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NEW TESTS OF CALENDAR EFFECTS ON EQUITY AND SECURITIZED REAL ESTATE MARKETS

Eddie C. M. HUI[1*], Ka Kwan Kevin CHAN[1]

[1] *Department of Building and Real Estate, The Hong Kong Polytechnic University, Hong Kong, China*

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Abstract. We construct two new tests of calendar effects, apply them on 12 stock indices during 1996–2016, and compare the results with that using Hui and Chan (2016)'s method. The results show that the January and Halloween effects are significant for the four western generalized equity indices for small moving-window sizes. Furthermore, the securitized real estate indices show a greater difference in the overall calendar effect between the three methods than the general equity indices do. This study has an implication that a certain sector of the market is riskier than the whole market.

Keywords: calendar effect, Shiryaev-Zhou index, moving-window size, trading strategy, smoothing effect.

Introduction

Many investors adhere to the "buy-and-hold" strategy backed by the efficient market hypothesis (EMH), which is supported by a lot of articles (e.g. Malkiel & Fama, 1970; Barber & Odean, 2000). However, after the global financial crisis in 2008, many scholars raised doubts on the EMH (Hui & Chan, 2018a). If the EMH does not hold, then "buy-and-hold" may not work. Monthly trends in stock price movement called "calendar effects" are found in many previous studies, with the Halloween and January effects being the most common ones. The former says that equities get significantly higher returns during November-April, and is first discovered by Bouman and Jacobsen (2002), who find much greater average stock returns in November–April during 1970–1998. The January effect states that equity returns are significantly higher in January, and is first found by Wachtel (1942) on high-yields stocks in the U.S.

Most of the previous studies on calendar effects use traditional methods like regression. Hui and Chan (2016) apply Shiryaev-Zhou index of variable moving-window size to test calendar effects of 12 stock indices during 1996–2014. The Shiryaev-Zhou index of a stock, commonly denoted by μ, is calculated by dividing the stock's annual drift (or return) by its annual volatility (or variance of return). Deducting 1/2 from the quotient results in the Shiryaev-Zhou index (see Section 3). It can be regarded as a benchmark value for trading stock as follows: buy and hold the stock until the end of the period if $\mu \geq 0$, and sell it immediately otherwise (Yam et al., 2012a, 2012b). From the Shiryaev-Zhou index, Hui et al. (2014b) derive the estimator of the Shiryaev-Zhou index $\hat{\mu}_i(n)$ (they fix the moving-window size n to be 130) and introduce a trading strategy as follows: buy a stock as soon as $\hat{\mu}_i(n)$ changes from negative to positive, and sell it as soon as $\hat{\mu}_i(n)$ changes from positive to negative. Hui and Chan (2017) extend their work by letting the moving-window size n to vary, deriving a generalized time-dependent strategy.

The method of Hui and Chan (2016) is based on Hui and Chan (2017)'s generalized time-dependent strategy of which one has to buy a stock (or stock index) as soon as the estimator of the Shiryaev-Zhou index $\hat{\mu}_i(n)$ changes from negative to positive, and sell it as soon as $\hat{\mu}_i(n)$ changes from positive to negative. The recent globalization has strengthened interrelationship between international financial markets, increasing their volatility. Hence stock prices fluctuate a lot and $\hat{\mu}_i(n)$ changes sign very frequently. Thus, we have to trade the stock frequently. Since $\hat{\mu}_i(n)$ lags behind the stock price (Hui & Chan, 2014), there is a chance that on day i, the stock price is rising even when $\hat{\mu}_i(n)$ is negative, so "buy-and-hold" would outperform the strategy. In reality, transaction costs exist and build up for the strategy. When the amount of transaction costs increases, there is a higher chance that the strategy underperforms "buy-and-hold" (Hui & Chan, 2014). In fact, some studies even find that the strategy

*Corresponding author. E-mail: *bscmhui@polyu.edu.hk*

underperforms "buy-and-hold" for the majority of the cases (see Section 1). In light of this, Hui and Chan (2018c) construct two alternative strategies of which after $\hat{\mu}_i(n)$ changes sign, an investor waits until $\hat{\mu}_i(n)$ remains at the same sign for two or three consecutive days before buying or selling the stock index (which are called Strategy 2 and Strategy 3 respectively in Hui and Chan, 2018a, see details in Section 3). This reduces the number of times of trading the stock index and is called "smoothing effect". Their results show that Strategy 3 outperforms the other two strategies in general, especially when transaction costs exist.

