, we present the results for the panel regressions and in section 4, we do the same for each country separately. Section 5 concludes.

2. Data and estimation

2.1 Stock indices

For the stock indices, we take daily data from the Datastream, and try to use the same indices that are used as a base when forming TRMI-variables at the index level. Prices are measured in US dollars and returns are calculated as logarithmic price differentials. We remove all the zero return days as they can be assumed to reflect holidays or other days when the market is closed. For some markets, the total return indices, which include reinvested dividends, are not available until 2010 and thus, as our main dependent variables, we use returns calculated from price indices.² More details on the indices we use and the indices that are used for TRMI-indices can be found from Appendix A, Table A1.

As for the control variables, we use returns from the past five days and the returns from regional (Europe, North America and Pacific) market portfolios, HML, SMB and UMD factors together with changes in VIX index. The data for regional market portfolios and other factors are

² Having as long time period as possible is important for the panel data setting in Subsection 4.3. As for robustness, we also estimate the basic results using returns from total return indices and they remain very similar.

from AQR Capital Management’s website and are originally related to the study by Asness and Frazzini (2013).³ Country division to regions can be found from Appendix A, Table A1.

2.2 TRMI variables

Thomson Reuters Marketpsych Indices (TRMI) are obtained from Thomson Reuters. They are measured at a company level for daily frequency, measured at 19:30 or 20:30 GMT using data from the past 24 hours as their observation period. TRMI index observations are built from the company level data. TRMI evaluates the data from news and social media contents and identifies specific emotions, macroeconomic and general buzz related words that are relevant for the entity. Subsequently, the volume and tone of phrases and words are converted into measurable variables. TRMIs are evaluated on three different content sets: news, social media, and the combined content. In our analysis we concentrate on the combined set. First observations for the indices are from 1998 which is thus the beginning of our sample period. Only English-language text is used for the analysis.

The TRMI database uses news from several of the mainstream news sources for the entire historical sample period. After 2005, also internet news content is used for the analysis. Internet news are restricted to top international and business news sources, top regional news sources, and leading industry sources. The social media data is less diverse. It starts in 1998 with content collected by MarketPsych Data and consists of discussions in internet forums and finance-specific tweets. After 2008, using popularity ranks measured by incoming links, top 30% of blogs, microblogs, and other social media content are also included to the data.

In total, TRMI Companies data covers more than 7,750 companies from over 30 countries, across the feeds and archives. However, index level data are available to only 15 largest markets. In general, these companies are selected based on their domicile, market capitalization and economic or industry significance. For each of these companies and their indices, TRMI measures daily 31 variables. These variables, their description and original range can be found from Appendix B, Table B1⁴.

Besides the 31 media content and tone related variables, there are two more variables which represent the amount of news used to calculate the variables. Buzz, represents a sum of entity-specific words and phrases used in TRMI computations i.e. it measures how many time a company is mentioned in the news. It can be non-integer when any of the words/phrases are described with a “minimizer”, which reduces the intensity of the primary word or phrase. For

³ <https://www.aqr.com/library/data-sets/the-devil-in-hmls-details-factors-daily>

⁴ The original indices in Appendix B, Table B1 are marked as ranging from either -1 to 1 or 0 to 1, corresponding to bipolar and unipolar indices, respectively. In practice, those denoted as “unipolar” can in fact range below 0, although not below -1. This occurs because unipolar indices reflect the orthogonal nature of many single emotions and topics. A negative comment such as, “I don’t enjoy owning this stock” is not emotively equivalent to, “I am pessimistic about the stock’s prospects” or “I am angry with the company’s management.” The initial statement is specifically one of negative Joy, which decreases the overall Joy index for assets related to that company. When there are many such negative Joy comments for an asset, the Joy index itself may show negative values. Nonetheless, in practice unipolar indices are positive over 90% of the time, because language typically reflects positive assertions and hence these variables are marked to range from “0 to 1”.

example, in the phrase “less concerned” the score of the word “concerned” is minimized by “less”. Additionally, common words such as “new” may have a minor but significant contribution to the Innovation TRMI. As a result, the scores of common words/phrases with minor TRMI contributions can be minimized. Relative Buzz, represents the fraction of all Buzz, for a particular time period and variable(s), which belongs to a particular asset. Thus Relative Buzz is between 0 and 1, and the sum of Relative Buzz across all assets for a particular time period and variable set always sum to 1.

If a value is missing for a variable, we set it to be zero. Strictly speaking, missing values have different meaning than zero since zero means that texts corresponding to positive and negative values add up to zero while missing value means the absence of any relevant text for the entity. However, since we are using changes in the TRMI variables as our independent variables, we need to have a reference point from the previous day to which we are comparing the change. Also, to calculate continuously compounded change percentages for the variables, we transform all of them positive by adding 2 to each of them.

To make the interpretation of the results easier and more concise, we divide the variables into three categories. First category is related to aggregate variables and to the amount of news related to the firms. These variables are Sentiment, EmotionVsFact, Market Risk, Buzz and RelativeBuzz. Sentiment, i.e. all the positive references net of negative references, is naturally one of the main interest in this study and gives us the closest comparison to previous studies. It can be assumed that it has a positive relation with returns. Other interesting aggregate variables are the EmotionVsFact, which measures how the returns behave as emotional variables begin to dominate over the factual based variables, and MarketRisk which captures the effects of positive emotions and expectations over negative emotions and expectations. Neither of these two has been previously studied in the literature. While MarketRisk can be assumed to have a positive sign (more positive emotional news should affect prices positively), in theory, it could be assumed that investors make better decisions when they are based on careful consideration and facts instead of feelings. Thus, the coefficients of EmotionVsFact should be negative. Buzz and RelativeBuzz show what is the relation between higher news visibility for the firm’s value.

Second category has emotionally charged variables. These are the changes in Optimism, Joy, LoveHate, Trust, Fear, Violence, Gloom, Stress, Anger, and Uncertainty. Of these variables, we can assume that the first five variables which measure positive feelings should have a positive relation to returns while the next seven measure negative emotions and uncertainty and should thus have negative sign.

Variables in the third category are more related to macroeconomic metrics, facts and forecasts of the firm and index performance. These include TimeUrgency, LongShort, LongShortForecast, PriceDirection, PriceForecast, Volatility, DebtDefault, AnalystRating, Dividends, EarningsForecast, FundamentalStrength, Layoffs, Litigation, Conflict, ManagementChange, ManagementTrust, Mergers, and Innovation. The relation to returns should be negative for DebtDefault and Conflict and hard to determine in advance for Volatility, Layoffs, Litigation, and Mergers and positive for the rest.

2.3 Determinants of sentiment sensitivity

In subsection 4.2 we study determinants of the sentiment sensitivity, i.e. variables causing a market to be affected by emotions, in a panel data setting. For this, we use several variables capturing differences in all, financial, economic, political and social environment. Most of our variables are at the country level but we also include yearly average of the VIX index as a proxy for global financial market uncertainty.

To measure market and banking sector development, we use several typically used measures. These are market capitalization to GDP –ratio, the total value of stocks traded to GDP –ratio and private credit to GDP –ratio. To measure country’s economic development, we include the logarithm of GDP per capita and GDP growth rate to estimations. These are all obtained from World Bank’s World Development Indicators. For political risks, we include the political risk measure from the International Country Risk Guide and to capture the effects of market behavior, we calculate average return and standard deviation for each index. It could be assumed that the higher the volatility and lower the returns, the more exposure to negative feelings could be observed.

We also calculate the institutional investor ownership ratio for each of the indices as a market capitalization of the stocks owned by institutions at the end of the year divided by the total market capitalization. For this we use the data collected by the FactSet Lionshares which includes the quarterly data of the institutional ownings. However, as there are differences in the reporting practices across countries, for some countries, we receive unexpectedly low values. Thus, as for robustness check, we drop some of the countries from the final data and keep these values only as indicative. To further study the involvement of more sophisticated investors, we include the average number of analysts following each stock in a country and the dispersion in their forecasts using data from IBES. However, again for these variables, we have only limited coverage and thus have to drop away some of the countries from the final data.

To measure the effects of cultural effects, we include Hofstede’s (2001) cultural dimensions to the panel data. Chui, Titman and Wei (2010) argue that individualism is positively associated with the trading volume, volatility and momentum profits due to its relation to overconfidence and self-attribution bias. These same biases together with other Hofstede’s cultural dimensions, Masculinity, Uncertainty avoidance, Long- vs short-term orientation and Power distance can have effects on the emotional sensitivity. Also, since only news in English are considered in the TRMI data, we include language dummy for those countries which have English as their official language.

As for a more technical variable related to TRMI measurement time and the opening time of the markets, we also include the amount of hours we have TRMI data before the markets closes i.e. the amount of hours from day $t - 1$ 20:00 GMT till day t to the time when the market closes. This measure is meant to capture possible effects of the non-synchronicity between the measuring times and information about the fundamental values of equities that is not already at market closing included in the prices. The lower the value, the more data in TRMI are not involved in prices and thus the emotional effects should also be larger. For USA and Canada we set this variable to be full 24 hours.

2.4 Estimation

We estimate regressions for both, explanatory and prediction purposes. In the former, we use contemporaneous variables which capture the same day effects of the TRMI variables and hence measure the correlation between the variables. Obviously, conclusions based on these results are rather limited due to endogeneity and non-synchronicity issues. For example it can be assumed that newspapers are reporting increasing stock prices when the stock prices are or have been increasing. Another problem with the data is related to their measurement time. TRMI variables are measured daily at 19:30-20:30 GMT using the news and social media data from the past 24 hours. As Figure 2 shows, the trading is still continuing in the North and South American markets (the US, Canada, Brazil) at that time and thus the variables do not necessarily capture all the relevant information from news for these markets and companies. However, we believe that any bias that this might cause is rather small and thus to remain consistent with the rest of the data, we estimate our models using the same day returns for all of the markets. Anyway, we can still study the relationship between the markets and the media created content and evaluate the usefulness of the TRMI variables i.e. do they capture what they are meant to measure.

In the following estimations, we study whether TRMI variables are able to predict stock returns by explaining the returns for the next five days with the TRMI variables. It should be noted that since we are studying the closing prices there has been at least a day of trading between the measurement of TRMI variables and the daily return and thus any significant TRMI variables should be considered violating the information efficiently related to the efficient market hypothesis. However, due to trading costs, it might still not be able to make any excess returns using the TRMI variables.

Fama and French (2012) argue that, due to shortcomings of global market integration, the global models have problems explaining average returns. Hence, as our basic estimation model, we use the regional Fama-French 3-factor model augmented with momentum factor i.e. our basic estimation model is:

$$R_{i,t+k} = \beta_{0,i} + \beta_{1,i}RMKT_t + \beta_{2,i}RHML_t + \beta_{3,i}RSMB_t + \beta_{4,i}RUMD_t + \beta_{5,i} \Delta TRMI_{i,t} + \sum \gamma_j Control_{i,t}^j + \varepsilon_{i,t+k} \quad (1)$$

where $R_{i,t+k}$ is the return of index i at day $t + k$, $k = 0, \dots, 5$, $RMKT_t$ is the return of regional market index, $RHML$ is the return from regional high minus low B/M-portfolios, $RSMB$ is the return from regional small minus big portfolios, $RUMD$ is the returns from high previous 2 to 12 month returns minus return from low previous returns from the same period and $\Delta TRMI_{i,k,t}$ denotes the change in k th TRMI variable related to firm i at time t .⁵ The first four factors ($RMKT_t$, $RHML_t$, $RSMB_t$ and $RUMD_t$) are interesting even on their own since they show how integrated each of the markets is to its region (or to global markets when the estimations are performed with global factors). However, our main interest lays in $\beta_{5,i}$ which captures the effects of the changes in TRMI variables to contemporaneous and future returns. As for other control variables ($Control$) we use returns from the past five days and the daily market volatility index (VIX) from the Chicago Board

⁵ For robustness, we also examine the results using global factors instead of regional factors and the regional Fama-French 5 factor plus momentum model but since the results remain very similar to our base estimation we do not report these results but instead they are available from the authors.

of Options Exchange. As the VIX index is commonly used to measure global uncertainty, we use it as common variable to all the markets.

