Original Article

A better 'autopilot' than Sell-in-May? 40 years in the US market

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Zvika Afik
is a lecturer of Finance at Ben-Gurion University. His main research interests are: credit risk, financial derivatives, risk management and hedging. He teaches MBA courses in derivatives, financial engineering, risk management and an investment committee course. Prior to joining BGU he has gained diverse experience in business management, technology project management, system engineering and consulting, mainly in electro-optics and software technology firms. He has a BSc and an MSc in Electrical Engineering from the Technion – Israel Institute of Technology (1979) and Tel Aviv University (1989), an MBA (Executive Program) from Concordia University in Montreal (1996) and a PhD in Finance from Tel Aviv University (2009).

Yaron Lahav
is an Assistant Professor of Finance at the department of business administration of the Guilford Glazer Faculty of Business and Management. His areas of expertise are behavioral and experimental finance, but his research also involves international tax. Prior to his current position, he was a senior consultant in the transfer pricing group of Deloitte Tax LLP in their national offices in Washington DC. He was also a financial manager at the Israeli Aerospace Industries and an economist in an Agro-Biotechnology start-up. He also consulted several companies and assisted research institutions in various projects. He received his PhD in economics from Emory University in 2007, and a BScAgr in agricultural economics and management from the Hebrew University of Jerusalem.

Correspondence: Yaron Lahav, Guilford Glazer Faculty of Business and Management, Department of Business Administration, Ben-Gurion University of the Negev, Room 116, Building 15, PO Box 653, Beer Sheva, 84105, Israel.
E-mail: ylahav@som.bgu.ac.il

ABSTRACT Sell-in-May, known also as the Halloween effect, continues to persist in many parts of the world and to puzzle researchers and practitioners. Prior research found that in a few certain countries, this effect is not statistically significant or does not exist. This article shows that although Halloween effect is significant in the United States, it can be quite easily replaced by another profitable calendar strategy: holding the market index just for the months of March and November each year and investing the money in the risk-free asset for the rest of the year. This strategy may not persist in the future, however it is puzzling how it prevailed over 43 years in the S&P-500 since 1970. We show that the superior performance of this strategy compared with its natural benchmarks is robust using risk-adjusted measures over multiple sub-periods in our sample.
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INTRODUCTION

Calendar anomalies are vastly documented in the literature. The 'Sell-in-May' effect, also known as the Halloween effect, is probably the most stable, pervasive and enigmatic one. Its underlying strategy follows a simple receipt – hold equity in the period 1 November to the end of April and sell the equity for cash (or a risk-free asset) on 1 May, and so forth. This strategy works every 2 out of 3 years according to Doeswijk (2008). In trying to decipher the mechanism of the Halloween effect in the US equity market, we find that monthly return patterns are generally unstable, except for March and November that seem to exhibit, on average, positive returns that are statistically significant over more than four decades.

We thus hypothesize that 'March & November' strategy – holding Treasury Bills (T-Bills) over 10 months and investing in the market index just in the months of March and November – is potentially a superior alternative to Sell-in-May. In this work we test this hypothesis and evaluate it using a variety of performance measures. An investment of US $1 at the beginning of 1970 for 43 years yields at the end of 2012 approximately $33 in 'Sell-in-May' and $23 in 'March & November'. These two strategies are superior to the pure index (Buy & Hold) and Treasury Bills (T-Bills) alternatives,[1] yielding $18 and $10, respectively, over the same period. Final realized returns however ignore the risk of the investment. When we evaluate a variety of risk-adjusted return measures, we find that 'March & November' is superior not only in a single experiment of 43 years investment horizon, but also over 396 sub-periods, each 10 years long (with statistical significance). The latter test also portraits the evolution of each strategy performance since 1970, starting the first decade on 2 January 1970, the second decade a month later and so forth.

The literature on calendar anomalies is extensive, and we present here only a sample of prior relevant research. A cornerstone is Bouman and Jacobsen (2002), followed by many others, including Jacobsen and Zhang (2012) and Andrade *et al* (2013). A more critical view of the effect is offered by Jacobsen and Marquering (2008) and Zhang and Jacobsen (2012).

