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Seasonal affective disorder: onset and recovery

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ABSTRACT

Kamstra et al. (2003, 2009, 2012) offer a seasonal affective disorder hypothesis to explain variations in the daily returns of stock indices. We examine Kamstra et al. (2012) new variable called *SAD* onset/recovery. The analysis reveals concerns for the validity of the *SAD* hypothesis.

"Tell 'em they're dreamin'!"
– The Castle (Australian Film, 1997).

1. Introduction

Kamstra et al. (2003) advance the hypothesis that the prevalence of the seasonal affective disorder (*SAD*) has a systematic influence on stock index prices. There is widespread interest in this hypothesis – a Google Scholar search (21 June 2012 – the winter solstice in the southern hemisphere) reveals that this study is cited in more than 280 papers.

We examine the revised empirical version of the Kamstra et al. (2003) *SAD* hypothesis. The focus is on the new variable called *SAD* onset/recovery. This variable is used to replace the two variables of their original model. This original model has attracted criticism in the literature. We examine six statistical issues of the new variable – these have not been previously critically evaluated in the literature. Each issue has a profound implication for the *SAD* hypothesis.

The *SAD* hypothesis is intuitively appealing. As the fall season evolves, there is an increase in the number of people suffering from the depressive illness called the seasonal affective disorder. This increase in depression, which creates a heightening in risk aversion, leads to a reduction in stock index prices. The winter solstice brings about a reversal in the mental processes of sufferers. The depression, and associated risk aversion, weakens and there is a corresponding increase in stock index prices. Asymmetry is a crucial feature of the hypothesis. The length of night is the "*instrument most closely tied by clinical research*" to the symptoms of the seasonal affective disorder (Kamstra et al., 2012, p. 943).

The original model, based on daily data with the control variables discarded for simplicity, is

$$r_t = \alpha_0 + \alpha_1 D_t^{Fall} + \alpha_2 SAD_t + e_t, \tag{1}$$

where r_t is the return of the stock index, D_t^{Fall} is a dummy variable with a value of 1 in the fall season, otherwise zero and SAD_t is an accurate measure of the hours of night in excess of 12 (see Kamstra et al., 2003, p. 333). Variable SAD_t is set to zero during the spring and the summer.

An explicit statement of the interpretation of Eq. (1) is found in Kamstra et al. (2012, p. 939, especially footnotes 3 and 4). The estimated coefficient of the D_t^{Fall} dummy variable $\hat{\alpha}_1$ captures the influence of the seasonal affective disorder in the fall and (ii) the estimated coefficient of the SAD_t variable $\hat{\alpha}_2$ captures the influence of the seasonal affective disorder in the winter (see also Kamstra et al., 2003; Kelly and Meschke, 2010). Dowling and Lucey (2008) use the variable names *SAD Fall* and *SAD Winter* to represent the variables D_t^{Fall} and SAD_t, respectively. The extensive empirical evidence, on average, shows $\hat{\alpha}_1$ is statistically less than zero and $\hat{\alpha}_2$ is

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statistically greater than zero (Kamstra et al., 2003, 2012; Dowling and Lucey, 2008; Kelly and Meschke, 2010). This confirms, so it is claimed, the predicted asymmetry and the Kamstra, Kramer and Levi *SAD* hypothesis.

However, there is debate relating to the validity of the Kamstra et al. (2003) model and the specification and interpretation of its coefficients (Jacobsen and Marquering, 2008, 2009; Kelly and Meschke, 2010; Keef and Khaled, 2011; Khaled and Keef, in press). This leads Kamstra et al. (2009, 2011, 2012) to propose two new measures of the seasonal affective disorder. These are called *SAD* incidence and *SAD* onset/recovery. Depending on the circumstances, one of these new variables is recommended to replace the two-variable Kamstra et al. (2003) model. The *SAD* incidence variable is recommended for the examination of ‘stock variables’, e.g., bid-ask spreads (see DeGennaro et al., 2008). The *SAD* onset/recovery variable is recommended for the examination of ‘flow variables’, e.g., stock index returns (see Kelly and Meschke, 2010; Kamstra et al., 2012).

These new measures, which can be obtained from www.lisakramer.com, are based on Lam’s (1998, Figure 1) clinical study of the onset and recovery of the seasonal affective disorder with 454 *SAD* affected patients (74% female) in Vancouver (latitude 49°N). This raises the issue of whether this sample reflects the population of Canada or, as Kamstra et al. (2011, p. 8) claim, “*the broader population of all North Americans*”.

The first variable is called *SAD* incidence, $Incidence_t$. Details on the construction of this variable are provided in Kelly and Meschke (2010) and Kamstra et al. (2011). We do not examine this variable because “*it is highly correlated with* SAD_t” (Keef and Khaled, 2011, p. 967). The estimated correlation coefficient is +0.97. Thus, in a statistical sense, the extra information contained in $Incidence_t$ compared to SAD_t, and vice versa, is very small.

The second variable is called *SAD* onset/recovery, $Onset/recovery_t$. This variable is the daily change in the *SAD* incidence variable multiplied by 30. This correction, we presume, is to convert the variable, and the resulting estimated regression coefficients, into manageable numbers. The variable $Onset/recovery_t$ is quasi sinusoidal with a range of −0.5 (spring solstice) to +0.5 (fall solstice).