3. Panel regressions

We first study the results in a panel framework by pooling all the data together and estimating equation (1) with $k = 0, \dots, 5$ for different TRMI variables separately. These results are found from Table 1.

TABLE 1 HERE

Column (1), when $k = 0$, shows the results from contemporaneous changes in prices and TRMI variables. Of the first category, Sentiment has a positive and highly significant coefficient showing that higher returns are also related to higher sentiment. Sentiment includes all the news, while EmotionVsFact and MarketRisk are aggregate variables related to the amount of emotions related news and their style. EmotionVsFact measures the difference between emotion and fact based news while MarketRisk measures the difference between positive and negative news. Thus an increase in EmotionVsFact –variable means that there are more emotions and feelings related mentions in the news and social media and an increase in MarketRisk means that there are more positive than negative news than before. It is not surprising that MarketRisk has a positive relation to returns as it could be assumed that more positive emotions are positively related to higher stock returns while a negative sign for EmotionVsFact implies a negative correlation between returns and the amount of emotions. However, as we are studying contemporaneous results, we cannot directly state whether the lower amount fact and topical related issues leads to lower the returns or are there just more feelings related variables mentioned in news during negative return days.

The other two variables, Buzz and RelativeBuzz, are both related to the amount of mentions in news and social media which are used when other TRMI variables are formed. Negative and significant coefficients for both of these suggest a negative relationship between the amount of mentions and the stock returns. This is not surprising in a sense that there are often more news and mentions on companies during more turmoil periods and RelativeBuzz gets its highest values on the second half of year 2008 at the beginning of the Global Financial Crisis.

For the second category, emotions related variables, the signs of the coefficients are as expected i.e. positive for positive emotions and vice versa for negative. Only exception is LoveHate which has a negative sign but even it is not significant. Besides LoveHate, Anger and Violence other emotions related variables are highly significant and especially Sentiment and Gloom have high t-values while the coefficients are largest for Fear and Gloom. Although, due to contemporaneous measurement, we cannot say anything about causation between returns and explanatory variables, by capturing the correct signs, it can be argued that the variables really measure what they are meant to measure.

Of the fact based variables, PriceDirection, PriceForecast, FundamentalStrength, DebtDefault, and Mergers have significant and positive sign and more mentions about Volatility imply negative relationship with returns. Other variables are not statistically significant. It is easy to understand that PriceDirection, PriceForecast and FundamentalStrength have positive signs. There are more news related to price increases when the price has increased and when accounting variables are reported to be positive. DebtDefault has a surprising, positive sign. One explanation for this might be that markets view debt defaults and bankruptcies as a way to get rid of uncertainty and thus it has a positive relation with returns. Also, more mentions of Merger activity is seen as a positive sign for markets while more volatility related news are related to negative returns.

Of the control variables, regional factors are highly statistically significant with positive relationship for regional market portfolios and HML portfolios and negative with SMB and UMD. VIX has a negative and highly significant coefficient indicating that during more turmoil period, when volatility is high, also the returns are lower. Previous returns do not seem to predict today's returns well since only $t - 4$ return has significant coefficient.

For prediction model in column (2), i.e. for $k = 1$, fewer variables have significant coefficients since the variables are already yesterday's news. However, positive feelings are carrying all the way to next day as Sentiment, MarketRisk, Optimism and Joy all have positive and significant coefficients implying that positive feelings also have a positive effect on next day's return. More emotions, in general, can also be related to higher returns as EmotionVsFact has a positive and significant coefficient. Of the other variables, more anger and disgust lead to lower returns while the sign for Uncertainty reverses to become positive. For the fact related variables, Volatility remains negative and significant while the positive references to buying and selling (LongShort and LongShortForecast) have positive effect on returns. The reversal of signs can also be seen from the control variables as all the standard FF3+UMD variables change their signs from column (1) and their values decrease substantially and become even insignificant for UMD. VIX remains negative and highly significant while several of the previous returns show negative relationship with future returns.

When comparing the coefficients between columns (2) and (3), one notably point is that for almost all the significant variables, coefficients have changed their signs. Both, EmotionVsFact and MarketRisk show that emotional, even positive, involvement today leads to lower returns in two days and this applies also for Joy. Only some of the previous day's return coefficients keep their signs but all the other significant coefficient go through a reversal. This same observation can also be made for the rest of the columns (4)-(6), i.e. when $k = 3, 4$ or 5 , as the effects from TRMI variables often tend to weaken and change signs from one day to another. The reversal of sign in emotional variables is in line with the predictions mentioned in the theoretical models (see DeLong et al. (1990) and for empirical evidence Tetlock (2007) and Da et al. (2015)).

3.2 Economic significance

We study the economic significance of the results calculating the effects of a one standard deviation change in the TRMI variable on stock returns. These are listed in Appendix C, Table C1 for the whole

sample and for each of the countries individually. The results for economic significance itself can be found from Table 2.

TABLE 2 HERE

As can be expected based on Table 1, several of the variables with significant coefficients also have the largest contribution to index returns. For example, Sentiment, MarketRisk, Optimism and PriceDirection all have large positive values while EmotionVsFact, Fear and Gloom have large negative relation to contemporaneous returns. When studying following day's returns, the same variables together with Uncertainty have the largest effects on returns but the values are already slightly smaller and the further the prediction returns, the smaller the contributions of the TRMI variables. To sum up, aggregate and emotional variables seem to have larger explanatory and predictive power than the fact based mentions in the news and social media.

4. Time-series regressions

Due to country and market development differences, laws and regulations, cultural issues and market participants, the emotional variables might affect countries very differently. For example, it has been often argued that the stock market in China does not work rationally but instead is closer to casino and driven by the sentiment of the unsophisticated individual investors. Hence it is appropriate to study the effects of TRMI variables for each of the markets separately and find explanations for possible differences between countries.

For this, we estimate equation (1) for contemporaneous case $k = 0$ for each of the countries separately and report the results in Table 2. Due to the differences in starting days and elimination of zero return days, there are slight differences between the samples of each of the countries. From R^2 s it can be observed that while our model captures 70 to 98% of the return variation for many of the developed markets, the R^2 values are quite modest for the Asian region (except for Japan) and especially the BRICs, Brazil, Russia, India and China, are not well described by their corresponding regional four factor models.

TABLE 3 HERE

The results are shown for each variable again in the same order as in Table 1 but this time the columns denote markets. As can be expected, most of the coefficients have the same signs and significances as in the panel regression case (i.e. positive feelings and news about companies are related positively to returns and vice versa for negative feelings and company information). However, the amount of significant TRMI varies substantially between countries and same can be observed also for their sizes. For example, surprisingly few of the fact based measures have

significant impact. Only for LongShort, PriceDirection, PriceForecast, Volatility, Mergers, and Innovation, four of more markets have significant (at 10% level) values.

Regional market portfolio has a significant and positive coefficient for all markets and same applies also to other factors for most markets. Most of the markets have a positive exposure regional HML and negative exposures to SMB and UMD. Interestingly, in emerging markets of China, Russia and Brazil have opposite signs than the developed markets for HML, SMB and UMD. As expected, VIX has a negative and significant sign on most cases and for many markets there is evidence of return reversal from the previous day.

There are two main observations from the Table 3. First, the coefficients for China are considerably larger than for the other countries. This implies that returns in China, are more related with changes in the emotion related news than in more developed markets. For example, the coefficients in China for almost any TRMI variable are often five to ten times larger than for any other market although the means and standard deviations for the variables (see Appendix C, Table C1) are rather similar and often even smaller than the whole data average. This cannot be simply explained by the difference between the opening hours and the TRMI measurement time as other Asian-Pacific markets have smaller coefficients or just with the emerging market status of China because the betas, although also often higher than in developed markets, are considerably smaller also for Brazil, Russia and India. Thus, based on these results, emerging stock markets, especially in China, are subject to higher exposure to emotional variables and thus the claims that sentiment and other feelings affect them significantly are not far-fetched. Second, some of the coefficients for the US market have a completely opposite sign than the other markets. Most notable of these is the PriceDirection which has a negative correlation with the returns. This cannot be explained by the fact that market closes after the TRMI variables are measured, since the same relation cannot be observed from Canada and Brazil. Both of these observations require closer examination and in the following we try to find variables that are able to explain the exposure to emotional variables.

4.2 Determinants of emotional sensitivity

Because the changes in TRMI variables differ between countries, we standardize TRMI variables by multiplying TRMI betas at country-year level with their corresponding standard deviations and eventually use these products as dependent variables in panel regressions⁶.

In the estimations we concentrate only on the main aggregate variables: Sentiment, EmotionVsFact and MarketRisk and estimate several model for each of these. In the first column, we use cultural and political risk related variables to explain the emotional sensitivity. These include Individualism (Indiv), Masculinity (Masc), Uncertainty avoidance (Uncert), Long- vs short-term orientation (LongShort), Power distance (PowerDist), English language dummy (Lang) and ICRG measure for political risk (PolRisk).

In the second column, we use economy and stock market development and market behavior related variables. These are market capitalization to GDP –ratio (Market cap), the total value of stocks traded to GDP –ratio (Stocks traded) and private credit to GDP –ratio (Credit) and the

⁶ Economic significances at the country level can be found from Appendix D, Table D1.

logarithm of GDP per capita (ln GDP), GDP growth rate (GDP growth) and the average returns (MeanRet) and standard deviations of the returns (STDRet).

In third column we use market participant related variables which have been constructed from microlevel data. These are the institutional investor ownership ratio (IO ratio), average number of analysts following the companies in the index (Analysts) and the average dispersion in the analyst recommendations (Dispersion).

In fourth column, it would combine the above mentioned variables but due to data limitations (we only have maximum of 249 observations from 15 countries) we only include those variables that are significant at the 10% level or better in columns (1)-(3). In all of the models, we also include TRMI non-synchronicity measure (NonSynch) and the yearly average of the VIX index (VIX). We estimate the models with pooled OLS method with Newey-West robust standard errors. Results for Sentiment sensitivity can be found from Table 4 while EmotionVsFact and MarketRisk – sensitivity results are in Appendix E, Table E1 and E2. The results are rather similar between the tables with the difference that for EmotionVsFact, the coefficients have opposite signs.

TABLE 4 HERE

Of the cultural related variables Masculinity and Power distance have significant and negative and Long- vs short-term orientation positive coefficient. These indicate that the more accepted the hierarchical structure of the society is and the more masculine, competition and achievement oriented the culture is, the less it is affected by Sentiment. Also the societies with more respect for traditional and suspicion for change (normative cultures) are less affected by Sentiment when compared with cultures with more pragmatic and modern approaches. Slightly surprisingly, uncertainty avoidance is not significant in any of the estimations. Besides the above mentioned variables, a lower political riskiness (i.e. higher PolRisk number), which is often found from more developed markets, is related to lower sentiment sensitivity.