Bouman and Jacobsen (2002) study 37 markets and find higher returns in 35 of these markets during the November to April half-year period compared with the May to October half-year period. November–April returns are statistically higher in 20 of the 37 markets. Bouman and Jacobsen (2002) discuss a wide range of plausible explanations for the Halloween effect without conclusive results, except, perhaps to its relation to vacation timing and length. As the Bouman and Jacobsen (2002) sample ends on August 1998, Andrade *et al* (2013) extend the sample period for the same markets analyzed by Bouman and Jacobsen (2002) and find that the 'Sell-in-May' effect is pervasive in financial markets even in the 10 years following the publication of Bouman and Jacobsen (2002) in the same markets. Using equally valuated and value-weighted global portfolios of the 37 markets, they also show that the average global effect is not stable, though the excess returns of November–April period over the rest of the year is positive more frequently than negative.

Jacobsen and Zhang (2012) study all 108 available stock market indices and find that the 'Sell-in-May' effect appears in 81 of them, that it is statistically significant in 35 countries, and that the 'reverse effect' (higher May–October returns) is statistically significant only in 2 countries. Their extensive research finds that the 'Sell-in-May' effect varies geographically and cross-nation, and it is more prevalent in Europe and does not appear in Israel, India and all the countries located in Central and South American area. Overall, Jacobsen and Zhang (2012) suggest that the Halloween effect is a strong market anomaly that has strengthened rather than weakened in the recent years. Jacobsen and Marquering (2008) show that results of prior literature attempting to explain stock return patterns by weather-induced mood shifts of investors, might be data-driven inference. Zhang and Jacobsen (2012) focus their attention on the entire trading history of the UK equity market, analyzing 317 years of monthly UK prices, starting from 1693. Their main conclusion is that seasonal monthly anomalies strongly depend on the sample period considered.

Darrat *et al* (2011) provide an international perspective on average monthly returns in the years 1988–2010. Zhang and Jacobsen (2012) summarize the main findings of 23 prior seasonality studies, including that of Darrat *et al* (2011). For the purpose of our article, it is interesting to note that March returns are statistically insignificant in all the listed countries, except for Ireland, where it is found positive (according to Bouman and Jacobsen, 2002; Darrat *et al*, 2011), and Turkey and Malaysia, where it is found negative.[2] In all the studies, November returns are statistically insignificant, except for Argentina, where it is found negative by Darrat *et al* (2011). Furthermore, there is no overlap of statistical significance of March and November returns in the sample of the 32 countries.

We augment the existing literature by demonstrating another calendar-related phenomenon that to our knowledge is not documented in prior studies, the March and November significant positive returns. Asking a few local investors, it seems that this effect is not known to practitioners. We do not claim to have an economic explanation for the existence of the effect over our sample of 43 years. Like Jacobsen and Marquering (2008), we remain doubtful whether finding an economic reason for such calendar effects is feasible. In addition, we do not argue with Zhang and Jacobsen (2012) that monthly anomalies ‘might simply be in the eye of the beholder and a result of data snooping’. We do point to our findings that demonstrate the superiority of the ‘March & November’ investment strategy over a period of 43 years, in a very developed, deep and liquid market.

The rest of the article proceeds as follows: The next section presents the data and methodology, the penultimate section presents the results and discusses them, and the final section concludes.

METHODOLOGY AND DATA

Data

For the US equity market index, we use monthly S&P-500 index adjusted closing time series, starting on 3 January 1950 and ending on 2 January 2013. To limit the ‘age’ of our data, for most of our analysis, we limit our sample to the period starting on 2 January 1970, for a total of 43 years. For the risk-free asset, we use a daily time series of the 13-weeks US T-Bill rate. ‘Yahoo! Finance’ is the source for both data sets.

Methodology

We follow the common methodology used by many prior researchers, incorporating a dummy variable S_t to assess the seasonal effect in the following regression:

$$r_t = \alpha + \beta \cdot S_t + \varepsilon_t \qquad (1)$$

where r_t is the monthly index return at time t, α is the intercept, S_t equals 1 for months May–October and 0 otherwise and ϵ_t is the usual error term. Similar to others, we use log-returns for r_t. We then test whether β is positive and statistically significant.

Similar to prior research, we find that we reject the null hypothesis that $\beta = 0$. Our next step is to assess monthly effects, in an attempt to discover a superior strategy to ‘Sell-in-May’. For that purpose, we use a monthly dummy variable in the following regression:

$$r_t = \sum_{j=1}^{12} \mu_j M_j + \zeta_t \qquad (2)$$

where M_j equals 1 for month j and 0 otherwise, μ_j is the average estimated return for month j and ζ_t is the error term. A statistically significant non-zero μ_j is a potential candidate for a calendar-based strategy. We repeat this regression for the entire sample (63 years) and for selected periods. For the rest of the analysis, we use only the last 43 years of the entire sample.

