



Does the weather have impacts on returns and trading activities in order-driven stock markets? Evidence from China

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ABSTRACT

We study the association between weather-related mood factors and stock index returns in an order-driven market, the Shanghai Stock Exchange (SSE) of China. Our results indicate that asset returns are unaffected by changes in mood introduced by factors including the weather and the onset and recovery from SAD. In contrast, many of these variables are strongly correlated with a reduction in market turnover and liquidity, consistent with investor mood driving variations in market activity. Overall, we show that in an order-driven market, environmental impacts on sentiment are likely to affect trading activities, but not returns.

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1. Introduction

Traditional finance theory holds that the stock market is fundamentally rational, and that it reflects only economic information relevant to asset pricing (Chang et al., 2008). Investors will usually act rationally when making their investment decisions, and will select their optimal portfolio weighting by evaluating the risk–return tradeoff in a mean–variance efficient framework. These are the fundamental conclusions of both the ‘portfolio theory’ of Markowitz (1952) and the ‘capital asset pricing model’ (CAPM) of Sharpe (1964). However, Lucey and Dowling (2005) argue that this ‘consequentialist’ perspective is inconsistent with reality, essentially because it ignores the impact of investor sentiment on such decision-making processes.

Over recent years, researchers have found that psychological factors appear to have significant influences on the trading decisions of investors within the financial markets, and thus, on both trading activities and returns. Many finance studies argue that when people feel good as a result of good weather, they will hold optimistic opinions on their future prospects (Daniel et al., 1998; Hirshleifer, 2001). Kamstra et al. (2003) argue that people are less tolerant to risk when days shorten, related to seasonal affective disorder. The relationships existing between weather, mood and the decision-making processes of investors have been the subject of extensive studies, and although weather is one of the most important environmental factors influencing our daily lives, the debate continues within the literature as to its influence on mood (Denissen et al., 2008; Huibers et al., 2010; Keller et al., 2005).

A relatively early study on the relationship between weather and stock returns was provided by Saunders (1993), who found a negative correlation between cloud cover in Manhattan and stock returns on the New York Stock Exchange (NYSE). The findings of Saunders (1993) sparked immediate attention on Wall Street; indeed, Stecklow (1993) commented in the *Wall Street Journal*:

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“Forget the January effect. A professor at the University of Massachusetts has come up with what he believes is a better indicator of when the stock market will rise or fall. Check the weather on Wall Street”.

Using stock exchange data on 26 countries and regions around the world, [Hirshleifer and Shumway \(2003\)](#) went on to report a similar negative relationship between cloud cover and stock returns, while [Chang et al. \(2008\)](#) found that the weather affects not only stock returns, but also the trading behavior of investors; for instance, cloud cover was found to have a negative effect on both stock price volatility and market depth. Using daily data on the Shanghai Stock Exchange (SSE), [Kang et al. \(2010\)](#) also reported a significantly negative impact on the returns in the A-shares market from extremely high humidity and extremely low sunshine levels.

Nevertheless, not all researchers find that weather has a significant impact on stock markets. [Goetzmann and Zhu \(2005\)](#) could find no clear relationship between trading by individual investors and local weather; even in New York, where most of the market makers and specialists gather, after considering liquidity, cloud cover was found to have only a limited impact on the stock markets. [Kamstra et al. \(2003\)](#) also reported that cloud cover and precipitation did not affect NYSE stock returns. Furthermore, based upon their use of mood-proxy variables to analyze the stock indices of 37 countries, as well as 21 MSCI small capitalization indices, [Dowling and Lucey \(2008\)](#) reported only a weak relationship between temperature and equity returns, concluding that it is ‘seasonal affective disorder’ (SAD), and not the weather, which has important influences on stock returns.