Surprisingly, none of the financial development variables is a significant but the growth in GDP has a positive relation to sentiment sensitivity, implying that the larger the growth, the larger the effect from changes in Sentiment-measure. Same applies also to yearly standard deviation indicating that during more turmoil periods, also the Sentiment has a larger role to play.

Of the market participant related variables, the higher the share of institutional ownership leads to the lower the effect of sentiment. This could be related to the investor sophistication indicating that the more sophisticated investors, the less they are affected by behavioral factors. The relation between investor sophistication and behavioral biases are also studied in Chang et al. (2015) who find significant effect for individual investors and Kaustia and Rantapuska (2016) who do not report direct mood related differences between institutions and individuals. However, it is puzzling that the number of analysts of the market is positively related to sentiment sensitivity since it could be assumed that the more there are sophisticated investors in the market, the lower the behavioral effects. The coefficient for Analysts remains positive even though the estimation would be performed without IO ratio. One explanation for this could be that

the more sophisticated institutional investors could increase the behavioral biases by following the behavior of less sophisticated investors. Results from both, the IO ratio and Analyst, have to be taken with a grain of salt, however, as, due to data availability, these variables cannot be measured accurately for all of the countries. Thus the results related to these should be considered as indicative.

Non-synchronicity measure has a significant and negative value in all models indicating that sentiment sensitivity is smaller for markets in which the closing time is closer to the moment when the TRMI variables are measured and thus the closing prices should also reflect larger information set.

5. Conclusions

We study the relationship between market returns and several emotions, facts and accounting related news and social media based variables for 15 major stock markets with a daily data. The variables use data from the past 24 hours of news articles and social media accounts and also consider the tone of the text. Originally the 33 variables are formed for each country at the firm level for the largest and most important companies but eventually aggregated to market level using the firms from the most commonly used market indices. We combine the market returns to these data and study whether the changes in indices can explain or predict the market outcomes. We also examine the emotional sensitivity of each of the markets individually and study which variables are able to explain the differences between the sensitivities.

We find several variables that are able to predict following day's returns and especially the positive emotions, Optimism and Joy, can be used to predict returns. Same applies also to aggregate variables, Sentiment, EmotionVsFact and MarketRisk, which measure the differences between all positive and negative news references, the amount of emotion related references net of fact based references and positive emotional references net of negative emotional references, respectively. All these variables have a positive relationship with contemporaneous and next day returns except EmotionVsFact which has a negative correlation with the contemporaneous market returns indicating that either there are more emotions involved during days of negative returns or that the more emotions with respect to facts, the smaller the returns. Moreover, we report a similar return reversal behavior which is consistent with the model by DeLong et al. (1990) and previous studies of Tetlock (2007) and Da et al. (2015) which indicates that the emotions related short term market behavior is mean reverting.

We also examine the differences in the market sensitivities to news based variables and find that emerging markets, and especially China, have larger sensitivity to news and emotions than more developed markets. Interestingly, the market in the US behaves often contrary to other markets and often has an opposite sign than others. Neither of these observations can be explained with non-synchronous measuring of the news based variables and market closing times since other markets closing at the same time do not experience the same effects. To answer these puzzling findings, we collect a set of explanatory variables and aim to explain the results with panel data setting identifying a number of cultural, political, economic, market volatility and market participants related variables that should affect the sensitivities to emotional variables.

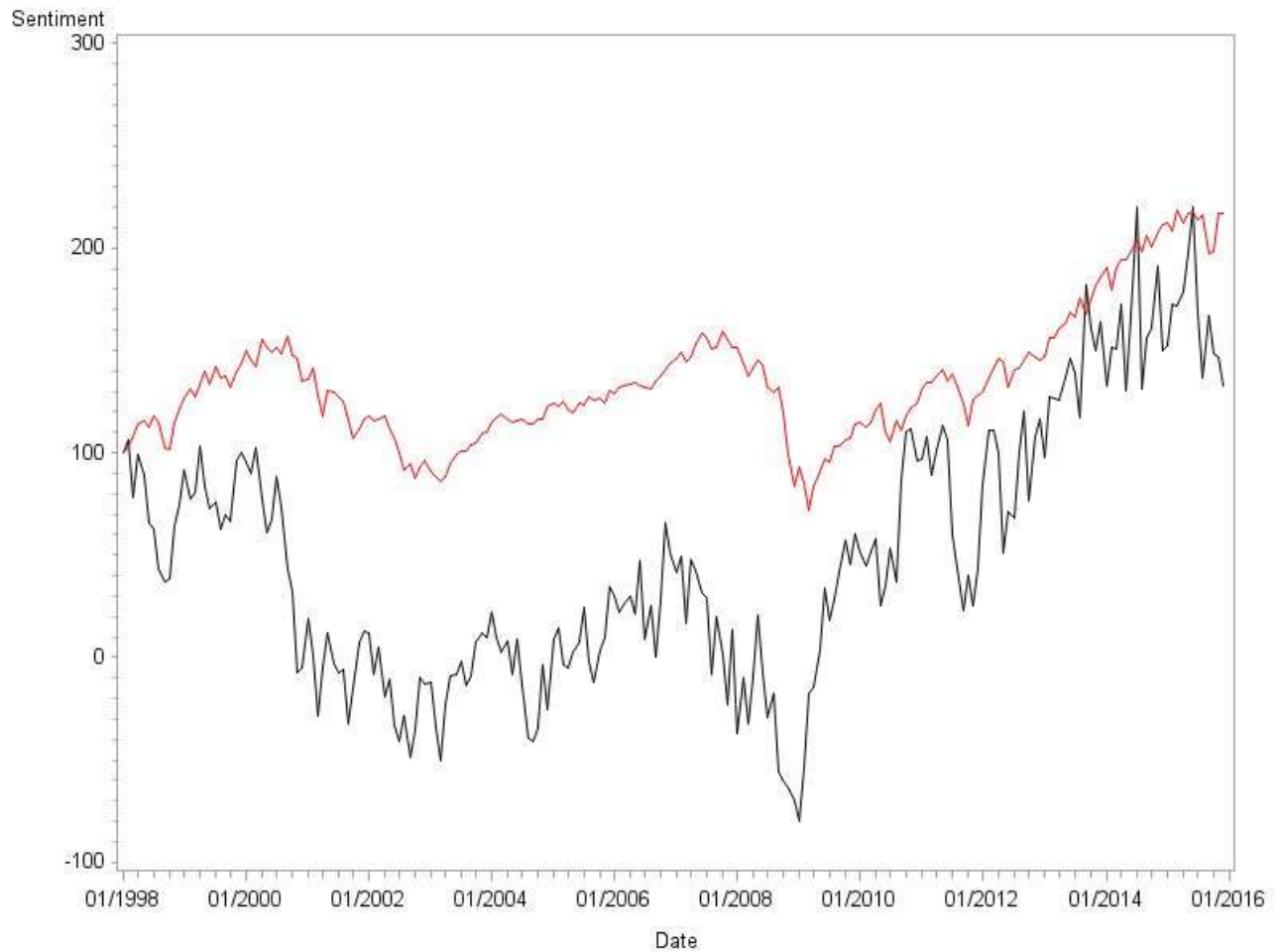
The future research on the topic of news and social media related emotional variables could study the effects at a firm level, considering more carefully the role of institutional investor ownings share and other microlevel variables.

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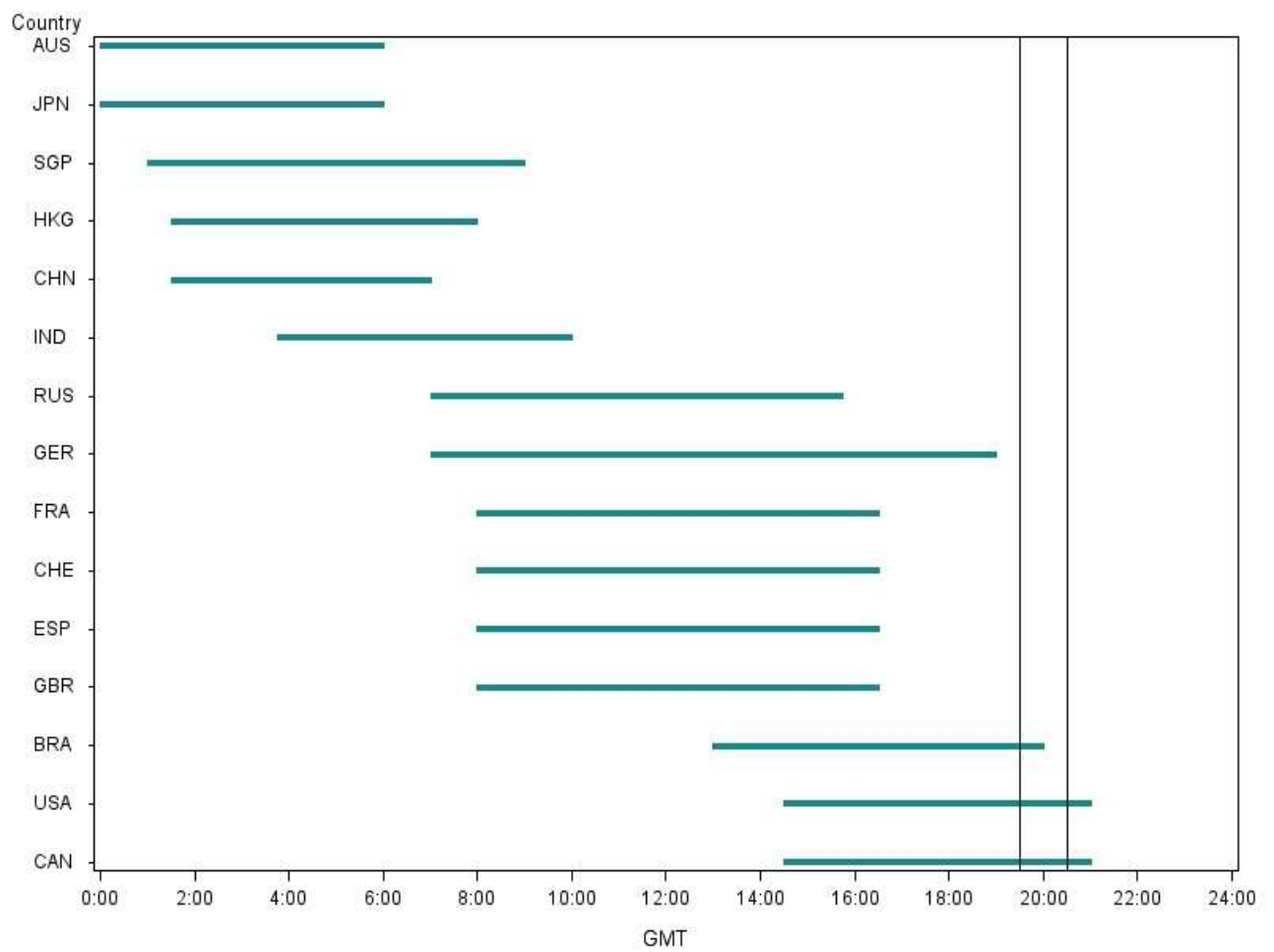
Figures

Figure 1. Media created sentiment and S&P 500



Scaled and demeaned difference between positive and negative news references (black line) and S&P 500 price index (red line).