For the S&P-500 index and our sample data, we select the months of March and November as we present in the section ‘Results, analysis and discussion’. We then construct four value paths (time series), each is 516-month long, starting with a \$1 investment on 2 January 1970 and ending on 2 January 2013: ‘Sell-in-May’ strategy, ‘March & November’ strategy, ‘Buy & Hold’ strategy and 'T-Bills' strategy. We do not limit our analysis to the final value of each investment strategy at the end of the 43 years. In addition to the value paths of the four investment strategies over the complete period, to assess the timing effect on the performance, we calculate and assess the performance of 396 decades, the first starting in January 1970, the second in February 1970 and so on, and the last in January 2003. To evaluate risk-adjusted performance, we use Sharpe Ratio (SR), Adjusted Sharpe Ratio (ASR) and Morningstar Risk Adjusted Returns (MRARs) as defined below.

The SR for investment strategy i in the period starting on month k and ending on month l is the customary:

$$SR_i(k,l) = \frac{\frac{1}{(l-k+1)}\sum_{t=k}^{l} r_{i,t} - r_{f,t}}{\sigma_i(k,l)} \quad (3)$$

where $r_{i,t}$ and $r_{f,t}$ are month t strategy i and risk-free asset returns, respectively, and $\sigma_i(k, l)$ is the standard deviation of strategy i returns in the period $[k, l]$.[3]

As SR is limited to the first two moments of the returns, we compute the ASR, which augments the SR by adding the effects of the third and fourth moments, m_3 and m_4, skewness and kurtosis, respectively (see, for example, Alexander and Sheedy, 2004):

$$ASR_i(k,l) = SR_i(k,l) \cdot \left[1 + \frac{m_{i,3}(k,l)}{6} \cdot SR_i(k,l) - \frac{m_{i,4}(k,l)-3}{24} \cdot SR_i(k,l)^2\right] \quad (4)$$

where all the variables are for strategy i and period $[k, l]$.

Finally, as ASR is still relatively unknown to many practitioners and academics, we also use the widely adopted industry standard MRAR (see Morningstar, 2009):

$$MRAR_i(k,l) = \left[\frac{1}{(l-k+1)}\sum_{t=k}^{l}\left(\frac{1+r_{i,t}}{1+r_{f,t}}\right)^{-\gamma}\right]^{-\frac{12}{\gamma}} - 1 \quad (5)$$

where γ is a risk-aversion parameter. Usually, Morningstar and others use $\gamma = 2$.

In addition to charting the decade performances versus their starting month, we compare the AR, ASR and MRAR of the strategies over 396 observations and test for significant differences using a non-parametric sign test, assessing whether there is a statistically significant performance superiority among 'March & November', 'Sell-in-May' and 'Buy & Hold' alternative strategies.

RESULTS, ANALYSIS AND DISCUSSION

Testing the 'Sell-in-May' effect

We start by testing the existence of the 'Sell-in-May' effect in the leading US market index, using the regression in equation (1) and the monthly data of the S&P-500 index in the period January 1970 until the end of 2012. The results are summarized in Table 1. Both the intercept (α) and the coefficient of the effect dummy (β) are positive, while we cannot reject the null hypothesis that the intercept is statistically insignificantly different from 0, β is significant at 10 per cent level. Hence, the Sell-in-May effect embodied in β equals 0.72 per cent. This is the average monthly return difference of the period November to April, above the average monthly return during the

Table 1: Presenting the regression results of equation (1) for S&P-500 index monthly returns in the period 2 January 1970–2 January 2013

	α	β		
Value	0.00195	0.00723	Observations	516
Standard deviation	0.00280	0.00397	R^2	0.00642
P-value	0.4878	0.0690	*F*-value	0.1918

Note: α is the intercept and β is the coefficient of the dummy S_t, which equals 1 for months May–October and 0 otherwise.

