Mood and UK equity pricing
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Mood and UK equity pricing

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We investigate the relationship between mood and UK equity pricing. Seven variables that are argued to proxy for mood are tested, including four weather variables (temperature, precipitation, wind speed and geomagnetic storms), and three biorhythm variables (Seasonal Affective Disorder, Daylight Savings Time Changes and lunar phases). Using GARCH specifications of the equity indices, and multiple constructs of each of the mood-proxy variables, we find evidence of a relationship between UK equity pricing and high temperatures and wind speed. However, the results are generally unfavourable towards a conclusion that investor mood influences aggregate UK equity pricing.

I. Introduction

Researchers in behavioural finance have had some recent success in finding a relationship between predictable fluctuations in investor mood and equity pricing. Psychologically constructed proxies for investor mood that have been found to influence equity pricing include the weather (Hirshleifer and Shumway, 2003), Seasonal Affective Disorder (Kamstra et al., 2003) and even the emotion arising from sporting events (Edmans et al., 2007).

The common thread that unites all the mood-proxy variables is that they are claimed to be psychologically robust i.e. they are developed based on psychological research showing the variable to be a reliable mediating influence on mood, and they represent broad measures that are believed to affect the mood of a large proportion of the population.

This short article studies the relationship between seven mood-proxy variables and UK equity pricing. Such a study has not previously been conducted. Using GARCH specifications for UK regular and small capitalization indices, we test four weather variables (temperature, precipitation, wind, geomagnetic activity), and three biorhythm variables (Seasonal Affective Disorder, Daylight Savings Time Changes, lunar phases).

By testing all variables over the same data set and time period using a robust econometric methodology, we are able to come to comparative conclusions about the strength of each of the individual variables in the UK context. We find that there is some evidence of a relationship between UK equity pricing and wind speed and high temperatures. However, the conclusion we reach is that there is only very limited evidence of a relationship between mood-proxy variables and aggregate UK equity returns.

II. Mood Proxies and Equity Pricing

It is an established psychological principle that the current mood state of a person influences their decision-making (e.g. Schwarz, 1990; Clore and Parrott, 1991; Forgas, 1995). Generally it can be stated that factors that induce positive mood in people lead them to make more optimistic judgements than if they were in a neutral mood, while factors that induce negative mood in people lead...
them to make more pessimistic judgements than if they were in a neutral mood.

The influence of mood on the decision-making process is especially pronounced when the decision involves risk and uncertainty (Loewenstein et al., 2001; Slovic et al., 2002). Even ‘irrelevant’ temporary mood states at the time of decision-making have been shown to influence decisions involving the weighing of long-term risks and benefits (Johnson and Tversky, 1983; Schwarz and Clore, 1983).

The finding regarding the influence of irrelevant mood states on decision-making is referred to as ‘mood misattribution’. An example of mood misattribution can be seen in Schwarz and Clore (1983) where it was found that, in a phone survey, people reported greater life satisfaction when the weather was sunny than when the weather was overcast and rainy. Transient fluctuations in the weather appeared to have a large influence on people’s assessment of their life satisfaction. Yet, objectively it should only have had a very minor, perhaps even no influence on the rating of life satisfaction.

Building on this body of research, recent studies in behavioural finance investigates whether equity investors might misattribute the source of their moods and allow irrelevant feelings to inform their equity investment decisions. This research concentrates on the relationship between equity prices and variables based on widespread proxies for mood, such as weather and biorhythms. These variables are hypothesized to be the most likely to be evident in equilibrium stock prices.

Weather is a comprehensively researched source of misattributed mood in psychology. Howarth and Hoffman (1984, p. 15) summarize research on the weather and mood as; ‘weather variables affect an individual’s emotional state or mood, which creates a predisposition to engage in particular behaviours.’ The essential finding of this area is that across a wide range of weather variables, good weather induces positive mood states and bad weather induces negative mood states. Some findings in tests for a possible relationship between equity pricing and weather-based mood-proxy variables include:

- Increasing levels of cloud cover, which is associated with depression (Eagles, 1994), is negatively related to equity returns (Saunders, 1993; Hirshleifer and Shumway, 2003).
- Very low temperatures, which lead to aggression (Rotton and Cohn, 2000), are positively related to equity returns (Cao and Wei, 2005).
- Geomagnetic storms, which are associated with increased levels of depression (Nastos et al., 2006), are negatively related to equity returns (Krivelyova and Robotti, 2003).
- Wind speed, which is weakly negatively associated with bad moods (Cooke et al., 2000), is negatively related to equity returns (Keef and Roush, 2005).