Figure 2. Opening hours of the international stock markets and TRMI measuring times



Tables

Table 1. Panel estimations

	(1)	(2)	(3)	(4)	(5)	(6)
	Ret(t)	Ret(t+1)	Ret(t+2)	Ret(t+3)	Ret(t+4)	Ret(t+5)
Aggregate variables						
Sentiment	0.018*** [25.691]	0.003*** [3.516]	0.001 [0.666]	-0.002** [-2.136]	0.001 [0.772]	0.001 [0.841]
EmotionVsFact	-0.003*** [-4.564]	0.002** [2.156]	-0.002** [-2.030]	0.002 [1.628]	-0.004*** [-3.145]	0.003*** [3.064]
MarketRisk	0.024*** [9.751]	0.011*** [3.393]	-0.008** [-2.314]	0.008** [2.371]	-0.007* [-1.866]	0.005 [1.642]
Buzz	0.000*** [-3.340]	0.000*** [3.245]	0.000 [0.388]	0.000 [0.884]	0.000 [0.187]	0.000*** [-3.695]
RelativeBuzz	-0.102*** [-3.422]	0.056 [1.434]	0.008 [0.186]	0.028 [0.653]	0.010 [0.235]	0.000 [-0.009]
Emotions related variables						
Optimism	0.014*** [4.776]	0.009** [2.476]	-0.003 [-0.798]	-0.006 [-1.332]	0.004 [1.015]	0.000 [-0.086]
Joy	0.037*** [3.173]	0.049*** [3.236]	-0.052*** [-3.083]	0.002 [0.142]	0.009 [0.547]	-0.014 [-0.896]
LoveHate	-0.010 [-0.976]	0.008 [0.594]	-0.001 [-0.046]	-0.011 [-0.678]	-0.007 [-0.420]	0.002 [0.113]
Trust	0.013*** [4.922]	0.002 [0.505]	0.011*** [2.763]	-0.006 [-1.598]	-0.003 [-0.872]	0.003 [0.943]
Fear	-0.062*** [-5.824]	0.010 [0.732]	-0.009 [-0.594]	-0.013 [-0.820]	-0.009 [-0.598]	-0.007 [-0.459]
Violence	-0.003 [-0.759]	-0.003 [-0.672]	0.007 [1.267]	0.001 [0.224]	0.001 [0.236]	0.012** [2.383]
Gloom	-0.053*** [-11.212]	-0.007 [-1.123]	-0.003 [-0.456]	0.006 [0.849]	-0.001 [-0.198]	-0.011* [-1.746]
Stress	-0.021*** [-5.713]	-0.004 [-0.820]	0.007 [1.216]	-0.004 [-0.817]	0.008 [1.438]	-0.009* [-1.722]
Anger	-0.002 [-0.129]	-0.065*** [-3.551]	0.046** [2.271]	-0.013 [-0.619]	-0.001 [-0.059]	0.014 [0.748]
Uncertainty	-0.018*** [-3.312]	0.031*** [4.319]	-0.035*** [-4.397]	-0.002 [-0.288]	0.009 [1.115]	-0.009 [-1.239]
Fact based measures						
TimeUrgency	0.004 [1.236]	-0.011** [-2.403]	0.005 [1.066]	-0.020*** [-4.042]	0.005 [0.955]	0.001 [0.166]
LongShort	0.000 [0.032]	0.015*** [3.801]	-0.021*** [-4.576]	0.001 [0.263]	0.006 [1.348]	0.006 [1.540]
LongShortForecast	-0.022 [-1.514]	0.041** [2.146]	0.007 [0.320]	-0.033 [-1.533]	0.058*** [2.720]	-0.013 [-0.635]
PriceDirection	0.062*** [15.456]	0.005 [0.918]	0.005 [0.775]	0.004 [0.756]	0.003 [0.505]	0.010* [1.761]
PriceForecast	0.077*** [2.915]	0.001 [0.015]	0.002 [0.041]	-0.009 [-0.241]	-0.008 [-0.215]	0.061* [1.722]
Volatility	-0.007* [2.915]	-0.013** [2.915]	0.029*** [2.915]	-0.012** [2.915]	-0.013** [2.915]	0.007 [2.915]

	[-1.808]	[-2.407]	[5.017]	[-2.140]	[-2.181]	[1.254]
DebtDefault	0.019**	-0.007	-0.049***	0.146***	-0.064***	-0.033**
	[1.978]	[-0.534]	[-3.445]	[10.222]	[-4.505]	[-2.478]
AnalystRating	0.001	0.012	0.017	-0.007	0.057**	-0.066***
	[0.052]	[0.485]	[0.637]	[-0.249]	[2.107]	[-2.625]
Dividends	0.019	0.048*	-0.031	0.004	-0.037	0.031
	[0.980]	[1.916]	[-1.133]	[0.130]	[-1.318]	[1.210]
EarningsForecast	0.001	0.010	0.007	-0.013	0.006	-0.003
	[0.155]	[0.944]	[0.605]	[-1.097]	[0.531]	[-0.261]
FundamentalStrength	0.010***	0.007	-0.001	-0.023***	0.062***	-0.041***
	[2.883]	[1.542]	[-0.167]	[-4.798]	[12.822]	[-9.047]
Layoffs	0.003	-0.016	-0.006	-0.007	0.033	0.005
	[0.162]	[-0.576]	[-0.204]	[-0.244]	[1.066]	[0.176]
Litigation	0.008	0.005	-0.046***	0.101***	-0.046***	0.004
	[0.919]	[0.451]	[-3.470]	[7.684]	[-3.515]	[0.335]
Conflict	-0.003	-0.004	0.003	-0.004	0.009**	-0.002
	[-1.022]	[-1.072]	[0.605]	[-0.844]	[2.126]	[-0.627]
ManagementChange	0.007	-0.003	0.010	-0.006	0.014	-0.029
	[0.388]	[-0.139]	[0.401]	[-0.229]	[0.591]	[-1.268]
ManagementTrust	0.006	-0.014	-0.034**	0.006	0.007	-0.010
	[0.570]	[-0.999]	[-2.178]	[0.401]	[0.460]	[-0.691]
Mergers	0.015**	-0.009	0.004	-0.006	-0.003	0.005
	[2.165]	[-1.003]	[0.371]	[-0.630]	[-0.246]	[0.485]
Innovation	0.031	0.059*	-0.080**	0.040	0.040	0.013
	[1.162]	[1.670]	[-2.043]	[1.011]	[1.013]	[0.373]
FF3+UMD+Controls						
MKT	0.883***	-0.058***	-0.010	0.000	0.006	-0.010
	[187.298]	[-6.234]	[-0.987]	[-0.042]	[0.616]	[-1.001]
HML	0.109***	-0.038**	0.054***	0.003	0.000	0.002
	[10.349]	[-2.275]	[2.924]	[0.174]	[-0.005]	[0.131]
SMB	-0.148***	0.041**	0.002	-0.002	-0.010	0.009
	[-14.458]	[2.545]	[0.106]	[-0.126]	[-0.553]	[0.572]
UMD	-0.059***	0.011	0.024**	-0.005	0.001	0.023**
	[-9.947]	[1.132]	[2.364]	[-0.460]	[0.113]	[2.386]
Ret(t)		0.007	-0.012*	-0.024***	0.025***	-0.023***
		[1.109]	[-1.664]	[-3.419]	[3.481]	[-3.492]
Ret(t-1)	0.003	-0.013***	-0.018***	0.012***	-0.025***	-0.017***
	[1.267]	[-3.095]	[-3.948]	[2.590]	[-5.652]	[-4.203]
Ret(t-2)	0.002	-0.013***	0.008*	-0.016***	-0.013***	0.004
	[0.698]	[-3.423]	[1.888]	[-3.893]	[-3.128]	[1.124]
Ret(t-3)	-0.001	0.019***	-0.013***	-0.015***	0.005	0.015***
	[-0.260]	[4.788]	[-2.960]	[-3.234]	[1.026]	[3.557]
Ret(t-4)	0.008***	-0.026***	-0.013***	0.007	0.005	-0.011***
	[3.246]	[-6.438]	[-2.861]	[1.583]	[1.134]	[-2.565]
Ret(t-5)	0.001	-0.007*	0.002	0.007*	-0.006	-0.002
	[0.500]	[-1.814]	[0.526]	[1.786]	[-1.410]	[-0.427]
VIX	-0.012***	-0.051***	-0.002	-0.001	0.004***	-0.001
	[-15.857]	[-43.714]	[-1.355]	[-0.647]	[3.154]	[-0.572]
Observations	61041	61026	61011	60996	60982	60969

R2	0.45	0.03	0.00	0.00	0.00	0.00
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Table 2. Economic significances of the panel estimations

Variable	Ret(t)	Ret(t+1)	Ret(t+2)	Ret(t+3)	Ret(t+4)	Ret(t+5)
Aggregate variables						
Sentiment	0.145	0.026	0.006	-0.018	0.006	0.006
EmotionVsFact	-0.026	0.016	-0.017	0.013	-0.026	0.023
MarketRisk	0.055	0.025	-0.019	0.019	-0.015	0.012
Buzz	-0.015	0.024	0.003	0.007	0.002	-0.028
RelativeBuzz	-0.019	0.010	0.001	0.005	0.002	0.000
Emotions related variables						
Optimism	0.027	0.018	-0.007	-0.011	0.008	-0.001
Joy	0.018	0.023	-0.025	0.001	0.004	-0.007
LoveHate	-0.006	0.004	0.000	-0.006	-0.004	0.001
Trust	0.027	0.004	0.022	-0.013	-0.007	0.007
Fear	-0.033	0.005	-0.005	-0.007	-0.005	-0.003
Violence	-0.004	-0.005	0.011	0.002	0.002	0.018
Gloom	-0.063	-0.008	-0.004	0.007	-0.002	-0.013
Stress	-0.032	-0.006	0.010	-0.007	0.012	-0.013
Anger	-0.001	-0.026	0.018	-0.005	0.000	0.006
Uncertainty	-0.019	0.032	-0.037	-0.002	0.009	-0.010
Fact based measures						
TimeUrgency	0.007	-0.019	0.009	-0.035	0.008	0.001
LongShort	0.000	0.027	-0.037	0.002	0.011	0.011
LongShortForecast	-0.009	0.016	0.003	-0.013	0.023	-0.005
PriceDirection	0.087	0.007	0.006	0.006	0.004	0.013
PriceForecast	0.019	0.000	0.000	-0.002	-0.002	0.015
Volatility	-0.010	-0.017	0.040	-0.017	-0.018	0.009
DebtDefault	0.011	-0.004	-0.027	0.080	-0.035	-0.018
AnalystRating	0.000	0.004	0.005	-0.002	0.017	-0.020
Dividends	0.005	0.013	-0.009	0.001	-0.010	0.009
EarningsForecast	0.001	0.007	0.005	-0.009	0.004	-0.002
FundamentalStrength	0.016	0.011	-0.001	-0.038	0.101	-0.066
Layoffs	0.001	-0.004	-0.002	-0.002	0.009	0.001
Litigation	0.005	0.003	-0.028	0.062	-0.028	0.002
Conflict	-0.006	-0.008	0.005	-0.007	0.017	-0.005
ManagementChange	0.002	-0.001	0.003	-0.002	0.005	-0.010
ManagementTrust	0.003	-0.007	-0.018	0.003	0.004	-0.005
Mergers	0.012	-0.007	0.003	-0.005	-0.002	0.004
Innovation	0.006	0.012	-0.016	0.008	0.008	0.003