Table 2: Presenting the regression results of equation (2) for S&P-500 index monthly returns in the period 2 January 1970–2 January 2013

Month (*j*)	1	2	3	4	5	6
μ_j	0.000120	0.010501	0.012100	0.002632	0.001418	0.003070
Standard deviation	0.006878	0.006878	0.006878	0.006878	0.006878	0.006878
P-value	0.9861	0.1275	*0.0792	0.7021	0.8367	0.6556
Month (*j*)	7	8	9	10	11	12
μ_j	0.000027	−0.008515	0.004818	0.010865	0.016912	0.012776
Standard deviation	0.006878	0.006878	0.006878	0.006878	0.006878	0.006878
P-value	0.9969	0.2163	0.4840	0.1148	**0.0143	*0.0638
Observations						516
R^2						0.02323
F-value						0.4505

*Significant at 10 per cent level, **significant at 5 per cent level.
Note: The 12 estimated parameters (μj_i) are the average returns of the months during the sample period.

rest of the year, which is less than 0.2 per cent in the sample period.

The monthly effect

Using the regression of equation (2), we calculate the average monthly returns for each of the calendar 12 months and their respective *P*-values. Table 2 summarizes the results and clearly shows that since 1970, the S&P-500, on average, has only 3 months that have statistically significant non-zero returns: March, November and December. Trying to discern monthly patterns, their stability and evolution over time, we also use visual presentations. Figure 1 graphically shows patterns of average S&P-500 monthly returns and their respective *P*-values in various periods. Although December has average positive returns (significant at 10 per cent level), since 1970 and even since 1950, the average returns are not statistically significant since 1990 and are even negative since 2000. Interestingly, October appears positive and statistically significant in the long history starting in 1950. However, it is positive and insignificant since 1970.

We thus hypothesize that one may capture most of the benefits of November to April season just by investing in the US equity market index only during March and November each year. To test this hypothesis, we evaluate the 'March & November' strategy as an alternative strategy to 'Sell-in-May'. Explicitly: invest in the market index during March and November and hold a risk-free asset otherwise. The rationale is quite elementary – do not take the risk when the reward is not significantly positive. The hypothesis underlying this strategy is that even when its holding period return is not higher than that of 'Buy & Hold' or 'Sell-in-May', its volatility and risk-adjusted returns would be superior. We test this hypothesis below.

Alternative investment strategy comparison

We compare four investment strategy alternatives: 'Buy & Hold', 'Sell-in-May', 'March & November' and the trivial baseline 'T-Bills'. We start with the simplest test. We construct 'Buy & Hold' and 'T-Bills' value paths (prices versus time), in steps of 1 month, starting with $1 each on 2 January 1970 and ending on 2 January 2013.[4] Combining properly these two time series we calculate the corresponding value paths of 'Sell-in-May' and 'March & November' strategies. Figure 2 shows these four value paths. In this example, an investment of $1, for 43 years, on 2 January 1970, yields on 2 January 2013