In this study, based on Hui and Chan (2018c)'s three trading strategies, we construct three tests (Methods 1, 2 and 3 (see Section 4)). Method 1 is the test by Hui and Chan, 2016, while Methods 2 and 3 are newly constructed) to investigate calendar effects of 12 stock indices during 1996–2016. In particular, the Halloween and January effects are investigated. We follow Hui and Chan (2016)'s method: the overall calendar effect is examined by analysis of mean (ANOM), and the Halloween effect is tested by logistic regression. We compare the results of the three methods based on the three trading strategies, so we can see that for each of the three strategies, whether the stock index is held for most of the time in a particular month. Since Hui and Chan (2018c)'s two alternative strategies are different from Hui and Chan (2017)'s strategy, the "holding periods" and "non-holding periods" are different. Hence we expect that the resulting calendar effects shown by the three strategies are also different. One of the contributions of our study is that our new tests of calendar effects (Methods 2 and 3) can show different patterns of calendar effects from that shown by Hui and Chan (2016)'s method. We also compare the results between western (US, UK, France and Germany) and Asian markets (Hong Kong and Japan), and between securitized real estate and general equity indices. Hence investors can see different patterns of calendar effects between different types of markets. This is useful for them to improve their trading strategies to increase their profits.

The article continues as follows: Section 1 wraps up previous works. Section 2 presents the data source. Section 3 describes the formula of the Shiryaev-Zhou index and its estimator, and list out Hui and Chan (2018c)'s three trading strategies. The tests of calendar effects are described in Section 4. Section 5 displays and analyzes the results. Last section concludes the article.

1. Literature review

There are plenty of studies on calendar effects, especially the Halloween and January effects. Tables 1 and 2 (Hui & Chan, 2016) summarize previous works.

Table 1. Results of previous works on Halloween Effect (source: Hui & Chan, 2015, 2016)

Article	Method	Countries and regions	Asset types	Period of observation	Result (significant or insignificant)
Sullivan, Timmermann, and White (2001)	Bootstrap	U.S.	Equity	1897–1996	Insignificant
Bouman and Jacobsen (2002)	Linear regression	Australia, Austria, Belgium, Canada, Denmark, France, Germany, Hong Kong, Italy, Japan, Netherlands, Norway, Singapore, Spain, Sweden, Switzerland, U.K., U.S., Argentina, Brazil, Chile, Finland, Greece, Indonesia, Ireland, Jordan, Malaysia, Mexico, New Zealand, Philippines, Portugal, Russia, South Africa, South Korea, Taiwan, Thailand, Turkey	Equity	1970–1998	Significant (except for one country)
Lucey and Whelan (2002)	Out-of-sample test	U.S., U.K., Ireland	Equity	1934–1999	Significant
Maberly and Pierce (2004)	Linear regression	U.S.	Equity	1970–1998	Insignificant
Brounen and Hamo (2009)	Linear regression	U.S., Japan, Hong Kong, U.K., Australia, France, Singapore, Canada, Netherlands, Austria, South Africa	Equity	1987–2007	Significant for 5 countries
Jacobsen and Visaltanachoti (2009)	Linear regression	U.S.	Equity	1926–2006	Significant
Lean (2011)	GARCH(1,1)	Hong Kong, China, Japan, Singapore, Malaysia, India	Equity	1991–2008	Significant

End of Table 1

Article	Method	Countries and regions	Asset types	Period of observation	Result (significant or insignificant)
Andrade, Chhaochharia, and Fuerst (2012)	Linear regression, out-of-sample test	Australia, Austria, Belgium, Canada, Denmark, France, Germany, Hong Kong, Italy, Japan, Netherlands, Norway, Singapore, Spain, Sweden, Switzerland, U.K., U.S., Argentina, Brazil, Chile, Finland, Greece, Indonesia, Ireland, Jordan, Malaysia, Mexico, New Zealand, Philippines, Portugal, Russia, South Africa, South Korea, Taiwan, Thailand, Turkey	Equity	1970–2012	Significant
Hui, Wright, and Yam (2014a)	Linear regression, White's Reality Check and Hansen's Superior Ability tests	Canada, U.S., Hong Kong, Japan, Philippines, Singapore, Belgium, Finland, France, Germany, Italy, Netherlands, Sweden, Switzerland, U.K., Australia	Real Estate (including REIT)	1984–2011	Linear regression: significant for two countries only. White's Reality Check and Hansen's Superior Ability tests: insignificant