Table 3. Time series estimations for each market separately

Aggregate variables	AUS	FRA	CHN	GER	SGP	GBR	HKG	ESP	BRA	IND	JPN	RUS	USA	CHE	CAN
Sentiment	0.038*** [11.943]	0.007*** [3.288]	0.153*** [26.265]	0.006*** [3.327]	0.017*** [13.401]	0.007*** [4.022]	0.032*** [17.724]	0.009*** [7.403]	0.031*** [10.145]	0.043*** [14.577]	0.011*** [6.321]	0.007* [1.924]	0.001 [0.474]	0.004 [1.619]	0.028*** [5.163]
EmotionVsFact	-0.008* [-1.658]	0.002 [0.877]	-0.087*** [-7.709]	-0.005** [-2.275]	-0.004*** [-2.598]	0.001 [0.193]	-0.005** [-2.298]	-0.002* [-1.790]	-0.004 [-1.051]	0.000 [0.130]	-0.005* [-1.870]	0.000 [-0.095]	-0.008*** [-2.955]	0.003 [0.913]	-0.013** [-2.040]
MarketRisk	0.051*** [4.308]	0.001 [0.160]	0.179*** [6.115]	0.002 [0.301]	0.019*** [4.004]	0.019*** [2.905]	0.035*** [5.450]	0.012*** [3.438]	0.044*** [4.698]	0.045*** [4.936]	0.017** [2.519]	0.008 [0.684]	-0.001 [-0.154]	-0.016** [-2.277]	0.052*** [3.193]
Buzz	0.000 [0.047]	0.000 [-0.566]	-0.001 [-1.322]	0.000 [1.490]	0.000 [-1.400]	0.000 [0.457]	0.000 [-1.265]	0.000*** [-2.893]	-0.001*** [-2.733]	-0.001** [-2.405]	0.000 [0.577]	0.000 [-0.119]	0.000*** [6.904]	0.000 [0.367]	-0.001*** [-4.054]
RelativeBuzz	-0.099 [-0.963]	-0.053 [-1.226]	-1.422*** [-7.201]	-0.143* [-1.787]	-0.521 [-1.062]	0.046 [1.112]	-0.769*** [-3.637]	-0.681*** [-2.850]	-2.022*** [-3.647]	-0.709** [-2.196]	0.034 [0.941]	-1.611 [-1.611]	-0.009* [-1.746]	-0.028 [-0.349]	-0.141* [-1.936]
Emotions related variables															
Optimism	0.033*** [2.625]	0.007 [0.866]	0.073** [2.124]	-0.004 [-0.585]	0.011** [2.040]	0.008 [1.141]	0.004 [0.526]	0.008* [1.806]	0.049*** [4.329]	0.046*** [4.304]	0.017** [2.218]	0.001 [0.084]	-0.014 [-1.405]	-0.005 [-0.675]	0.048*** [2.582]
Joy	0.017 [0.359]	0.027 [0.955]	0.118 [0.881]	-0.020 [-0.933]	0.034* [1.709]	0.004 [0.153]	0.057* [1.714]	0.017 [0.699]	0.088** [2.135]	0.104** [2.371]	0.063** [2.026]	0.045 [0.767]	-0.060*** [-2.607]	0.022 [0.808]	0.121* [1.934]
LoveHate	-0.011 [-0.319]	-0.009 [-0.227]	-0.138 [-0.805]	-0.049** [-2.030]	0.002 [0.113]	-0.001 [-0.036]	0.000 [-0.008]	-0.002 [-0.174]	0.070 [1.543]	-0.023 [-0.567]	-0.047 [-1.033]	-0.010 [-0.203]	-0.116*** [-3.763]	0.025 [0.701]	0.136* [1.658]
Trust	0.013 [1.438]	0.013* [1.822]	0.078*** [2.614]	0.006 [0.952]	0.007 [1.483]	0.002 [0.308]	0.028*** [4.121]	0.004 [0.857]	0.031*** [2.787]	0.026** [2.221]	0.008 [1.255]	0.010 [0.734]	0.024*** [3.129]	-0.005 [-0.726]	-0.006 [-0.486]
Fear	-0.058 [-1.282]	-0.038 [-1.114]	-0.957*** [-8.016]	-0.044* [-1.779]	-0.042** [-2.244]	-0.019 [-0.714]	-0.072*** [-2.598]	-0.034** [-2.065]	-0.116*** [-2.719]	-0.083* [-1.773]	-0.053** [-1.990]	0.021 [0.409]	0.023 [0.488]	0.017 [0.558]	0.057 [0.741]
Violence	-0.013 [-1.022]	0.002 [0.351]	0.079* [1.702]	-0.010 [-1.079]	0.015* [1.943]	0.005 [0.499]	0.006 [0.478]	0.000 [0.044]	-0.011 [-0.711]	-0.014 [-1.195]	0.009 [0.941]	-0.010 [-0.582]	-0.016*** [-2.797]	0.007 [0.900]	0.059*** [3.288]
Gloom	-0.033* [-1.944]	-0.001 [-0.094]	-0.402*** [-8.706]	-0.002 [-0.205]	-0.015 [-1.598]	0.003 [0.301]	-0.037*** [-2.947]	-0.023*** [-3.073]	-0.087*** [-5.294]	-0.065*** [-3.565]	-0.032*** [-2.925]	-0.053** [-2.009]	-0.023* [-1.782]	-0.003 [-0.256]	-0.080*** [-2.874]
Stress	0.000 [-0.015]	-0.005 [-0.435]	-0.228*** [-5.204]	-0.005 [-0.557]	0.007 [0.962]	0.013 [1.306]	-0.014 [-1.409]	-0.010* [-1.851]	-0.031** [-2.070]	-0.033** [-2.117]	-0.008 [-0.753]	-0.019 [-1.174]	-0.034*** [-2.833]	0.003 [0.337]	-0.054** [-2.045]
Anger	0.083* [2.625]	0.010 [0.866]	0.140 [2.124]	0.009 [-0.585]	0.002 [2.040]	-0.023 [1.141]	-0.052 [0.526]	0.018 [1.806]	-0.044 [4.329]	0.089* [4.304]	0.048 [2.218]	-0.066 [0.084]	-0.094*** [-1.405]	0.020 [-0.675]	0.006 [2.582]

	[1.658]	[0.310]	[0.885]	[0.308]	[0.064]	[-0.740]	[-1.178]	[0.902]	[-0.706]	[1.773]	[1.170]	[-0.885]	[-3.227]	[0.675]	[0.091]
Uncertainty	0.060*	-0.045**	0.173*	-0.002	0.022	-0.007	0.017	0.006	0.024	0.057**	0.042**	-0.057***	-0.007	-0.022	0.014
	[1.742]	[-2.155]	[1.941]	[-0.146]	[1.596]	[-0.434]	[1.030]	[0.828]	[1.087]	[2.500]	[2.069]	[-2.743]	[-0.278]	[-1.149]	[0.322]
Fact based measures															
TimeUrgency	-0.016	0.003	0.008	-0.007	0.003	0.002	0.020	-0.002	0.001	0.012	0.006	0.003	-0.025	0.005	-0.002
	[-0.812]	[0.224]	[0.145]	[-0.748]	[0.465]	[0.140]	[1.611]	[-0.289]	[0.069]	[0.685]	[0.567]	[0.224]	[-1.499]	[0.399]	[-0.077]
LongShort	0.021	0.016	-0.049	-0.001	0.008	-0.003	0.010	-0.003	0.006	0.073***	0.026*	-0.008	0.048***	-0.017	-0.061**
	[0.996]	[1.170]	[-1.455]	[-0.112]	[1.116]	[-0.257]	[1.077]	[-0.877]	[0.369]	[4.157]	[1.683]	[-0.658]	[3.410]	[-1.216]	[-2.142]
LongShortForecast	0.016	-0.102	-0.076	0.040	-0.027	-0.050	-0.056	-0.025	0.075	0.063	0.038	-0.033	0.113	-0.038	0.040
	[0.132]	[-1.533]	[-0.333]	[1.063]	[-0.921]	[-0.928]	[-1.316]	[-1.204]	[0.913]	[0.777]	[0.600]	[-0.640]	[1.387]	[-0.597]	[0.288]
PriceDirection	0.227***	0.005	0.427***	0.021**	0.074***	0.060***	0.095***	0.035***	0.087***	0.105***	0.034***	0.025	-0.060***	0.029**	0.246***
	[11.176]	[0.435]	[8.809]	[2.029]	[9.892]	[4.879]	[9.626]	[6.060]	[6.094]	[7.225]	[4.033]	[1.101]	[-4.365]	[2.035]	[7.113]
PriceForecast	0.145	-0.088	0.813**	-0.035	0.118**	0.174***	0.107**	0.088**	0.038	0.074	-0.014	0.181	-0.210*	-0.141*	0.153
	[1.341]	[-1.043]	[2.496]	[-0.535]	[2.059]	[2.671]	[2.081]	[2.114]	[0.488]	[0.823]	[-0.265]	[0.868]	[-1.953]	[-1.690]	[0.999]
Volatility	0.020	-0.009	0.254***	0.003	0.008	0.020	0.032***	-0.010	0.007	0.000	0.029**	-0.023	0.034*	0.017	0.058
	[0.777]	[-0.539]	[4.357]	[0.209]	[1.110]	[1.367]	[2.608]	[-1.548]	[0.436]	[-0.021]	[2.161]	[-1.639]	[1.678]	[0.966]	[1.526]
DebtDefault	0.032	-0.022	0.053	0.009	-0.063***	0.041	-0.019	0.000	-0.046	-0.047	-0.025	0.042	-0.005	-0.009	-0.046
	[0.921]	[-0.695]	[0.346]	[0.367]	[-2.573]	[1.407]	[-0.634]	[-0.001]	[-0.939]	[-0.795]	[-0.779]	[1.301]	[-0.198]	[-0.246]	[-0.571]
AnalystRating	0.013	0.045	0.117	-0.008	0.015	0.027	0.077	-0.014	0.012	0.112	-0.043	-0.012	0.023	-0.001	0.117
	[0.133]	[0.903]	[0.423]	[-0.199]	[0.384]	[0.584]	[1.248]	[-0.577]	[0.148]	[1.254]	[-0.547]	[-0.162]	[0.428]	[-0.018]	[0.986]
Dividends	0.046	-0.071	-0.496	0.016	0.064	-0.001	-0.065	0.012	0.282**	-0.024	0.051	0.020	-0.001	-0.004	0.057
	[0.325]	[-0.815]	[-0.628]	[0.237]	[0.626]	[-0.023]	[-0.714]	[0.481]	[2.245]	[-0.170]	[0.469]	[0.360]	[-0.021]	[-0.065]	[0.507]
EarningsForecast	0.018	0.028	0.151	0.009	0.007	-0.016	0.097***	0.015*	-0.015	-0.012	-0.005	-0.024	0.017	-0.009	-0.003
	[0.413]	[0.847]	[1.467]	[0.459]	[0.369]	[-0.806]	[3.446]	[1.743]	[-0.352]	[-0.478]	[-0.273]	[-0.571]	[0.600]	[-0.432]	[-0.057]
FundamentalStrength	-0.008	0.005	0.074*	0.009	0.022***	-0.004	0.033***	0.003	-0.015	0.015	0.005	0.007	0.016	0.010	-0.005
	[-0.470]	[0.544]	[1.849]	[1.062]	[2.700]	[-0.585]	[3.520]	[0.688]	[-0.944]	[1.149]	[0.577]	[0.480]	[1.442]	[0.992]	[-0.194]
Layoffs	0.027	-0.023	0.189	0.008	0.016	-0.025	0.051	-0.028	0.153**	-0.048	0.007	-0.245	-0.110**	-0.058	0.036
	[0.387]	[-0.399]	[0.549]	[0.278]	[0.231]	[-0.591]	[0.745]	[-1.160]	[2.178]	[-0.742]	[0.147]	[-0.751]	[-2.006]	[-1.170]	[0.324]
Litigation	0.030	-0.015	0.296**	-0.031*	0.011	0.023	-0.062	0.014	0.043	0.011	-0.005	0.011	-0.026	0.016	0.040
	[1.210]	[-0.594]	[2.109]	[-1.652]	[0.654]	[0.936]	[-1.329]	[1.212]	[1.010]	[0.361]	[-0.217]	[0.210]	[-1.069]	[0.903]	[0.555]
Conflict	0.021	0.002	-0.030	-0.003	0.001	0.008	-0.012	-0.001	0.001	0.017	-0.007	-0.010	-0.032***	-0.002	-0.014
	[1.462]	[0.260]	[-0.688]	[-0.440]	[0.105]	[0.897]	[-1.294]	[-0.249]	[0.119]	[1.174]	[-0.776]	[-0.833]	[-2.561]	[-0.260]	[-0.596]
ManagementChange	0.040	-0.071	-0.262	-0.031	0.004	-0.007	-0.051	-0.045	0.112	0.055	-0.031	-0.011	-0.043	-0.053	0.018