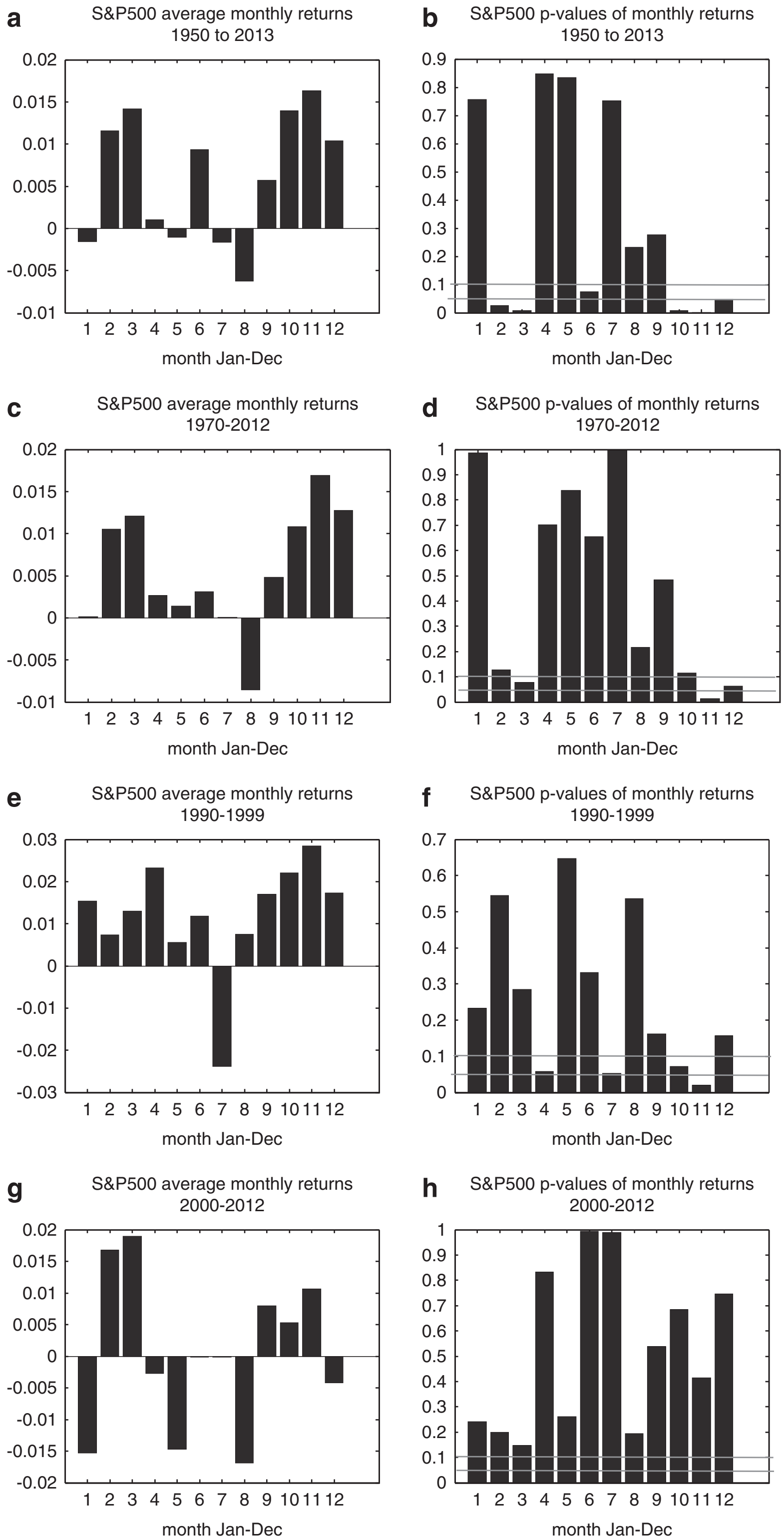

Figure 1: Patterns of average S&P-500 monthly returns and their respective *P*-values in various periods. Returns are in decimal (fractions) per month. The light-colored horizontal lines on the *P*-value charts mark the 10 and 5 per cent significant levels. (a): Averages 1950–2012. (b): *P*-values 1950–2012. (c): Averages 1970–2012. (d): *P*-values 1970–2012. (e): Averages 1990–1999. (f): *P*-values 1990–1999. (g): Averages 2000–2012. (h): *P*-values 2000–2012.

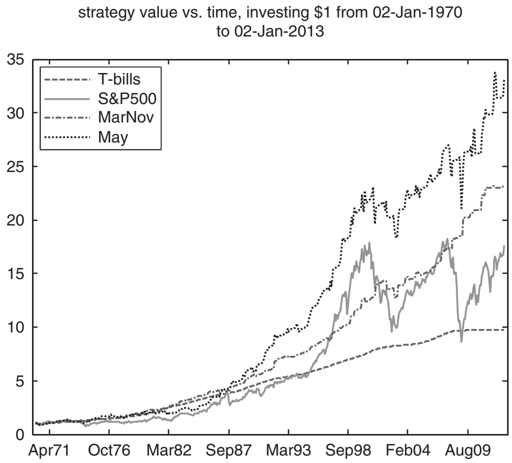

Figure 2: Value paths of $1 investment on 2 January 1970 in the four alternative strategies, until 2 January 2013, a total of 43 years. The vertical axis is in dollars. The dashed line is 'T-Bills', the solid line is 'Buy & Hold', the dotted line is 'Sell-in-May' and the dash-dot line is 'March & November' value path.

approximately $18 in 'Buy & Hold', $10 in 'T-Bills', $33 in 'Sell-in-May' and $23 in 'March & November'.