2. Statistical properties of *SAD* onset/recovery

After the control variables are deleted for simplicity, the regression model is

$$r_t = \beta_0 + \beta_1 Onset/recovery_t + e_t. \quad (2)$$

The estimated coefficient $\hat{\beta}_1$ is frequently negative across a large number of countries (Kelly and Meschke, 2010; Kamstra et al., 2012; Pyles, 2009). Thus, there is no doubt the *SAD* onset/recovery variable captures a consistent effect in international stock index returns. To focus the analysis, we concentrate on the fall season combined with the winter season. We examine six issues.

2.1. Seasonal asymmetry

Asymmetry between the fall and the winter is a fundamental feature of the Kamstra et al. (2003) *SAD* hypothesis/model. The prediction for the *SAD* onset/recovery variable is “*If the SAD hypothesis is supported by the data, we should see that the onset of SAD is associated with lower returns and recovery is associated with higher returns*” (Kamstra et al., 2012, p. 947). The interpretation is based on the empirical observation that $\hat{\beta}_1 < 0$ combined with the fact that the *SAD* onset/recovery variable is positive in the fall and negative in the winter. In the fall, $\hat{\beta}_1 < 0$ with $Onset/recovery_t > 0$ predicts negative returns. In the winter, $\hat{\beta}_1 < 0$ with $Onset/recovery_t < 0$ predicts positive returns. The presence of sign asymmetry, as predicted by the Kamstra et al. (2003) hypothesis, is observed.

Such logic is questionable. With the exception of the mean value, the statistical properties of a variate $\tilde{X}$ plus a constant λ are the same as the statistical properties of the variate $\tilde{X}$. Consider a modified version of the *SAD* onset/recovery variable, $Onset/recovery_t^{+10}$, which is defined as

$$Onset/recovery_t^{+10} = Onset/recovery_t^{KKL} + 10. \quad (3)$$

This variable has a positive value for all t and it can be shown the transformation does not affect the estimated slope coefficient, i.e., $\hat{\beta}_1^{+10} = \hat{\beta}_1^{KKL}$. Thus we have eliminated the mooted asymmetric seasonal relationship, between $Onset/recovery_t$ and stock returns, which was not there in the first place! The modified *SAD* onset/recovery variable is consistently positive.

But Kamstra, Kramer and Levi take the analysis one step further. The economic impact of the seasonal affective disorder on stock returns, at a point (or period) in time, is estimated by multiplying the constant $\hat{\beta}_1$ times the value of $Onset/recovery_t$ variable (Kamstra et al., 2012, p. 947). To illustrate, consider two dates equidistant from the winter solstice, called ‘Fall day’ and ‘Winter day’, respectively. The statistical properties of the *SAD* onset/recovery variable dictate

$$[\hat{\beta}_1 \times Onset/recovery_t]^{Fall\ day} = -[\hat{\beta}_1 \times Onset/recovery_t]^{Winter\ day}. \quad (4)$$

Kamstra et al. (2012, p. 947) acknowledge the fact that “*the SAD onset/recovery variable imposes symmetry*” in absolute magnitudes (see Eq. (4)). Despite this, they empirically confirm Eq. (4) using 12 individual countries and 5 portfolios of countries, involving six control variables and 5 different estimation methods (Kamstra et al., 2012, Panels F amd G of Tables 3 and 4).

2.2. Turn of the year effect

Kelly and Meschke (2010, p. 1317), in their criticism of the Kamstra et al. (2003) model, suggest the observed *SAD* effect might be driven by “*higher returns around the turn of the year*”. The *SAD* onset/recovery variable appears, at first sight, to be immune to this vexing issue. “*The concern Kelly & Meschke raise... although specious... is nonetheless handled directly*” by the use of the *SAD* onset/recovery variable (Kamstra et al., 2012, p. 946). It is remarkable that this new *SAD* variable has an inbuilt control for a specious effect. The attractive feature is that this variable “*is nearly zero during December and January and thus cannot influence returns during these months*” (Kamstra et al., 2012, p. 946). Perhaps this does not need to be said, but we feel obliged to state explicitly that this is faulty logic. The enhanced *SAD* onset/recovery variable $Onset/recovery_t^{+10}$ is not “*nearly zero*” around the winter solstice yet generates the same estimated coefficient.

2.3. Between-country differences

An integral part of the Kamstra et al. (2003) *SAD* hypothesis is the prediction that the influence of the seasonal affective disorder on stock returns is positively related to latitude. This is a testable hypothesis. Kelly and Meschke (2010) use the *SAD* onset/recovery variable with a wide range of countries. This is somewhat surprising, given the fact that this variable is based on Canadian clinical data. It is unfortunate that the variable can only be used to reliably test the prediction of a positive association of the *SAD* effect with latitude if it can be established that the Canadian *SAD* onset/recovery variable applies equally to all countries. In the context of their two-variable 2003 model, Kamstra et al. (2012) offer liberal, and wide-ranging, criticisms of the issues raised by Kelly