	[0.613]	[-1.132]	[-1.078]	[-0.721]	[0.115]	[-0.122]	[-1.173]	[-1.358]	[1.070]	[0.754]	[-0.417]	[-0.177]	[-0.469]	[-0.967]	[0.157]
ManagementTrust	0.041	0.050*	-0.027	0.023	0.036	-0.003	0.026	-0.002	-0.048	0.042	0.015	-0.014	-0.028	0.047	-0.046
	[1.063]	[1.707]	[-0.181]	[1.035]	[1.453]	[-0.128]	[0.925]	[-0.186]	[-0.896]	[0.889]	[0.388]	[-0.294]	[-0.610]	[1.595]	[-0.678]
Mergers	0.107***	0.001	0.301**	0.016	0.025	-0.015	0.026	0.001	0.047	0.016	0.086**	0.029	0.080***	-0.038**	-0.074
	[2.909]	[0.049]	[2.526]	[1.074]	[1.340]	[-0.870]	[0.944]	[0.151]	[1.537]	[0.662]	[2.263]	[0.721]	[3.170]	[-2.312]	[-1.410]
Innovation	-0.058	0.053	0.727***	-0.084*	-0.012	0.015	0.061	0.038	0.225*	0.060	-0.066	-0.017	0.124**	0.017	-0.065
	[-0.558]	[1.083]	[2.640]	[-1.813]	[-0.276]	[0.376]	[0.742]	[1.065]	[1.651]	[0.602]	[-1.046]	[-0.066]	[2.160]	[0.292]	[-0.521]
FF3+UMD+Controls															
MKT	0.844***	1.097***	0.688***	0.990***	0.619***	0.892***	0.760***	1.152***	0.925***	0.517***	1.133***	1.095***	0.953***	0.808***	0.976***
	[45.784]	[142.772]	[18.362]	[85.147]	[35.353]	[98.429]	[40.759]	[84.295]	[28.384]	[18.298]	[102.244]	[27.962]	[309.575]	[70.167]	[57.429]
HML	0.277***	-0.102***	0.881***	-0.033	0.062	-0.052***	0.034	0.093***	0.423***	0.051	-0.012	0.213**	-0.002	0.033	0.207***
	[6.443]	[-6.559]	[7.223]	[-1.423]	[1.530]	[-2.846]	[0.782]	[3.306]	[8.783]	[0.770]	[-0.458]	[2.508]	[-0.343]	[1.407]	[8.271]
SMB	-0.079*	-0.349***	0.340***	-0.518***	-0.247***	-0.328***	-0.527***	-0.010	0.174***	-0.138**	-0.094***	0.565***	-0.208***	-0.070***	0.096***
	[-1.727]	[-21.518]	[3.586]	[-21.216]	[-5.764]	[-17.205]	[-11.359]	[-0.331]	[3.306]	[-2.001]	[-3.291]	[6.822]	[-42.649]	[-2.906]	[3.534]
UMD	-0.167***	-0.064***	0.013	-0.088***	-0.107***	-0.041***	-0.148***	-0.054***	0.083***	0.070*	-0.123***	0.021	-0.048***	-0.051***	0.064***
	[-7.031]	[-7.166]	[0.226]	[-6.618]	[-4.797]	[-3.895]	[-6.124]	[-3.372]	[2.929]	[1.894]	[-8.505]	[0.440]	[-18.069]	[-3.802]	[4.360]
Ret(t-1)	-0.041***	-0.014***	0.020	-0.022***	-0.061***	-0.010*	-0.051***	-0.006	0.092***	0.055***	-0.059***	0.016	-0.037***	-0.009	0.123***
	[-3.666]	[-3.301]	[1.093]	[-3.577]	[-5.004]	[-1.772]	[-4.582]	[-0.766]	[7.169]	[3.757]	[-8.689]	[1.574]	[-19.412]	[-1.158]	[12.593]
Ret(t-2)	0.013	-0.005	-0.040**	0.029***	0.036***	0.000	0.009	-0.012*	-0.031**	0.000	-0.015**	0.019**	0.000	-0.023***	-0.064***
	[1.128]	[-1.203]	[-2.219]	[4.855]	[3.024]	[-0.067]	[0.784]	[-1.719]	[-2.398]	[-0.008]	[-2.167]	[2.109]	[-0.246]	[-2.842]	[-6.532]
Ret(t-3)	-0.042***	-0.006	0.032*	0.020***	0.010	-0.020***	0.012	-0.003	-0.014	0.030**	-0.003	0.008	0.006***	-0.012	0.020**
	[-3.808]	[-1.457]	[1.779]	[3.316]	[0.839]	[-3.547]	[1.118]	[-0.397]	[-1.047]	[2.105]	[-0.402]	[0.812]	[2.867]	[-1.496]	[2.013]
Ret(t-4)	0.026**	-0.001	0.051***	0.006	0.047***	0.008	0.001	-0.005	0.010	0.025*	0.005	-0.007	0.002	0.007	0.018*
	[2.330]	[-0.199]	[2.811]	[0.951]	[3.940]	[1.502]	[0.073]	[-0.744]	[0.772]	[1.744]	[0.770]	[-0.722]	[0.886]	[0.858]	[1.850]
Ret(t-5)	-0.022**	-0.007*	0.015	-0.011*	0.023*	0.002	-0.016	0.011	0.004	-0.012	0.008	0.005	0.001	-0.035***	-0.023**
	[-1.989]	[-1.808]	[0.816]	[-1.893]	[1.953]	[0.315]	[-1.468]	[1.559]	[0.324]	[-0.809]	[1.154]	[0.612]	[0.491]	[-4.438]	[-2.367]
VIX	-0.024***	-0.001	-0.014***	-0.007***	-0.027***	0.000	-0.016***	-0.004**	-0.003	-0.033***	0.014***	-0.024***	-0.008***	0.007***	0.028***
	[-9.684]	[-1.312]	[-2.901]	[-4.126]	[-11.705]	[-0.111]	[-6.120]	[-2.074]	[-0.446]	[-8.634]	[9.436]	[-4.206]	[-13.767]	[4.309]	[8.993]
Observations	4280	4280	2529	4279	4052	4277	4238	4114	4135	4087	4268	3663	4279	4279	4281
R ²	0.49	0.93	0.18	0.85	0.43	0.87	0.50	0.80	0.33	0.17	0.82	0.36	0.98	0.73	0.61

Table 4. Determinants of sentiment sensitivity

Sentiment	(1)	(2)	(3)	(4)
Intercept	1.502*** [6.95]	0.942*** [4.14]	0.407*** [6.34]	1.516*** [5.39]
Indiv	-0.001 [-0.86]			
Masc	-0.006*** [-4.35]			-0.004** [-1.98]
Uncert	-0.001 [-1.12]			
LongShort	0.005*** [4.19]			0.003* [1.70]
PowerDist	-0.006*** [-3.63]			-0.007*** [-4.01]
Lang	0.042 [0.88]			
PolRisk	-0.010*** [-6.06]			-0.014*** [-3.56]
Market cap		0.000 [-0.30]		
Stocks traded		0.000 [1.15]		
Credit		0.001 [1.50]		
ln GDP		-0.087*** [-4.37]		0.017 [0.61]
GDP growth		0.016** [2.56]		0.019** [2.52]
MeanRet		-0.097 [-0.49]		
STDRet		0.169*** [4.13]		0.096* [1.86]
IO ratio			-0.382*** [-5.35]	-0.171* [-1.86]
Analysts			0.045*** [3.27]	0.038** [2.58]
Dispersion			0.252 [1.33]	
NonSynch	-0.010*** [-4.70]	-0.011*** [-5.83]	-0.027*** [-7.17]	-0.020*** [-5.09]
VIX	0.008*** [3.34]	-0.004 [-1.24]	0.007** [2.25]	0.006 [1.46]
Observations	204	213	156	138
R ²	0.55	0.52	0.48	0.65

Appendix

Appendix A, Table A1. Countries and their indices

Country	Region	TRMI Description	Resembling Index	Datastream index used for market returns
USA	North America	Top 500 US-based companies	S&P 500	S&P 500 COMPOSITE
Australia	Pacific	Top 500 Australia-based companies	ASX All Ordinaries	S&P/ASX 300
Brazil	North America	Top 50 Brazil-based companies	IBRX 50	TR Brazil 50 - XBR50IL
Canada	North America	Top 250 Canada-based & Toronto-listed companies	S&P/TSX Composite	S&P/TSX COMPOSITE INDEX
Switzerland	Europe	Top 20 Switzerland-based companies	Swiss Market	SWISS MARKET (SMI)
China	Pacific	Top 300 China-based companies	CSI 300	SHANGHAI SHENZHEN CSI 300
Germany	Europe	Top 30 Germany-based companies	Deutsche Börse DAX 30	DAX 30 PERFORMANCE
Spain	Europe	Top 35 Spain-based companies	IBEX 35	IBEX 35
France	Europe	Top 40 France-based companies	CAC 40	FRANCE CAC 40
UK	Europe	Top 100 UK-based & LSE-listed companies	FTSE 100	FTSE 100
Hong Kong	Pacific	Top 50 Hong Kong-listed companies based in Hong Kong and China	Hang Seng	HANG SENG
India	Pacific	Top 50 India-based companies	Nifty 50	NIFTY 500
Japan	Pacific	Top 225 Japan-based companies	Nikkei 225	NIKKEI 225 STOCK AVERAGE
Russia	Europe	Top 50 Russia-based companies	RTS	RUSSIA RTS INDEX
Singapore	Pacific	Top 30 Singapore-based companies	FTSE Straits Times	STRAITS TIMES INDEX L