Table 2. Results of previous works on January Effect (source: Hui & Chan, 2015, 2016)

Article	Method	Countries and regions	Asset types	Period of observation	Result (significant or insignificant)
Keim (1983)	Linear regression	U.S.	Equity	1963–1979	Significant
Agrawal and Tandon (1994)	Linear regression	Australia, Belgium, Brazil, Canada, Denmark, France, Germany, Hong Kong, Italy, Japan, Luxembourg, Mexico, Netherlands, New Zealand, Singapore, Sweden, Switzerland, U.K., U.S.	Equity	1971–1987	Significant for 10 countries
Cheung and Coutts (1999)	Linear regression	Hong Kong	Equity	1985–1997	Insignificant
Fountas and Segredakis (2002)	Linear regression	Argentina, Chile, Colombia, Greece, India, Jordan, Korea, Malaysia, Mexico, Nigeria, Pakistan, Philippines, Portugal, Taiwan, Thailand, Turkey, Venezuela, Zimbabwe	Equity	1987–1995	Insignificant (except for Chile)
Gu (2003)	Power ratio method	U.S.	Equity	1929–2000	Declining (becoming less significant over time)
Hansen, Lunde, and Nason (2005)	ρ test	Denmark, France, Germany, Hong Kong, Italy, Japan, Norway, Sweden, U.K., U.S.	Equity	1896–2002	Significant
Hardin III, Liano, and Huang (2005)	Linear regression	U.S.	REIT	1994–2002	Insignificant for the REIT value-weighted index, but significant for the REIT equal-weighted index
Brounen and Hamo (2009)	Linear regression	U.S., Japan, Hong Kong, U.K., Australia, France, Singapore, Canada, The Netherlands, Austria, South Africa	Equity	1987–2007	Insignificant
Kang, Jiang, Lee, and Yoon (2010)	Linear regression	China	Equity	1996–2007	A-share: insignificant B-share: significant at 10% level, but insignificant at 5% level
Almudhaf and Hansz (2011)	Linear regression	Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, U.K.	Securitized real estate	1990–2007	Insignificant (except for Switzerland)
Hui et al. (2014a)	Linear regression, White's Reality Check and Hansen's Superior Ability tests	Canada, U.S., Hong Kong, Japan, Philippines, Singapore, Belgium, Finland, France, Germany, Italy, Netherlands, Sweden, Switzerland, U.K., Australia	Real Estate (including REIT)	1984–2011	Insignificant

While the previous studies listed in the above tables contribute to knowledge by testing the significance of Halloween and January effects of various markets, they produce mixed results. For Halloween effect, the majority of previous works show that the effect is significant, but some others find insignificant Halloween effect (see Table 1). The results of January effect are even more diverged: about half of the studies find significant January effect, while others show that the effect is insignificant (see Table 2). The majority of the articles work on equity markets. Only a sparse number of them investigate real estate markets. Thus, the true pattern of calendar effects of property markets is still unknown. Furthermore, most of the previous studies apply traditional methods like linear regression. Only a few of them use alternative tests. Different methods may lead to different results. For example, Hui et al. (2014a) examine calendar effects of 27 securitized real estate indices from 20 countries. Applying linear regression, statistically significant calendar anomalies persist. However, no calendar rule outperforms the "buy-and-hold" strategy significantly according to the White's Reality Check (White, 2000) and Hansen's Superior Predictive Ability (Hansen, 2005) tests.

Recently, some studies apply Shiryaev-Zhou index to investigate calendar effects. Hui and Chan (2015) apply Shiryaev-Zhou index to examine the January and Halloween effects of 8 securitized property markets, fixing the moving-window size to be 130 days. Therefore, the resulting strategy may not be optimal. Furthermore, we cannot see how the calendar effect varies as the moving-window size increases or decreases. Therefore, Hui and Chan (2016) apply Shiryaev-Zhou index of variable moving-window size to test calendar effects of 12 stock indices. However, as mentioned in introduction, $\hat{\mu}_i(n)$ changes sign frequently, so we have to trade the stock/stock index for many times for the underlying trading strategy. Hui and Chan (2018a) test this underlying strategy on 12 stock indices, and find that their strategy outperforms "buy-and-hold" for only slight majority of the cases. Hui and Chan (2018b) apply the same strategy on 12 Hong Kong listed stocks. They even find that the strategy underperforms "buy-and-hold" for slight majority of the cases. In light of this, this study introduces two new tests of calendar effects based on Hui and Chan (2018c)'s two newly constructed strategies of which one waits until $\hat{\mu}_i(n)$ remains at the same sign for two or three consecutive days before buying or selling the stock/stock index (which are called Strategy 2 and Strategy 3 respectively in Hui and Chan, 2018c). This leads to a "smoothing effect", reducing the number of times of trading the stock/stock index and yields a greater profit than the original strategy (which is called Strategy 1 in Hui and Chan, 2018c). Hence we can see that for Strategies 2 and 3, whether we should hold the stock/stock index for the majority of the time in a particular month. This is useful for investors to improve their trading strategies to earn more profits.

