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# Sentiment and stock returns: The SAD anomaly revisited

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ABSTRACT

Widely-cited research by Kamstra et al. (2003) argues that changes in mood resulting from Seasonal Affective Disorder (SAD) drive changes in investor risk aversion and cause seasonal patterns in aggregate stock returns around the world. In this paper we reexamine the so-called SAD effect by replicating and extending Kamstra et al. (2003). We study the psychological underpinnings of the SAD hypothesis and show that the time-series predictions of the SAD model do not correspond to the seasonal patterns in depression found in the general population. We also investigate the cross-sectional prediction that SAD has a greater effect on stock markets in countries where SAD is more prevalent and find no relation between the prevalence of SAD and stock returns. Finally, we document that the SAD effect is mechanically driven by an overlapping dummy-variable specification and higher returns around the turn of the year.



## 1. Introduction

Seasonality in international stock returns has been known for decades (Rozeff and Kinney, 1976; Gultekin and Gultekin, 1983). As Fig. 1 shows, the average monthly global stock returns are negative in September and extremely positive around the turn of the year.

Do these seasonalities in stock returns represent an exploitable violation of the efficient market hypothesis? Not if they are pure coincidence. In other words these seasonalities may be apparent *ex post*, but investors could not have profited because they did not know about them *ex ante* (Wu and Zhang, 2009). If they are predictable *ex ante*, stock return seasonals constitute an important challenge to the efficient market hypothesis because rational traders should be able to exploit them for large economic gains. Not all traders are rational, however. There is a large literature in financial economics documenting that sentiment affects investor behavior (Kahneman and Tversky, 1979; Odean, 1998a,b, 1999, Barber and Odean, 2000, 2001, 2002; Grinblatt and Keloharju, 2000, 2001a,b, 2008; Lo et al., 2005). It therefore comes as no surprise that financial researchers investigate whether predictable patterns in investor behavior cause predictable patterns in stock returns.

An influential article in the *American Economic Review* by Kamstra et al. (2003) (hereafter, KKL2003) argues that a psychological condition called Seasonal Affective Disorder (SAD) drives changes in the risk aversion of the marginal investor and causes the seasonal patterns in stock return displayed in Fig. 1. SAD is a mood disorder in which individuals suffer from depression as a result of fewer daylight hours in fall and winter.[1] KKL2003 hypothesizes that the onset of seasonal depression results in greater risk aversion in the affected subset of investors, who therefore sell stock, decreasing prices in the fall as the days get shorter. As the days lengthen and the mood of these seasonally depressed investors improves in winter, they buy stock, driving up prices. Expected returns as predicted by the SAD model are plotted in Fig. 2 for several markets. KKL2003 examines stock index returns from nine countries (12 indices) and reports statistically significant negative coefficients on a fall dummy and significant positive coefficients on a SAD measure[2] for six out of nine countries.

In this paper we critically reexamine KKL2003. First, our survey of the psychological literature shows that the seasonality of the model-predicted returns (depicted in Fig. 2) does not correspond to patterns of seasonal depression in the general population.

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[1] For an overview of SAD, see Partonen and Lönnqvist (1998).
[2] The KKL2003 SAD measure is an interaction term of a dummy variable equal to one for all days during fall and winter and a normalized measure of the length of the night. See Section 4 for details.

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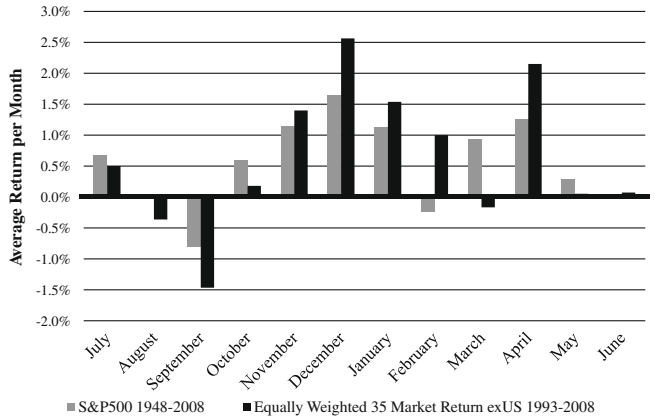


**Fig. 1.** Average monthly return around the world. The figure above plots the equally weighted average monthly index return for all countries included in this study. For each country we select one index and calculate continuously compounded monthly returns from daily data (for the US we select the S&P 500, for the UK, the Datastream Total Market Index). Then we calculate the simple monthly average return across all 35 indices, excluding the US, in the given month. We only calculate average returns if all series are available. For this reason the series covers 1993 through 2008. Then we average across all years and the average is presented above. The US series is the average over 1948 through 2008.