Appendix B, Table B1. TRMI variables and their description

Index	Description: 24 hour rolling average score of references in news and social media to...	Range
Aggregate variables		
Sentiment	overall positive references, net of negative references	-1 to 1
EmotionVsFact	all emotional sentiments, net of all factual and topical references	-1 to 1
MarketRisk	positive emotionality and positive expectations net of negative emotionality and negative expectations. Includes factors from social media found characteristic of speculative bubbles – higher values indicate greater bubble risk. Also known as the “Bubbleometer.”	-1 to 1
Buzz	sum of entity-specific words and phrases used in TRMI computations	
Relative Buzz	fraction of all Buzz which belongs to a particular asset [asset/group]	0 to 1
Emotions related variables		
Optimism	optimism, net of references to pessimism	-1 to 1
Joy	happiness and affection	0 to 1*
LoveHate	love, net of references to hate	-1 to 1
Trust	trustworthiness, net of references connoting corruption	-1 to 1
Fear	fear and anxiety	0 to 1*
Violence	violence and war	0 to 1*
Gloom	gloom and negative future outlook	0 to 1*
Stress	distress and danger	0 to 1*
Anger	anger and disgust	0 to 1*
Uncertainty	uncertainty and confusion	0 to 1*
Fact based measures		
TimeUrgency	urgency and timeliness, net of references to tardiness and delays	-1 to 1
LongShort	buying, net of references to shorting or selling	-1 to 1
LongShortForecast	forecasts of buying, net of references to forecasts of shorting or selling	-1 to 1
PriceDirection	price increases, net of references to price decreases	-1 to 1
PriceForecast	forecasts of asset price rises, net of references to forecasts of asset price drops	-1 to 1
Volatility	volatility in market prices or business conditions	0 to 1*
DebtDefault	debt defaults and bankruptcies	0 to 1*
AnalystRating	upgrade activity, net of references to downgrade activity	-1 to 1
Dividends	dividends rising, net of references to dividends falling	0 to 1*
EarningsForecast	expectations about improving earnings, less those of worsening earnings	-1 to 1
FundamentalStrength	positivity about accounting fundamentals, net of references to negativity about accounting fundamentals	-1 to 1
Layoffs	staff reductions and layoffs	0 to 1*
Litigation	litigation and legal activity	0 to 1*
Conflict	disagreement and swearing net of agreement and conciliation	-1 to 1
ManagementChange	changes in a company's management team, net of references to stability in the management team	-1 to 1
ManagementTrust	trust expressed in a company's management team, net of references to reports of unethical behavior amongst the management team	-1 to 1
Mergers	merger or acquisition activity	0 to 1*
Innovation	innovativeness	0 to 1*

Appendix C, Table C1. Means and Standard deviations of the TRMI variable changes

	Parameter	ALL	AUS	FRA	CHN	GER	SGP	GBR	HKG	ESP	BRA	IND	JPN	RUS	USA	CHE	CAN
Aggregate variables																	
Sentiment	MEAN	-0.22	-0.14	-0.09	-0.17	-0.19	-0.63	-0.04	-0.45	-0.29	-0.35	-0.12	-0.45	-0.55	0.03	0.03	0.07
	STD	7.95	5.57	3.25	5.86	5.76	12.64	4.54	9.98	10.15	8.66	9.50	7.05	14.54	1.23	4.79	2.58
EmotionVsFact	MEAN	0.08	-0.14	-0.37	-0.24	-0.25	0.54	-0.17	0.24	1.26	0.28	-0.36	-0.26	1.31	-0.25	-0.22	-0.25
	STD	7.33	3.76	2.42	3.04	4.22	9.08	3.07	7.48	11.34	7.71	9.33	3.60	17.07	0.87	3.92	2.17
MarketRisk	MEAN	0.04	0.08	0.01	0.06	0.05	0.06	0.08	0.07	0.08	0.04	0.02	0.00	-0.04	0.03	0.06	0.04
	STD	2.29	1.47	0.93	1.20	2.04	3.18	1.25	2.64	3.32	2.73	2.93	1.72	4.18	0.32	1.58	0.87
Buzz	MEAN	34.19	29.12	29.56	35.64	40.08	45.02	34.48	38.44	43.44	41.49	32.42	35.40	32.37	24.57	27.08	26.02
	STD	83.60	68.25	54.72	74.23	89.74	111.92	72.45	95.02	116.19	90.37	88.12	77.20	119.07	36.78	67.96	45.34
RelativeBuzz	MEAN	0.01	0.00	0.02	0.03	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.03	0.00	-0.02	0.00	0.01
	STD	0.18	0.16	0.17	0.19	0.13	0.03	0.20	0.08	0.05	0.05	0.08	0.28	0.05	0.46	0.12	0.18
Emotions related variables																	
Optimism	MEAN	-0.02	-0.01	-0.01	-0.01	-0.03	-0.09	0.02	-0.01	-0.01	0.01	-0.04	-0.05	-0.05	-0.02	0.00	-0.01
	STD	1.98	1.44	0.79	1.02	1.92	2.74	1.11	2.31	2.67	2.31	2.53	1.41	3.65	0.26	1.43	0.76
Joy	MEAN	-0.03	-0.03	-0.03	-0.02	-0.05	-0.04	-0.04	-0.02	-0.01	-0.04	-0.02	-0.04	0.01	-0.02	-0.02	0.00
	STD	0.48	0.35	0.23	0.27	0.47	0.76	0.31	0.50	0.48	0.64	0.66	0.35	0.81	0.11	0.36	0.22
LoveHate	MEAN	-0.01	0.00	-0.01	-0.02	-0.03	-0.04	-0.02	-0.01	0.01	-0.02	-0.02	-0.02	0.03	-0.02	-0.01	-0.01
	STD	0.54	0.50	0.17	0.20	0.40	0.78	0.25	0.49	0.85	0.65	0.72	0.24	1.04	0.08	0.31	0.19
Trust	MEAN	0.07	0.04	0.07	0.08	0.06	0.09	0.11	0.09	0.11	0.08	0.05	0.08	0.02	0.05	0.04	0.08
	STD	2.08	1.91	0.91	1.16	1.71	3.06	1.32	2.53	2.71	2.53	2.28	1.58	3.65	0.31	1.55	1.09
Fear	MEAN	0.01	-0.01	0.00	0.00	0.00	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.00	0.00	0.00
	STD	0.53	0.39	0.19	0.29	0.41	0.80	0.30	0.63	0.76	0.63	0.54	0.39	1.01	0.05	0.34	0.20
Violence	MEAN	-0.12	-0.22	-0.22	-0.11	-0.17	-0.10	-0.14	-0.08	-0.04	-0.14	0.07	-0.22	-0.01	-0.14	-0.10	-0.15
	STD	1.54	1.34	0.94	0.75	1.10	1.90	0.83	1.31	1.67	1.71	2.81	0.99	2.82	0.40	1.21	0.77
Gloom	MEAN	0.01	-0.01	-0.01	-0.01	0.00	0.04	-0.02	0.03	0.09	0.02	-0.02	0.02	0.05	-0.02	-0.02	-0.01
	STD	1.21	1.03	0.54	0.74	1.01	1.71	0.78	1.36	1.64	1.59	1.57	0.96	1.95	0.19	0.87	0.51
Stress	MEAN	-0.03	-0.07	-0.09	-0.11	-0.07	0.01	-0.07	-0.06	0.06	0.00	-0.06	-0.10	0.18	-0.05	-0.04	-0.08
	STD	1.51	1.04	0.61	0.79	1.11	2.00	0.83	1.67	2.13	1.76	1.76	0.93	3.15	0.20	1.07	0.55

Anger	MEAN	-0.02	-0.03	-0.04	-0.03	-0.03	-0.03	-0.04	-0.01	-0.02	-0.02	-0.02	-0.03	0.00	-0.03	-0.03	-0.02
	STD	0.40	0.33	0.22	0.23	0.33	0.58	0.26	0.37	0.62	0.41	0.52	0.24	0.66	0.08	0.38	0.21
Uncertainty	MEAN	-0.02	-0.03	-0.03	-0.04	-0.03	-0.05	-0.05	-0.03	-0.03	-0.04	0.00	-0.02	0.07	-0.01	-0.04	-0.03
	STD	1.04	0.53	0.32	0.39	0.71	1.13	0.48	1.02	1.49	1.29	1.16	0.51	2.52	0.10	0.72	0.34
Fact based measures																	
TimeUrgency	MEAN	-0.06	-0.08	-0.08	-0.07	-0.06	-0.09	-0.07	-0.04	-0.04	-0.08	-0.02	-0.17	-0.08	-0.03	-0.03	-0.03
	STD	1.73	1.02	0.49	0.67	1.04	2.54	0.66	1.37	1.97	1.80	1.54	0.97	4.67	0.15	0.83	0.46
LongShort	MEAN	0.00	0.02	-0.01	-0.11	0.01	-0.01	-0.02	-0.02	0.04	0.00	0.00	-0.02	0.02	-0.01	0.02	-0.01
	STD	1.77	0.85	0.48	1.05	1.00	2.13	0.70	1.80	3.43	1.61	1.90	0.69	3.95	0.18	1.04	0.51
LongShortForecast	MEAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	-0.01	0.00	0.00	0.00
	STD	0.40	0.14	0.10	0.15	0.25	0.53	0.15	0.38	0.55	0.31	0.35	0.16	1.10	0.03	0.19	0.11
PriceDirection	MEAN	0.03	0.01	0.03	0.03	0.04	0.05	0.03	0.04	0.05	0.02	0.03	0.00	0.02	0.01	0.02	0.01
	STD	1.40	0.86	0.53	0.74	0.98	2.07	0.68	1.81	2.16	1.81	1.74	1.48	2.14	0.19	0.86	0.41
PriceForecast	MEAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	STD	0.24	0.16	0.08	0.11	0.15	0.27	0.12	0.33	0.27	0.33	0.28	0.23	0.53	0.02	0.15	0.09
Volatility	MEAN	0.00	-0.02	-0.01	0.00	-0.03	0.01	0.00	0.02	0.00	0.01	0.01	-0.02	0.10	0.00	0.00	0.00
	STD	1.39	0.67	0.39	0.59	0.79	2.08	0.55	1.36	1.78	1.53	1.21	0.77	3.54	0.12	0.63	0.38
DebtDefault	MEAN	0.01	0.02	0.01	0.00	0.02	0.01	0.00	0.00	0.02	0.01	0.00	0.00	0.06	0.00	0.01	0.00
	STD	0.55	0.47	0.21	0.22	0.41	0.62	0.27	0.53	0.67	0.52	0.45	0.33	1.46	0.09	0.32	0.18
AnalystRating	MEAN	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	STD	0.30	0.18	0.13	0.12	0.26	0.39	0.17	0.26	0.46	0.31	0.31	0.14	0.67	0.05	0.25	0.12
Dividends	MEAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
	STD	0.28	0.14	0.08	0.04	0.14	0.15	0.17	0.18	0.47	0.21	0.17	0.09	0.84	0.04	0.16	0.12
EarningsForecast	MEAN	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.01
	STD	0.66	0.38	0.20	0.35	0.52	0.80	0.37	0.65	1.24	0.64	0.95	0.51	1.14	0.08	0.46	0.24
FundamentalStrength	MEAN	0.05	0.03	0.06	0.02	0.05	0.03	0.06	0.00	0.07	0.04	0.11	0.06	0.07	0.03	0.04	0.04
	STD	1.62	1.04	0.66	0.85	1.24	1.88	0.99	1.73	2.41	1.65	2.00	1.10	3.54	0.21	1.10	0.56
Layoffs	MEAN	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00
	STD	0.27	0.24	0.11	0.10	0.35	0.22	0.18	0.25	0.47	0.36	0.39	0.20	0.16	0.04	0.38	0.13
Litigation	MEAN	0.00	0.02	-0.01	-0.01	0.01	-0.03	0.00	-0.01	0.00	-0.01	-0.02	0.01	0.02	0.00	0.02	0.00
	STD	0.61	0.66	0.26	0.25	0.52	0.91	0.31	0.35	1.13	0.60	0.80	0.41	0.94	0.10	0.54	0.19
Conflict	MEAN	-0.05	-0.09	-0.08	-0.08	-0.06	-0.07	-0.08	-0.05	-0.04	-0.02	-0.03	0.01	-0.04	-0.03	-0.06	-0.04
	STD	1.91	1.21	0.74	0.79	1.38	2.34	0.89	1.74	3.15	2.37	2.01	1.14	4.17	0.20	1.15	0.64

