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The wandering weekday effect in major stock markets

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ABSTRACT

This paper reports a *wandering weekday effect*: the pattern of day seasonality in stock market returns is not fixed, as assumed in the Monday or weekend effects, but changes over time. Analysing daily closing prices in eleven major stock markets during 1993–2007, our results show that the wandering weekday is not conditional on average returns in the previous week (the "twist" in the Monday effect). Nor does it diminish through the period of analysis. The results have important implications for market efficiency, and help to reconcile mixed findings in previous studies, including the reported disappearance of the weekday effect in recent years.

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1. Introduction

Seasonality effects in stock markets refer to a diverse set of findings concerning calendar "anomalies" (Thaler, 1987a,b) in the market. Collectively they show that returns are consistently higher on some days of the week, or at some times of the month, or in some months of the year, than others. These patterns are not limited to US equity markets, but appear in futures, Treasury bills, debts and exchange rates, and in non-US countries (Pettengill, 2003).

The efficient market hypothesis (EMH) suggests that all past financial information is already reflected in current stock market prices or returns (Fama, 1970). Therefore, seasonality effects challenge the EMH because they imply that, in the absence of transaction costs, excess returns can be made simply by knowing what day of the week it is, whether it is January, if it is around the turn of the month, and so on. Moreover, any persistence over time of a seasonality effect is an additional threat to EMH, because in the efficient market, once a seasonal inefficiency comes to light it should immediately self-destruct as being part of the newly updated body of information available to the public which prices are supposed to full reflect (EMH/weak). Yet apparently the Monday effect was known to traders as far back as the 1920s (Pettengill, 2003). This article describes and investigates a new and more subtle conception of seasonality which is therefore a new kind of challenge to EMH: the possibility that seasonality is in a continual state of flux, rather than fixed over time.

One frequently tested claim, day seasonality, is that returns stand predictable higher on certain days of the week than on others. Day seasonality has a number of variant formulations. The standard *Monday effect* suggests that Monday's returns are lower than those for Tuesday through Friday (French, 1980; Kamara, 1997); the *weekend effect* examines the difference between returns for Mondays and Fridays alone (Cross, 1973); and the *weekday effect* (also *day-of-week effect*, Ke et al., 2007) is simply that weekdays differ in their expected returns. Being the most general test of day seasonality, the weekday effect is preferable to testing the Monday or weekend effects because it prevents researchers from prematurely committing to an unnecessarily narrow focus and thereby missing important results. Our results support this argument.

However, going beyond the weekday effect, the main innovation in this article is to challenge the assumption of fixity in day seasonality. Previous studies, assuming that seasonality should be steady over time, have presented mixed and inconsistent findings at different sample periods even for the same indices, detailed in Section 2. But we allow that the pattern of day seasonality within a market may shift over time, yet in a manner that is distinguishable from a random process. Thus, "mixed and inconsistent findings" would be the natural state of affairs when testing for fixed seasonality. We call this the *wandering weekday effect* to

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distinguish it from the previously researched fixed weekday effect. To test the wandering weekday effect we model it as the interaction of the weekday effect with time, and establish that it is present in all the leading stock markets. We also show that the wandering weekday is robust to different formulations, is not driven by market trends (Jaffe et al., 1989), and has not vanished over time, contrary to Kohers et al. (2004).

The wandering weekday is important for several reasons. Looking to future research, it establishes a whole new way that markets can be shown to be inefficient, instantly increasing the vulnerability of EMH. By the same token, it means that any general theory of weekday effects must be able to account for a much more complex set of findings, which makes life difficult for them too. Looking to past research, it helps explain why evidence concerning a (fixed) weekday effect has sometimes been equivocal: different results are to be expected if data have been sampled in different time frames.

The layout of this article is as follows. Section 2 reviews past evidence for seasonality effects. Section 3 describes the sample and models to be run. Section 4 presents the results in four subsections. Section 5 is the discussion.

2. Seasonality in flux

One of the implicit assumptions made in past seasonality research is that seasonality effects are relatively stable through time. The labels on many of these findings emphasize this stability: *The Weekend Effect*, *The Monday Effect, The January Effect*, *The Turn of the Month Effect*. Researchers have acknowledged that seasonality may manifest differently for different markets, and have found *between*-market variations in these effects. For instance, Agrawal and Tandon (1994) found seven markets in their sample exhibited lowest returns on Mondays, as typically found in US data, whereas eight markets had lowest returns on Tuesdays. More recently, Basher and Sadorsky (2006) have also found divergences between day-of-the-week effects in stock markets in emerging economies.