Naturally, one may expect that this 43-year investment horizon is not economically homogeneous and that drawing conclusions from a single path strongly depends on the specific realization and might be misleading. Furthermore, observing the final value at the end of the investment horizon ignores the volatility and thus the perceived risk of the strategy. As we use real market data and the market index history is limited to a 'single realization', we use 396 'sliding' decade investment horizons, the first starts in January 1970, the second in February 1970 and so on, and the last in January 2003. This resampling of the available historical data generates 396 realizations, allowing us to gain insight into the dependence on the starting date and to enhance the robustness of the four alternative strategies comparison. We repeat the calculations of investment returns per decade for each of the strategies. The four paths are depicted in Figure 3 (the top-left corner). There is no clear winning strategy based solely on holding period returns. 'Buy & Hold' and 'Sell-in-May' seem most volatile and sensitive to their starting date. In 'good' years, they provide superior returns and in 'bad' times they are the clear losers. 'T-Bills' depicts the mildest path and seems the least attractive whereas 'March & November' appears an improved version of 'T-Bills', with higher returns and volatilities, or on the other hand, as a damped (hedged) version of 'Buy & Hold' and 'Sell-in-May' strategies. To gain further insight, one needs to assess risk-adjusted performance measures.

Adding the risk embedded in the strategies to our analysis, we calculate risk-adjusted performance measures for each of the three strategies that invest in the risky asset (the index) for each of the 396 decades. The SR of these returns (Figure 3 top-right), ASR (Figure 3 bottom-left) and MRAR (Figure 3 bottom-right). The risk-adjusted performances help to untangle the competition among 'March & November', 'Sell-in-May' and the 'Buy & Hold' strategies. The SR of 'March & November' is higher than that of the 'Buy & Hold' strategy, except for two, relatively short, periods (late 70s to early 80s and late 80s to early 90s) where the SRs of the two strategies are quite close to each other. The SR of the 'Sell-in-May' and the 'Buy & Hold' strategies are close to each other, except for the 80s, where 'Sell-in-May' SR surpasses that of the other two strategies. The ASR patterns are similar to those of the SR measure. The MRAR chart provides a different risk-adjusted measure perspective. Its pattern for 'March & November' is quite stable and positive (except for a very short period in the early 70s) whereas the MRAR of the other two strategies is quite volatile with long periods of negative values. Only during the 80s, the MRAR of 'Sell-in-May' surpasses that of 'March & November' strategy.

To further rate the risky alternatives, we compare their relative performance evolution using a non-parametric sign test. First, we reject the null hypothesis that the 396 decade returns of 'March & November' are not significantly higher than those of