Other behavioural finance research has tested mood-proxy variables developed based on biorhythms, the body’s natural biological cycles. These cycles have been linked to mood moderation and fluctuation in the psychological literature. Findings on the relationship with equity pricing include:

- Seasonal Affective Disorder (SAD), which is the cycle of depression caused by the reduction in the hours of sunlight in the day from the Autumn Equinox (21 September) to the Winter Solstice (21 December), and the subsequent lifting of that depression between the Winter Solstice and the Spring Equinox (21 March), has been linked to a similar pattern in equity pricing (Kamstra et al., 2003).
- Daylight Savings Time Changes (DSTC), where depression is induced by the sleep disruption of losing or gaining an hour’s sleep around DSTC events (Monk and Aplin, 1980), has been negatively related to equity returns following a DSTC weekend (Kamstra et al., 2000).
- Lunar phases, although not psychologically related to depression cycles (Rotton and Kelly, 1985), but perhaps popularly linked to depression cycles around full moons (Iosif and Ballon, 2005), has been linked to a negative relationship with equity returns around full-moon periods (Yuan et al., 2001; Dichev and Janes, 2003).

### III. Data and Tests

The previous findings regarding a relationship between equity pricing and various proxies for investor mood have usually emerged from tests of a particular mood-proxy variable in isolation from other potential mood-proxy variables, and using diverse datasets and econometric methodologies. We retest the mood-proxy variables using a uniform set of equity data, a range of specifications for each mood-proxy variable, a robust econometric testing approach and with the specific aim of extracting findings relevant to the UK. This section describes the data used in these tests.
Our equity data consists of the ‘Datastream’ UK equity index (‘UK Main’) and the MCSI UK small capitalization index (‘UK Small’), for the period from 12 December 1994 to 10 November 2004. The descriptive statistics for each of these indices are contained in Table 1. These statistics show the data to be nonnormal.

We also carry out standard ARCH diagnostic tests including an examination of Autocorrelation Function/Partial Autocorrelation Function tables, Ljung–Box Q-statistics and Engle’s ARCH test. The results, also reported in Table 1, lead to the conclusion that there are ARCH/GARCH effects in both equity series.

Our approach to specifying the most appropriate GARCH specification for each index consists of testing the equity pricing series against a range of 13 GARCH specifications and selecting the most appropriate based on Log Likelihood Ratio Tests (LLRT). The range of GARCH specifications covered basic GARCH, Exponential GARCH, and Leveraged GARCH. Sub-specifications included the addition of ARCH-in-Mean effects, and assumptions regarding error distributions as following either: normal, student’s $t$ or generalized error distributions (GED).

These (unreported) specification tests lead to a diagnosis of the UK Main index being best specified as a Leveraged-GARCH(1,1) with ARMA(1,1) and GED error distribution assumption. The UK Small index is found to be best specified as an Exponential GARCH(1,1) with ARMA(1,1), an ARCH-in-Mean term, and a student’s $t$ error distribution assumption.

In addition to these GARCH specifications, all mood-proxy tests included a Monday dummy to account for potentially anomalous returns on that day, and the ‘Datastream’ World Index to remove some of the global influences on UK equity pricing.