2. Data

The whole period is 1 January 1996–31 December 2016, a total of 5480 observations. The period is traced back by 240 days (the maximum moving-window size) to 28 January 1995. We select one securitized real estate index and one general equity index for each of the six economies: Hong Kong, Japan, U.S., U.K., France and Germany. The 12 stock indices in Table 3 are chosen. The reason for choosing the 12 stock indices is explained in Hui and Chan (2018b).

Table 3. The stock indices we choose

Economy	General equity index	Securitized real estate index
Hong Kong	Hang Seng Index (HSI)	FTSE EPRA/NAREIT Hong Kong Index (ELHK)
Japan	Nikkei 225 Index (NKY)	FTSE EPRA/NAREIT Japan Index (ELJP)
U.S.	S&P 500 Index (SPX)	FTSE EPRA/NAREIT US Index (UNUS)
U.K.	FTSE 100 Index (UKX)	FTSE EPRA/NAREIT UK Index (ELUK)
France	CAC 40 Index (CAC)	FTSE EPRA/NAREIT France Index (EPFR)
Germany	DAX Index (DAX)	FTSE EPRA/NAREIT Germany Index (EPGR)

3. The Shiryaev-Zhou index and the trading strategies

The Shiryaev-Zhou index comes from. Shiryaev, Xu, and Zhou (2008), who solve the problem of minimizing the time between a stock's maximum and selling prices by deriving the "goodness index" of a stock. Du Toit and Peskir (2008) provide a probabilistic proof of the solution. Yam, Yam, Yung, and Zhou (2009, 2012a, 2012b) resolve the same problem in the binomial tree setting and generalize the Shiryaev-Zhou index over the corresponding framework. Hui et al. (2014a) derive a trading strategy from the Shiryaev-Zhou index and apply it on four western securitized real estate indices and six Asian securitized real estate indices respectively. Both of them find that their strategy outperforms "buy-and-hold" in general.

The Shiryaev-Zhou index is described by the following formula (Yam et al., 2009, 2012a, 2012b; Hui et al., 2014a; Hui & Chan, 2018c):

$$\mu = (\alpha - 0.5\sigma^2) / \sigma^2 = \alpha / \sigma^2 - 0.5, \tag{3.1}$$

where: α is the annual drift (or return) of the stock; and σ is its annual volatility (or variance of return).

In reality, the values of α, σ are always varying and their exact values are normally not known. Therefore, we adopt the moving-window approach by Wong et al. (2012) to estimate their values, and obtain the estimator of the Shiryaev-Zhou index (Hui & Chan, 2016, 2018a, 2018b):

$$\hat{\mu}_i(n) = \frac{\hat{\alpha}_i(n) - 0.5\hat{\sigma}_i^2(n)}{\hat{\sigma}_i^2(n)}, \tag{3.2}$$

where: n denotes the moving-window size; $\hat{\alpha}_i(n)$ and $\hat{\sigma}_i^2(n)$ are the estimators of α and σ^2 on day i respectively.

As in Hui and Chan (2016), we choose the following 6 moving-window sizes: 40, 80, 120, 160, 200, 240.

Hui and Chan (2018c) apply $\hat{\mu}_i(n)$ to derive three trading strategies. We make the following assumptions:

(1) We make the transaction price of a stock index to be its closing price.

(2) The amount of cash held at the start of the period is enough to cover all transactions during the period.