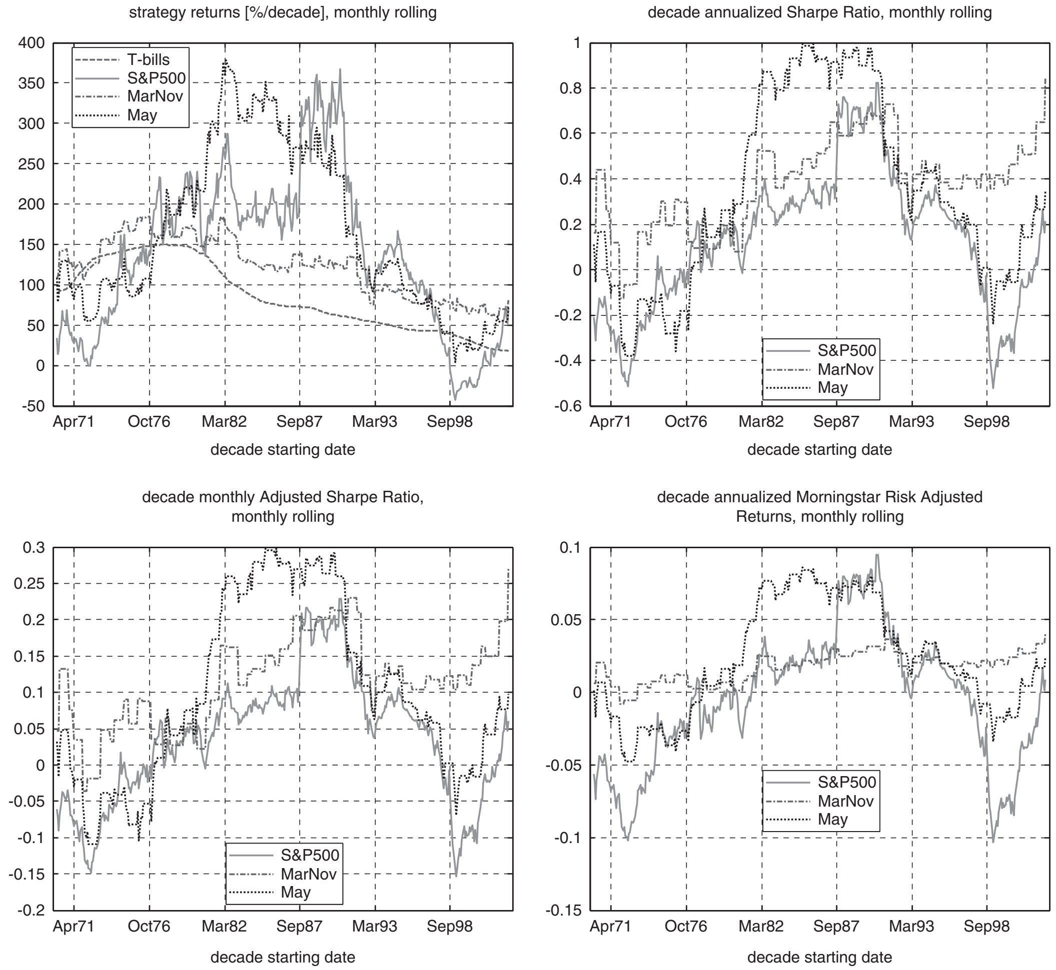

Figure 3: Performance measures of 396 sliding decades versus decade starting date, the first starts in January 1970, the second in February 1970 and so on, the last starts in January 2003. The top-left chart shows the decade net returns (in per cent) for the four strategies. The top-right chart shows the evolution of the annualized SR for the three risky asset investment strategies, the bottom left is the corresponding evolutions of the ASRs (monthly, not annualized), and the bottom right is the corresponding chart of the MRARs (annualized). These charts use the same color and line types as in Figure 2.

'Sell-in-May' (P-value = 1.3 per cent). We test a similar null hypothesis comparing 'March & November' to 'Buy & Hold' and find that it is rejected at the 1 per cent level. Focusing on risk-adjusted performance measures, we reject the null hypothesis that 'March & November' is not performing better than 'Sell-in-May' (P<0.1 per cent for SR and ASR). For the MRAR, we cannot reject the null hypothesis (P-value = 0.119), however, our subjective preference, comparing the three alternatives in Figure 3 (bottom right chart) prefers the MRAR of 'March & November' over that of the alternatives, mainly because of its relatively long-term stability.

We find the above results an evidence for the superiority of 'March & November' over the other tested strategies in our sample period. Obviously, we do not claim that such an advantage would prevail in the future, as we do not have a proven explanation for the performance of S&P-500 in the specific months of March and November. We consider a few alternative explanations, which seem to be far-fetched (or simply false) but

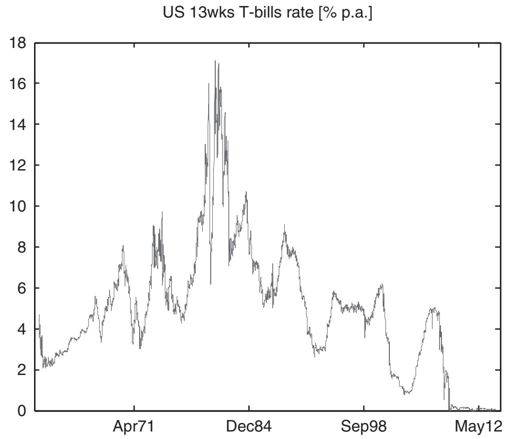

Figure 4: US 13-week T-Bill historical yields (in per cent per annum).
Source: Yahoo! finance.

yet, worth noting. The only unproven conjecture we offer presently to this unresolved anomaly is an optimism cycle that manifest itself more prominently in the United States in the months of November and March.[5] Hirshleifer and Shumway (2003) show, testing 26 stock exchanges around the globe, that return is lower in cloudy days. As most of the months between November and May are winter months, one would expect the Halloween effect to be negative.[6] In this context, the months of March and November are different. The month of March signifies the beginning of spring. As the connections between weather and mood, and between mood and decisions is well-established in the literature, the high return in the month of March can be attributed to mood effects. The month of November is the beginning of the holiday season. As shown in previous work (see, for example, Ariel, 1990; Kim and Park, 1994 and many others), holidays have a significantly positive effect on stock markets.