Notwithstanding these studies, which all find some kind of weekday effect in markets, other researchers have found little or no weekday effects: Apolinario et al. (2006) studied fifteen European markets in the period 1997–2004, but found significant weekday effects in only two markets. In their analysis of the Shanghai and Shenzhen markets, Gao and Kling (2005, p. 75) claimed that "the year-end effect was strong in 1991 – but disappeared later". There are different ways to interpret these results. One commonly held view is that the final destination of all seasonality effects should be the null hypothesis. Seasonal effects should not survive public knowledge of their existence, and so will attenuate over time, showing that markets have become more efficient (Kohers et al., 2004).

On the other hand, it is possible that seasonal effects continually evolve. As an example, Mehdian and Perry (2001) found that negative Monday returns pre-1987 had become significant positive Monday returns in the post-1987 period. Evolving seasonality effects may manifest as apparent attenuation at a particular point in time, or when averaged over a period that includes both traditional and reversed Monday effects. Evolving seasonality may therefore present as absence of seasonality. The more general point is that all weekday effects in all stock markets may be in a permanent state of flux so that different researchers looking at the same series may variously report the standard effect, an absence of the effect, a reversal, or a totally new configuration, all depending on the haphazard sampling of time period that they analyse. What might be driving this flux?

One possibility that we will examine in some detail is that the wandering weekday may be driven by the conditional Monday effect, also known as the "twist" in the Monday effect (Jaffe et al., 1989). It has been found that markets on the down-turn exhibit the traditional Monday effect more strongly than markets on the up-turn, whether up-/down-turn is defined at the week level (Jaffe et al., 1989) or much longer (Liano, 1989).

However, it is also clear that the way business was done forty years ago is different from how it is done today, so the conditions that promoted a Monday effect in 1970 may no longer exist today. Settlement procedures change, governments change the days on which they announce key economic indicators (Steeley, 2001), the availability of electronic trading, the changing nature of the weekend, all have the potential to alter the significance of each day of the week. Therefore, many forces may drive the weekday effect into a continually adjusting pattern of changes. In addition, endogenous forces may destabilize the weekday effect. Contrary to the assumption that irrational effects will be automatically traded away once brought to light, there is evidence that markets over-react (De Bondt and Thaler, 1985; Lehmann, 1990), though the success of momentum trading (Antoniou et al., 2007; Asem, 2009) suggests a contrary view. If sufficient people responded to the simple formula of "Buy on Monday sell on Friday", over-reaction to seasonality effects might push Monday returns up beyond equilibrium, leading to a new pattern of seasonality, which would eventually be reacted to, and so on. What would make recursive over-reaction hard to constrain is the difficulty of framing a rational reaction to irrational and erratic tendencies.

3. Hypotheses and methods of analyses

3.1. Fixed day seasonals

Before examining the wandering weekday effect we pause to examine the day seasonals under the assumption that they do *not* vary with time, which is the usual stance taken in the literature. Temporarily laying aside the time dimension allows us to re-create what researchers would have found in this data and the conclusions they would have been forced to draw from it about EMH. This makes it a useful point of reference to judge the benefits of our later analyses of time-varying effects.

Also, the three different formulation of day seasonality are pitted against each other here. We show that the general weekday effect is more sensitive in detecting violations of EMH than the Monday or weekend effect. This superiority of the weekday formulation justifies its later use in more complicated time-varying analyses.

Until fairly recently, the standard way to analyze weekday effects was using OLS regression with daily returns as the dependent and weekday dummy variables as the independent measures. See, for example, Kamara (1997, p. 70). More recently, the ARCH/GARCH family of models (Engle, 1982; Bollerslev, 1986) have become standard. They allow researchers to model variance as conditional on past variance and error, rather than fixed throughout the series, as in regression. A GARCH(p,q) model has p autoregressive lags or ARCH terms, and q moving average lags (GARCH terms). Engle (2001, p. 166) states that "GARCH(1,1) is the simplest and most robust of the family of volatility models," and is the most widely applicable, see also Apolinario et al. (2006). Therefore, we use GARCH(1,1) to impose a standardized analysis across all markets we consider.

Obviously, day seasonality should manifest in serial correlation at lags of order 5, 10, 15, 20, etc. (Copeland and Wang, 1994), which could form the basis for an alternative perspective to that presented here. However, in this article we use ARMA terms as a simple robustness test. If the weekday/wandering weekday is unaffected by the presence or absence of ARMA terms, then the

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