Denote the final day of the period by day N. The first strategy is called Strategy 1 (Hui & Chan, 2018b):

1. On day 1, if $\hat{\mu}_1(n) \geq 0$, buy 1 unit of the stock index. No action is taken otherwise.
2. From day 2 to day N-1, adopt the following rule:
   (a) if $\hat{\mu}_{i-1}(n) \geq 0$ and $\hat{\mu}_i(n) \geq 0$, no action is taken.
   (b) if $\hat{\mu}_{i-1}(n) \geq 0$ and $\hat{\mu}_i(n) < 0$, sell the entire 1 unit of the stock index we hold.
   (c) if $\hat{\mu}_{i-1}(n) < 0$ and $\hat{\mu}_i(n) \geq 0$, buy 1 unit of the stock index.
   (d) if $\hat{\mu}_{i-1}(n) < 0$ and $\hat{\mu}_i(n) < 0$, no action is taken.
3. On day N, if 1 unit of the stock index is still held, sell all of it. Otherwise, no action is taken.

According to Hui and Chan (2018c), since $\hat{\mu}_i(n)$ changes sign very frequently, one has to trade the stock index for a lot of times when he/she adopts Strategy 1, so this strategy may underperform "buy-and-hold", especially when transaction costs exist. Therefore, Hui and Chan (2018c) construct two new trading strategies of which we wait until $\hat{\mu}_i(n)$ remains at the same sign for a number of consecutive days before changing our buying/selling position. For first strategy, after $\hat{\mu}_i(n)$ changes sign, an investor waits until the sign of $\hat{\mu}_i(n)$ remains unchanged for 2 consecutive days, then he/she buy or sell the stock index. This is called Strategy 2 (Hui & Chan, 2018c):

1. On day 1, if $\hat{\mu}_1(n) \geq 0$, buy 1 unit of the stock index. No action is taken otherwise.
2. On day 2, no action is taken.
3. From day 3 to day N-1 (denote that day by day i):
   (a) If one is holding entire cash, then buy 1 unit of the stock index if $\hat{\mu}_i(n) >= 0$ on days i –1 and i. Otherwise, no action is taken.
   (b) If one is holding 1 unit of the stock index, then sell all of it if $\hat{\mu}_i(n) < 0$ on days i –1 and i. Otherwise, no action is taken.
4. On day N, if 1 unit of the stock index is still held, sell all of it. Otherwise, no action is taken.

For the second strategy, after $\hat{\mu}_i(n)$ changes sign, an investor waits until the sign of $\hat{\mu}_i(n)$ remains unchanged for 3 consecutive days, then he/she buy or sell the stock index. This is called Strategy 3 (Hui & Chan, 2018a):

1. On day 1, if $\hat{\mu}_1(n) \geq 0$, buy 1 unit of the stock index. No action is taken otherwise.
2. On both day 2 and day 3, do not take any action.
3. From day 4 to day N-1 (denote that day by day i):
   (c) If one is holding entire cash, then buy 1 unit of the stock index if $\hat{\mu}_i(n) >= 0$ on days i –2, i –1 and i. Otherwise, no action is taken.
   (d) If one is holding 1 unit of the stock index, then sell all of it if $\hat{\mu}_i(n) < 0$ on days i –2, i –1 and i. Otherwise, no action is taken.
4. On day N, if 1 unit of the stock index is still held, sell all of it. Otherwise, no action is taken.

Hui and Chan (2018a) test Strategies 1, 2 and 3 on the 12 stock indices chosen in Section 2 during the period December 29, 1995 – December 31, 2016. They find that Strategies 2 and 3 outperform Strategy 1 in overall. In particular, Strategy 3 earns the maximum profit out of the three strategies, and hence is the best strategy. Since Strategies 1, 2 and 3 are different, their "holding periods" (periods of which the stock index is held according to Strategies 1, 2 or 3) and "non-holding periods" (periods of which entire cash is held according to Strategies 1, 2 or 3) are also different. Therefore, our tests (see Section 4) based on the three strategies will result in different patterns of calendar effects as shown in Section 5.

4. Testing the calendar effects

We construct three tests of calendar effect according the Hui and Chan (2018c)'s three trading strategies. For the first method (the method by Hui and Chan, 2016, denoted by Method 1), the Halloween and January effects can be represented by the following hypotheses:

H_{11} (Halloween effect): the proportion of time of which the stock index is held according to Strategy 1 is significantly higher (i.e. the "holding period" of Strategy 1 is significantly longer) during November – April. (null hypothesis: H_{10}).

J_{11} (January Effect): the proportion of time of which the stock index is held according to Strategy 1 is significantly higher (i.e. the "holding period" of Strategy 1 is significantly longer) in January. (null hypothesis: J_{10}).