Both 'Sell-in-May' and 'March & November' seem to benefit from high yields on T-Bills, reaching an unusual peak in the early 80s (see Figure 4 for historical 13-week T-Bill yields). The relatively long period of low yields on T-Bills in the recent years of our sample on one hand, and the more frequent downturns in the equity market on the other hand (see Figure 2) could be pre-cursors for new patterns and potentially new attractive investment strategies in the years to come. It remains to be seen, in the future, whether March and November would retain their outstanding positive returns.

We ignore tax effects as these are often specific to an investor. We also ignore transaction costs that are considered in prior papers to be insignificant for the 'Sell-in-May' strategy. Bouman and Jacobsen (2002), for example, estimate the round-trip cost at 1 per cent for the index and suggest using futures instead, which lower the round-trip cost to 0.1 per cent. We therefore propose that the actual execution of the 'March & November' strategy would be rolling 1-year T-Bills and synthetically hold the index in the months of March and November by 1-month futures.

CONCLUSION

This article confirms prior literature results that the Halloween effect is statistically significant in the US equity market. However, this article is the first to identify that just 2 months every year, March and November, yield on average positive returns that are statistically significant. This finding allows a profitable investment strategy, based on historical data. The strategy is simply to hold the market index (S&P-500 in our analysis) during the months of March and November. In the rest of the year (10 months) invest the money in a risk-free asset (US T-Bills in our analysis). We show that this strategy is superior to the alternatives of 'Sell-in-May', 'Buy-and-Hold' or 'T-Bills' using risk-adjusted measures including SR, ASR and qualitatively the MRARs. This result is confirmed on 396 10-year holding periods in 1970–2012, starting at the beginning of each calendar month, the first in January 1970, the second in February 1970 and so on, and the last in January 2003.

Trying to find an economic reason for the prevailing of such simple calendar investment opportunity, we have to admit that we find none convincing. We adopt Jacobsen and Marquering (2008) conclusion regarding weather and season effects on market returns: 'Lots of things are correlated with the seasons and it is hard to distinguish between them when trying to "explain" seasonal patterns in stock returns'.

We believe that our article augments the existing literature in two ways. We believe it is the first to present the 'March & November' calendar effect. Second, it applies a set of tests to robustly assess the effect and the viability of its related investment strategy in two key manners. First, it does not focus on a single period or a few investment periods, which might be sensitive to the arbitrary choice of the starting date and a particular market timing. We do that by using the 'sliding' decade investment procedure. Second, we use four performance measures, three of them are risk-adjusted of which one even explicitly include the third and fourth moments of the result distribution. Furthermore, we use a non-parametric test to assess the ranking of the alternative strategies.

We do not know whether the recent convergence of decade investment returns is a passing phenomenon or a persistent one (see upper right chart of Figure 3). In either case, it seems that the attractiveness of the 'March & November' (and to a lesser degree of 'Sell-in-May') depends on the available risk-free rates. When T-Bills yields are low, 'March & November' returns are reduced and its advantage is merely its reduced volatility.

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NOTES

1. In the pure index strategy, the index is bought on the first day of the investment and held to the end of the investment horizon. We call this strategy 'Buy & Hold'. In the pure T-Bills we use (for our analysis purposes) a rolling position in which 1 month to maturity bills are purchased at the beginning of each month with the proceeds of the maturing prior month bills. We call this strategy 'T-bills'. We discuss practical implementation of the various strategies later in this article.
2. According to Fountas and Segredakis (2002) and Darrat *et al* (2011) for both countries, and for Malaysia also by Bouman and Jacobsen (2002), Ho (1990) and Lean (2011).
3. This actually conforms to the original definition of Sharpe (1966), which is often used. An alternative definition to the denominator, proposed by Sharpe (1994), is the standard deviation of the excess returns. However, the results usually do not differ materially.
4. As we use real market data and the exchange is closed on weekends, some holidays and special dates, when this happens on a desired trading day, our MatLab procedure seeks the nearest following day for inclusion in the value path.
5. Doeswijk (2008) proposes an optimism cycle for the mechanism behind the Halloween effect.
6. Hirshleifer and Shumway (2003) measured cloudiness as the difference between the level of cloudiness in a day to weekly average, which may provide an explanation for the conflict.

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