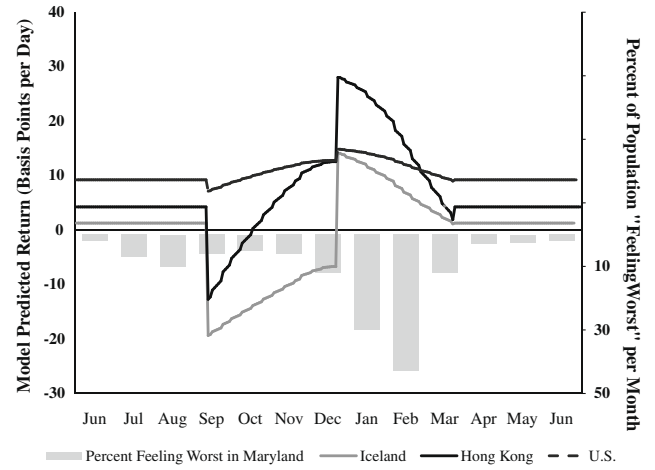


**Fig. 2.** Model-predicted returns and timing of peak depression. The figure above plots seasonal variations in stock returns as predicted by KKL2003's SAD model for three selected countries and seasonal variations in the fraction of people feeling worst. Specifically, the exact model expected returns in basis points plotted are: Iceland $1.3 + 20.8 \times D^{fall} + 1.5 \times SAD$, Hong Kong $4.3 + 15.5 \times D^{fall} + 19.2 \times SAD$, US (S&P 500) $9.2 + 2.1 \times D^{fall} + 1.9 \times SAD$. The left axis corresponds to these three time series. On the right axis the figure recreates a chart from Kasper et al. (1989) which presents the percentage of the population reporting feeling worst in that month in a study of randomly selected households in Montgomery County, Maryland, USA. The right axis ordering is reversed, e.g. 43.2% of respondents report feeling worst in January and/or February, whereas 9.6% of respondents report feeling worst in July and/or August.

Second, we replicate the original KKL2003 study and extend the sample from 9 countries (12 indices) to 36 countries (47 indices). Third, we use the extended sample to see whether there are more pronounced stock market effects due to SAD in countries where the marginal trader is more likely to be afflicted by SAD. KKL2003 uses latitude to proxy for this likelihood because previous research has shown that SAD is more prevalent at higher latitudes. We examine the link between SAD prevalence and the magnitude of seasonal returns more directly and find that there is no economically meaningful relation between the magnitude of the fall and SAD coefficients and the prevalence of SAD.

Finally, we show that the statistical significance of the fall dummy is largely driven by a *de facto* overlapping dummy-variable specification in which the SAD measure, a highly persistent level variable, acts as a fall-winter dummy. To illustrate, consider if returns were quite large during winter but in fall no different from spring and summer. In a specification with a fall and a fall-winter dummy, the fall-winter dummy would capture the positive winter returns and implicitly attribute them to the entire period from fall to winter, while the intercept captures average returns in spring and summer. Because fall returns are no different from spring and summer, the coefficient on the fall dummy would have to be of equal magnitude and opposite sign to the fall-winter coefficient. Hence, the overlap between the two dummies would *mechanically* induce statistical significance where a properly specified model would find none. We break the SAD variable into two components, fallSAD and winSAD and find that once the overlapping dummy specification is eliminated, the significance of the fall dummy goes away.

While there is a large and growing literature that uses KKL2003 to motivate their research, several other studies are critical of the SAD hypothesis. Goetzmann and Zhu (2005) examines investor trading activity in five major US cities from January 1991 to November 1996 and concludes that their "results offer little support for the argument that investor behaviour is influenced by seasonality in the length of daytime hours" (p. 566). Jacobsen et al. (2006) studies seasonalities in US sectors, and Joshi and Bhattarai (2007) examines the effects of cloud cover, temperature and the KKL2003 SAD measure on the Nepalese stock market and reports that only cloud cover is positively correlated with daily stock returns. Edmans et al. (2007) points out that KKL2003 relies on a continuous proxy for investor mood which has a lower signal-to-noise ratio in returns than studies that employ an event approach.

We owe the greatest intellectual debt to Jacobsen and Marquering (2008, 2009) which reexamine the evidence which links SAD and temperature induced changes in mood to stock returns. They point out that it is difficult to differentiate between the various explanations for stock market seasonalities and show that neither the SAD nor temperature arguments are robust with respect to the countries' latitude. They conclude "that it is simply not enough to link temperature and SAD directly to stock returns on the assumption that these variables affect mood and therefore affect stock returns" (p. 539) and call for further research on this topic. We answer their call by identifying important weaknesses in the development and econometric implementation of the SAD hypothesis.

While our econometric critique is specific to KKL2003's proposed SAD effect, our review of the medical and psychological evidence has broader implications for behavioral studies in finance and economics. Specifically, our critical reexamination illustrates that an association between sentiment-affecting events and stock prices is not sufficient to credibly establish a causal link between the two.

## 2. Medical basis of the hypothesis development

In this section we critically review the psychological underpinnings of KKL2003's SAD hypothesis. To understand the psychological issues that this hypothesis raises, imagine that a person named Sadie represents the marginal investor of a sizable group of SAD-afflicted investors, while Sunny represents the marginal investor of the remaining population that is not affected by SAD. As Sadie experiences increasing symptoms of seasonal depression, she becomes more risk-averse and sells off part of her stock holdings to Sunny. Sunny is only willing to increase his exposure to stocks if the expected return increases by some amount. As the days