Most of the existing studies examining the relationship between the weather and stock markets tend to focus on the developed capital markets; however, the trading mechanisms in these well developed capital markets differ markedly from the mechanism on the Chinese stock exchanges, with a notable difference in the stock price formation process. For example, the stock prices on the NYSE are mainly formed on the basis of quotes by market makers. Given that the world's leading financial institutions and investors assemble in Manhattan, New York, and since their offices are all concentrated in the lower Manhattan area, it would seem reasonable to assume that the quoting behavior of market makers might be vulnerable to the impacts of the weather in Manhattan.

Within the overall field of research into weather and stock returns, order-driven trading markets have received relatively little attention, as compared to quote-driven markets. Given that the stock exchanges in China were set up relatively late, from the very beginning, they adopted a full electronic order-driven trading system with no role for market makers; thus, all sales and purchases offered by investors are entered into the matching system of the exchange through brokers.

Taking the SSE as an example, the sale and purchase orders come from all over China; clearly, therefore, if we are to find that weather has impacts on stock market trading, then such trading should reflect the weather conditions across the entire country, not just those pertaining to Shanghai alone. Hence, this is likely an extremely complex and difficult problem to verify. Nevertheless, according to statistics provided by the SSE, the security businesses located in Shanghai are responsible for initiating the majority of transactions on the SSE; indeed, according to the “Monthly Bulletin of Statistics, December 2009” issued by the SSE, the total dollar trading volume on the SSE in 2009 was 34.6511 trillion Yuan, with security businesses located in Shanghai accounting for 32.48% of this total dollar trading volume, and thereby contributing most of all of the major cities in China. This volume therefore provides the basis for our study of the potential impacts of weather on trading in an order-driven market.

The motivation for our study, and the questions we set out to answer, are as follows: (i) Several studies find that weather affects trading in well-developed capital markets ([Chang et al., 2006, 2008](#); [Hirshleifer and Shumway, 2003](#); [Saunders, 1993](#)), but is this also true for emerging capital markets, particularly those that are order-driven, and would such psychological factors have significantly different impacts on the structure in a quote-driven market (as examined in most of the extant literature) vis-à-vis an order-driven market?; (ii) The prior literature confirms that weather conditions affect asset pricing ([Hirshleifer and Shumway, 2003](#); [Saunders, 1993](#)), but do they also affect market liquidity, price volatility and/or other trading variables?; (iii) In [Saunders \(1993\)](#), the focus was placed on a single indicator of weather conditions, cloud cover, but could other weather factors such as temperature, humidity and wind speed also affect the trading activities of investors? In this study, we construct multivariate regressions to analyze the effects of a broader range of weather variables on the stock market; (iv) The prior studies (such as [Dowling and Lucey, 2008](#); [Kang et al., 2010](#)) primarily examine the impact of daily weather conditions on stock returns while ignoring “the vagaries of the weather” during each day; however, weather conditions may change substantially during a trading day. Therefore, a considerable amount of useful information may be lost by adopting a methodology which involves the average daily weather indicators. In the present study, we examine the impact of intraday weather indicators on stock markets, and assess the influence of weather on the financial markets at the micro-level.

We demonstrate that although not all SSE orders come from the Shanghai area, the weather in Shanghai does indeed affect the index; however, in contrast to the results reported on the well-developed securities markets of Europe and the US, our results indicate that the effects of weather on stock returns are insignificant, whereas the impact of weather on turnover, volatility and liquidity is highly significant. Our study provides important additional evidence on the potential impacts of weather on the mood and trading behavior of investors in an emerging order-driven stock market, thereby making a positive contribution to the extant literature.

The remainder of this paper is organized as follows. [Section 2](#) provides a review of the literature, followed in [Section 3](#) by a description of the data. The research methodology adopted for this study is presented in [Section 4](#), along with our empirical results. Finally, the conclusions drawn from our study are presented in [Section 5](#).

2. Literature review

2.1. Weather and mood

The daily activities of people are affected by various environmental factors, with weather being one such factor of considerable importance. Any significant change in the weather is likely to affect the plans and consequences of our daily lives, so weather is

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