### Mood-proxy data

Seven mood-proxy variables are tested, with a number of specifications of each variable developed. These include the weather variables of temperature, precipitation, wind and geomagnetic storms and the biorhythm variables of SAD, DSTC and

<table>
<thead>
<tr>
<th>Table 1. UK equity data descriptives</th>
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<tbody>
<tr>
<td><strong>Descriptive statistics</strong></td>
</tr>
<tr>
<td>Mean</td>
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<tr>
<td>UK main</td>
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<tr>
<td>UK small</td>
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</tbody>
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<table>
<thead>
<tr>
<th>ACF (1-8) and PACF (1-8) of Residuals</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK main ACF</td>
<td>0.2202</td>
<td>−0.0020</td>
<td>−0.0504</td>
<td>0.0210</td>
<td>0.0814</td>
<td>−0.0108</td>
<td>0.0075</td>
<td>0.0648</td>
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<tr>
<td>UK small ACF</td>
<td>0.2597</td>
<td>0.1437</td>
<td>0.1086</td>
<td>0.1381</td>
<td>0.0604</td>
<td>0.0516</td>
<td>0.0463</td>
<td>0.0792</td>
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Ljung–Box Q-statistics of squared residuals

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<tr>
<th>Q(4-1)</th>
<th>Q(8-1)</th>
<th>Q(12-1)</th>
<th>Q(16-1)</th>
<th>Q(20-1)</th>
<th>Q(24-1)</th>
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</thead>
<tbody>
<tr>
<td>UK main</td>
<td>971.1874</td>
<td>1001.7235</td>
<td>1029.6142</td>
<td>1036.0007</td>
<td>1041.6852</td>
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<tr>
<td>UK small</td>
<td>621.5034</td>
<td>793.0503</td>
<td>943.5619</td>
<td>1039.4557</td>
<td>1095.0838</td>
</tr>
</tbody>
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Engle’s ARCH (1) test

<table>
<thead>
<tr>
<th>$F$-Stat (sig.)</th>
<th>Chi-Sqr (sig.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK main</td>
<td>988.02 (0.00)</td>
</tr>
<tr>
<td>UK small</td>
<td>403.65 (0.00)</td>
</tr>
</tbody>
</table>
lunar phases. All variables are tested individually, unless otherwise indicated.

Daily temperature, wind, precipitation and geomagnetic storms data was obtained from the ‘National Oceanic and Atmospheric Administration’. We use the ‘Global Summary of Day’ database to extract the relevant UK wind, precipitation and temperature data, and, following Krivelyova and Robotti (2003), the ‘AP Index’ to construct the geomagnetic storm variable. The variables created for weather are:

1. Basic Wind, Temperature, Precipitation: These three variables use the raw weather data in their construction.
2. Deseasonalized Wind, Temperature, Precipitation: We follow Hirshleifer and Shumway (2003) in constructing deseasonalized measures of each of the three weather variables. The approach we adopt is to calculate an average value for a weather variable for the UK for each month over the life of the dataset, and then subtract the average from the actual value on a given day to get the deseasonalized value.
3. High Precipitation, High Wind, High Temperature, Low Temperature: These extreme weather variables are dummy variables that take a value of 1 when the weather measure on a particular day is in the top 10% (also bottom 10% in the case of temperature) for the UK over the time period.
4. Geomagnetic Storms: Three variables are constructed. A regular variable (‘GeoRange’) just includes the geomagnetic storm activity value on a particular day. A second variable (‘Geo-Mild’) is a dummy variable that takes a value of 1 for the 6 days following an occurrence of a mild geomagnetic storm (AP Index value of over 29). A third variable (‘Geo-Major’) is also a dummy variable that takes a value of 1 for the 6 days following a major geomagnetic storm (AP Index value over 49).

The three biorhythm factors are constructed into variables as follows:

5. SAD: The SAD variables are calculated using the formula developed by Kamstra et al. (2003) This formula gives a measure of the reduction in the hours of sunlight in the day from the Autumn Equinox to the Winter Solstice, and the lengthening of the day after the Winter Solstice up to the Spring Equinox (the variable is 0 at any other time in the year). In addition to the main SAD variable (‘SAD Cycle’), a secondary variable is created (‘SAD Autumn’) to capture possible asynchronous effects of SAD between Autumn and Winter; this is a dummy variable which takes a value of 1 for periods between the Autumn Equinox and the Winter Solstice, and 0 otherwise. As a form of triangulation testing, a dummy variable for the first 15 days of January (‘SAD Jan’) is also tested against SAD Cycle, to check if any possible SAD finding might be simply proxying for the known anomaly of positive returns in early January.