We adopt Hui and Chan (2016)'s method to test the overall calendar effect: for each moving-window size n and each stock index, define a dummy variable R_{1i} by $R_{1i} = 1$ when $\hat{\mu}_{i-1}(n) \geq 0$ (i.e. the stock index is held according to Strategy 1 on day i), and 0 otherwise. Hence the period of which $R_{1i} = 1$ is called the "holding period" of Strategy 1, while the period of which $R_{1i} = 0$ is called the "non-holding period" of Strategy 1. Therefore, the average value of R_{1i} in each month indicates the percentage of time of which the stock index is held in that month according to Strategy 1. The overall calendar effect (and hence the January effect) is tested using analysis of mean (ANOM). The details of ANOM are described in Hui and Chan (2016). To examine the overall calendar effect, we use the software Minitab 17 to perform a one-way ANOM of R_{1i} with month as the factor.

For the second method (denoted by Method 2), the Halloween and January effects can be represented by the following hypotheses:

H_{21} (Halloween effect): the proportion of time of which the stock index is held according to Strategy 2 is significantly higher (i.e. the "holding period" of Strategy 2 is significantly longer) during November – April. (null hypothesis: H_{20}).

J_{21} (January Effect): the proportion of time of which the stock index is held according to Strategy 2 is significantly higher (i.e. the "holding period" of Strategy 2 is significantly longer) in January. (null hypothesis: J_{20}).

We also apply ANOM to test the overall calendar effect as in Method 1. However, the dummy variable R_{1i} is replaced by R_{2i}, which is defined by $R_{2i} = 1$ if the stock index is held according to Strategy 2 on day *i*, and 0 otherwise. Hence the period of which $R_{2i} = 1$ is called the "holding period" of Strategy 2, while the period of which $R_{2i} = 0$ is called the "non-holding period" of Strategy 2. The average value of R_{2i} in each month indicates the percentage of time of which the stock index is held in that month according to Strategy 2.

For the third method (denoted by Method 3), the Halloween and January effects can be represented by the following hypotheses:

H_{31} (Halloween effect): the proportion of time of which the stock index is held according to Strategy 3 is significantly higher (i.e. the "holding period" of Strategy 3 is significantly longer) during November – April. (null hypothesis: H_{30}).

J_{31} (January Effect): the proportion of time of which the stock index is held according to Strategy 3 is significantly higher (i.e. the "holding period" of Strategy 3 is significantly longer) in January. (null hypothesis: J_{30}).

As in Methods 1 and 2, we apply ANOM to test the overall calendar effect. However, we use a new dummy variable R_{3i} which is defined by $R_{3i} = 1$ if the stock index is held according to Strategy 3 on day *i*, and 0 otherwise. Hence the period of which $R_{3i} = 1$ is called the "holding period" of Strategy 3, while the period of which $R_{3i} = 0$ is called the "non-holding period" of Strategy 3. The average value of R_{3i} in each month indicates the percentage of time of which the stock index is held in that month according to Strategy 3.

For the normal method, we use ANOM, too, but R_{1i} is replaced by the continuously compounded daily return $r_i = \log\left(\frac{S_i}{S_{i-1}}\right)$, where S_i is the stock index on day *i*.

We apply regression to test the Halloween effect. However, since the dependent variables R_{1i}, R_{2i} and R_{3i} are dummy variables which have values of either 0 or 1, linear regression is inappropriate. Instead, logistic regression is applied. For Method 1, the following model is set up (Hui & Chan, 2016):

$$\operatorname{logit}\left(E\left(R_{1i} \mid D_i\right)\right) = \alpha + \beta D_i + \varepsilon_i, \tag{4.1}$$

where: $\operatorname{logit}(x) = x/(1-x)$, $E(X)$ represents the expected value of X; D_i is a dummy variable which is equal to 1 when day *i* is in the period November – April, and 0 otherwise. Logistic regression is applied to (4.1), and a one-tailed z-test is conducted on $\frac{\hat{\beta}}{\hat{\sigma}}$, where $\hat{\beta}$ is the estimator of β, and $\hat{\sigma}$ is the standard deviation of $\hat{\beta}$. Again, we use Minitab 17 to perform logistic regression.

For Methods 2 and 3, the model is same as (4.1), but the dependent variable R_{1i} is replaced by R_{2i} and R_{3i} respectively.