ManagementChange	MEAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00
	STD	0.34	0.31	0.10	0.15	0.24	0.48	0.16	0.41	0.34	0.24	0.48	0.14	0.80	0.03	0.20	0.13
ManagementTrust	MEAN	0.00	0.01	0.00	0.00	0.00	-0.01	0.01	-0.01	-0.02	-0.01	0.00	0.00	0.02	0.00	0.00	0.01
	STD	0.53	0.49	0.22	0.24	0.47	0.63	0.32	0.60	0.86	0.47	0.63	0.28	1.02	0.05	0.41	0.21
Mergers	MEAN	0.01	0.03	0.02	0.01	0.00	-0.01	0.01	0.00	-0.02	0.02	-0.01	0.01	0.03	0.01	0.01	0.03
	STD	0.80	0.45	0.26	0.29	0.68	0.84	0.47	0.60	1.67	0.84	1.26	0.26	1.19	0.10	0.72	0.30
Innovation	MEAN	0.00	-0.01	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00
	STD	0.20	0.16	0.13	0.13	0.21	0.35	0.19	0.19	0.31	0.19	0.25	0.16	0.19	0.04	0.18	0.11
N		66472	4650	4652	2619	4649	4216	4644	4641	4651	4314	4478	4667	4466	4528	4646	4651

Appendix D, Table D1. Economic significances of the time series estimations

Variable	AUS	FRA	CHN	GER	SGP	GBR	HKG	ESP	BRA	IND	JPN	RUS	USA	CHE	CAN
Aggregate variables															
Sentiment	0.212	0.022	0.894	0.034	0.213	0.033	0.318	0.087	0.265	0.408	0.077	0.097	0.001	0.018	0.073
EmotionVsFact	-0.029	0.006	-0.264	-0.023	-0.040	0.002	-0.040	-0.021	-0.027	0.004	-0.019	-0.005	-0.007	0.010	-0.029
MarketRisk	0.075	0.001	0.216	0.003	0.061	0.023	0.093	0.040	0.121	0.131	0.029	0.034	0.000	-0.026	0.045
Buzz	0.001	-0.004	-0.046	0.015	-0.022	0.004	-0.021	-0.034	-0.072	-0.063	0.006	-0.004	0.017	0.004	-0.056
RelativeBuzz	-0.016	-0.009	-0.264	-0.019	-0.016	0.009	-0.065	-0.033	-0.094	-0.055	0.010	-0.079	-0.004	-0.003	-0.026
Emotions related variables															
Optimism	0.047	0.006	0.075	-0.007	0.031	0.009	0.009	0.021	0.113	0.117	0.024	0.004	-0.003	-0.007	0.037
Joy	0.006	0.006	0.031	-0.009	0.026	0.001	0.028	0.008	0.056	0.069	0.022	0.037	-0.006	0.008	0.027
LoveHate	-0.006	-0.002	-0.028	-0.020	0.002	0.000	0.000	-0.002	0.045	-0.016	-0.011	-0.010	-0.010	0.008	0.025
Trust	0.024	0.012	0.090	0.009	0.023	0.002	0.070	0.010	0.078	0.059	0.013	0.036	0.008	-0.008	-0.006
Fear	-0.022	-0.007	-0.276	-0.018	-0.034	-0.006	-0.045	-0.026	-0.072	-0.045	-0.021	0.021	0.001	0.006	0.011
Violence	-0.017	0.002	0.059	-0.011	0.030	0.004	0.008	0.000	-0.018	-0.039	0.009	-0.028	-0.007	0.009	0.045
Gloom	-0.034	-0.001	-0.298	-0.002	-0.025	0.002	-0.050	-0.037	-0.138	-0.102	-0.031	-0.103	-0.004	-0.003	-0.041
Stress	0.000	-0.003	-0.179	-0.006	0.015	0.011	-0.023	-0.021	-0.054	-0.059	-0.008	-0.059	-0.007	0.004	-0.029
Anger	0.028	0.002	0.032	0.003	0.001	-0.006	-0.019	0.011	-0.018	0.046	0.012	-0.043	-0.008	0.008	0.001
Uncertainty	0.032	-0.014	0.067	-0.001	0.024	-0.004	0.017	0.010	0.031	0.066	0.021	-0.142	-0.001	-0.016	0.005
Fact based measures															
TimeUrgency	-0.016	0.001	0.005	-0.007	0.008	0.001	0.027	-0.003	0.002	0.018	0.006	0.013	-0.004	0.004	-0.001
LongShort	0.017	0.008	-0.051	-0.001	0.017	-0.002	0.018	-0.010	0.009	0.138	0.018	-0.031	0.009	-0.017	-0.031
LongShortForecast	0.002	-0.010	-0.012	0.010	-0.014	-0.008	-0.021	-0.014	0.023	0.022	0.006	-0.036	0.003	-0.007	0.004
PriceDirection	0.195	0.003	0.314	0.021	0.153	0.041	0.172	0.075	0.157	0.182	0.050	0.054	-0.011	0.025	0.102
PriceForecast	0.023	-0.007	0.088	-0.005	0.032	0.022	0.035	0.024	0.012	0.021	-0.003	0.097	-0.005	-0.021	0.015
Volatility	0.013	-0.004	0.151	0.002	0.017	0.011	0.044	-0.018	0.011	-0.001	0.022	-0.082	0.004	0.010	0.022
DebtDefault	0.015	-0.005	0.012	0.004	-0.039	0.011	-0.010	0.000	-0.024	-0.021	-0.008	0.062	0.000	-0.003	-0.008
AnalystRating	0.002	0.006	0.015	-0.002	0.006	0.005	0.020	-0.007	0.004	0.034	-0.006	-0.008	0.001	0.000	0.014
Dividends	0.007	-0.005	-0.021	0.002	0.010	0.000	-0.011	0.005	0.058	-0.004	0.005	0.017	0.000	-0.001	0.007
EarningsForecast	0.007	0.006	0.052	0.005	0.006	-0.006	0.063	0.019	-0.010	-0.012	-0.003	-0.028	0.001	-0.004	-0.001

FundamentalStrength	-0.008	0.004	0.063	0.011	0.041	-0.004	0.058	0.008	-0.024	0.030	0.006	0.023	0.003	0.011	-0.003
Layoffs	0.006	-0.003	0.019	0.003	0.004	-0.005	0.013	-0.013	0.056	-0.019	0.001	-0.040	-0.005	-0.022	0.005
Litigation	0.020	-0.004	0.073	-0.016	0.010	0.007	-0.022	0.015	0.026	0.009	-0.002	0.010	-0.003	0.009	0.008
Conflict	0.025	0.002	-0.024	-0.004	0.002	0.007	-0.022	-0.003	0.003	0.033	-0.008	-0.040	-0.006	-0.003	-0.009
ManagementChange	0.012	-0.007	-0.038	-0.007	0.002	-0.001	-0.021	-0.016	0.027	0.026	-0.004	-0.008	-0.001	-0.011	0.002
ManagementTrust	0.020	0.011	-0.006	0.011	0.023	-0.001	0.016	-0.002	-0.023	0.026	0.004	-0.014	-0.001	0.019	-0.010
Mergers	0.048	0.000	0.086	0.011	0.021	-0.007	0.016	0.002	0.039	0.020	0.022	0.035	0.008	-0.027	-0.022
Innovation	-0.010	0.007	0.092	-0.017	-0.004	0.003	0.012	0.012	0.042	0.015	-0.010	-0.003	0.005	0.003	-0.007

Appendix E, Table E1. Determinants of EmotionVsFact sensitivity

EmotionVsFact	(1)	(2)	(3)	(4)
Intercept	-0.270** [-2.26]	-0.010 [-0.09]	-0.095*** [-3.38]	0.007 [0.08]
Indiv	0.001 [1.13]			
Masc	0.002*** [2.71]			0.000 [-0.18]
Uncert	0.000 [-0.60]			
LongShort	-0.002*** [-3.31]			-0.001 [-0.91]
PowerDist	0.003** [2.47]			0.001 [1.14]
Lang	-0.029 [-1.07]			
PolRisk	0.001 [1.10]			
Market cap		0.000 [1.35]		
Stocks traded		0.000 [-1.12]		
Credit		0.000* [-1.68]		0.000 [-0.92]
ln GDP		0.003 [0.36]		
GDP growth		-0.009*** [-2.93]		-0.008** [-2.30]
MeanRet		-0.031 [-0.36]		
STDRet		-0.067*** [-2.83]		-0.053** [-2.27]
IO ratio			0.071** [2.49]	0.017 [0.52]
Analysts			-0.012** [-2.18]	-0.011** [-2.11]
Dispersion			-0.063 [-0.73]	
NonSynch	0.000 [-0.09]	0.002* [1.90]	0.005*** [3.63]	0.002 [1.19]
VIX	0.000 [-0.47]	0.003** [2.09]	0.000 [-0.03]	0.002 [1.41]
Observations	204	213	156	138
R ²	0.19	0.27	0.21	0.37

Appendix E, Table E2. Determinants of MarketRisk sensitivity

MarketRisk	(1)	(2)	(3)	(4)
Intercept	0.568*** [4.22]	0.388*** [3.43]	0.105*** [3.64]	0.535** [2.14]
Indiv	-0.001*** [-2.74]			-0.001 [-1.21]
Masc	-0.003*** [-3.11]			-0.002** [-2.03]
Uncert	0.001 [1.16]			
LongShort	0.002*** [3.17]			0.002* [1.79]
PowerDist	-0.003*** [-3.15]			-0.002** [-2.53]
Lang	0.072*** [3.15]			0.052*** [3.27]
PolRisk	-0.004*** [-3.67]			-0.003 [-1.51]
Market cap		0.000 [0.54]		
Stocks traded		0.000 [-0.20]		
Credit		0.000 [-0.20]		
ln GDP		-0.029*** [-3.01]		-0.003 [-0.20]
GDP growth		0.003 [1.34]		
MeanRet		-0.145** [-2.45]		-0.150* [-1.83]
STDRet		0.057*** [2.95]		0.022 [0.83]
IO ratio			-0.068** [-2.58]	-0.002 [-0.06]
Analysts			0.011* [1.95]	0.000 [0.00]
Dispersion			-0.013 [-0.17]	
NonSynch	-0.002 [-1.39]	-0.003*** [-3.07]	-0.006*** [-4.41]	-0.002 [-0.57]
VIX	0.002** [2.24]	-0.004** [-2.01]	0.001 [1.20]	-0.001 [-0.47]
Observations	204	213	156	138
R ²	0.36	0.35	0.16	0.41