6. DSTC: DSTC in the UK occurs each year on the last Sunday in March (clocks go forward 1 h), and the last Sunday in October (clocks go back 1 h). The regular DSTC variable (‘DSTC’) is a dummy variable which takes a value of 1 on a Monday following any DSTC. Two further dummy variables are also created which take a value of 1 only following either a March DSTC (‘DSTC Spring’), or an October DSTC (‘DSTC Autumn’).

7. Lunar Phases: We collected data on lunar phases from www.lunaroutreach.org. Three groups of lunar phases variables were constructed out of this data which gave dates and times for full-moon events. For the first variable (‘Lunar Cycle’) we used the formula in Yuan et al. (2001), which gives a value to each day over the time period based on how close the day was to a full moon. The variable varies between 1 (full moon) and −1 (new moon). The second group of variables (‘Lunar New 3’ and ‘Lunar Full 3’) are dummy variables which take a value of 1 for the date of a new (full) moon, and the calendar day before and after. The third group of variables (‘Lunar New 15’ and ‘Lunar Full 15’) are the same as the second group, except that the dummy value of 1 extends to the seven calendar days on either side of a new (full) moon.

IV. Results and Analysis

The results for the weather variables are reported in Table 2 and the biorhythm results are reported in Table 3.

Turning first to the weather results, we find that the regular temperature variable approaches being significantly positively related to UK Main equity returns. However, this is not replicated for the UK Small index. It would be expected that any true
mood-proxy variable would be of greater significance for small capitalization equities where there is greater uncertainty. The deseasonalized temperature is also insignificant. The most interesting results are for high temperatures. Both the Main and Small indices report being highly significantly positively related to high temperatures. In moderate climates like that in the UK, we would expect that high temperatures would have a good mood influence (Keller et al., 2005), rather than causing aggression
or apathy, as is the case with extremely high temperatures, and thus this finding is consistent with that psychological research. The low-temperature variable has a negative, but insignificant, relationship with both indices.

The precipitation findings present a somewhat contradictory set of results. The regular precipitation variable is significantly negatively related to UK Main equity returns, but is not significant for the UK Small index. This pattern is repeated for the deseasonalized and high-precipitation variables. This suggests an uncertain influence of precipitation-induced mood fluctuation on equity returns.

Wind speed is significantly negatively related to UK small capitalization equity returns, while being negatively, but insignificantly, related to the UK Main index. This could suggest a negative relationship between wind speed and UK equity returns, however, the other wind variables do not present as clear a relationship.

A pattern similar to the precipitation findings is also found in the tests of a potential relationship with geomagnetic storms. It is only the UK Main index
that shows the expected negative relationship, and not the UK Small index.

The results for SAD show that SAD Autumn is significantly negatively related to the UK Small index. This is consistent with the depression arising from the shortening of daylight hours over the period this variable measures. The finding is, however, reversed for the UK Main index, suggesting that if there is a negative relationship between SAD Autumn and equity returns, it is only to be found in small capitalization equity pricing. The SAD Cycle variable shows a negative relationship, significantly so when tested with the early January dummy variable. This is inconsistent with the psychological literature.

We find similarly inconsistent findings for both the DSTC and lunar phases tests. In the DSTC tests, we find different directions of relationship between the UK Main and UK Small results. There are also problems with interpreting the lunar phases findings because the findings are stronger for the main index compared to the small capitalization index.

Throughout all the tests the findings for a relationship between the mood-proxy variables and variance do not show a pattern of relationship.

V. Conclusions

This article has investigated the relationship between variables that are argued to proxy for mood and UK equity pricing. The results show some indication of a relationship between equity pricing and wind and high temperature. Wind appears to be negatively related to equity pricing, and high temperatures positively related to equity returns.

The more striking finding is that all other specifications of mood-proxy variables show no relationship, or mixed evidence of relationship, with UK equity pricing. Given that we tested 23 different mood-proxy variable specifications, the finding that only two variables show a relationship cannot be claimed to be strong evidence of a relationship between investor mood and UK equity pricing.

These findings do not preclude investor’s mood influencing their investing decisions, but it does suggest that any influence is not strong enough to be reflected in aggregate UK equity prices.

References