For the normal method, we apply the following linear regression model (Hui & Chan, 2016):

$$r_i = \gamma + \lambda D_i + \varepsilon_i, \tag{4.2}$$

where: $r_i = \log\left(\frac{S_i}{S_{i-1}}\right)$ and D_i is the dummy variable in (4.1). A one-tailed z-test is conducted on $\frac{\hat{\lambda}}{\hat{\varphi}}$, where $\hat{\lambda}$ is the OLS estimator of λ, and $\hat{\varphi}$ is the standard deviation of $\hat{\lambda}$.

Methods 1, 2 and 3 are based on Strategies 1, 2 and 3 respectively. The dummy variables R_{1i}, R_{2i} and R_{3i} indicate the "holding periods" (i.e. periods of which we should hold the stock index according to the strategy) of Strategies 1, 2 and 3 respectively. The difference between the dummy variables R_{1i}, R_{2i} and R_{3i} results in the difference between the pattern of calendar effects shown by Methods 1, 2 and 3. Hence this study is different from Hui and Chan (2016)'s work.

Method 1 by Hui and Chan (2016) can show the proportion of time of which the stock index is held in each month according to Strategy 1, and Hui and Chan (2016) find that this method can show additional channels of calendar effects. However, Hui and Chan (2018c) find that Strategy 1 underperforms "buy-and-hold" for slight majority of the cases. In light of this, Hui and Chan (2018c) construct two new strategies (Strategies 2 and 3 in this study). They show that the two strategies, especially Strategy 3, outperform Strategy 1 and "buy-and-hold" in general. Since Methods 2 and 3 can show the proportion of time of which the stock index is held in each month according to Strategies 2 and 3 (which are superior to Strategy 1 according to Hui and Chan, 2018c) respectively, they are superior to Strategy 1, and can help investors to improve their strategies to increase their profits.

5. Results

5.1. Overall calendar effect and January effect

We use the methods described in Section 4 to examine the calendar effects of the 12 stock indices. Firstly, we apply ANOM to test the overall calendar effect and January effect. We list out the results in the Tables 4, 5, 6 and 7.

The entries in Tables 4, 5, 6 and 7 indicate the mean value of $\log\left(\frac{S_i}{S_{i-1}}\right)$, R_{1i}, R_{2i} and R_{3i} of that index in the corresponding month for the corresponding moving-window size, respectively. The green/red entries indicate that they lie above/below the 95% confidence interval respectively. For Tables 5, 6 and 7, the green entries mean that the "holding periods" of Strategies 1, 2 and 3, respectively, are significantly longer at 5% level, while the red entries mean that the "holding periods" of Strategies 1, 2 and 3, respectively, are significantly shorter at 5% level. In particular, the entries in the column January indicate whether the January effect is significant at 5% level. Green entries imply that the January effect is significant at 5% level, while red entries mean that the January effect goes into reverse, and the effect is significant at 5% level.

Table 4. The test results for the overall calendar effect using the normal method

Index	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
HSI	–0.000771	0.000959	–0.000801	0.001112	–0.000370	0.000130	0.000996	–0.000816	–0.000158	0.000532	0.000876	0.000468	(–0.0020, 0.0023)
NKY	–0.000149	0.000336	0.000681	0.000832	–0.000624	0.000793	-0.000712	–0.001013	–0.000246	–0.000969	0.000459	0.000441	(–0.0018, 0.0018)
SPX	–0.000004	–0.000253	0.000746	0.000945	0.000097	–0.000124	0.000037	–0.000481	–0.000172	0.000707	0.000769	0.000621	(–0.0014, 0.0019)
UKX	–0.000547	0.000408	0.000168	0.000964	–0.000335	–0.000685	0.000317	–0.000123	–0.000643	0.000633	0.000340	0.000896	(–0.0015, 0.0017)
CAC	0.000229	0.000062	0.000647	0.001103	–0.000358	–0.000196	–0.000099	–0.000702	–0.000936	0.000735	0.000657	0.000838	(–0.0018, 0.0021)
DAX	0.000167	0.000057	0.000466	0.001527	0.000096	0.000131	0.000278	–0.001433	–0.001083	0.000967	0.001259	0.001106	(–0.0017, 0.0023)

Index	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
ELHK	–0.000015	0.000612	–0.000582	0.001148	–0.001003	–0.000445	0.001501	–0.000322	–0.001010	0.000484	0.001167	0.001158	(–0.0024, 0.0028)
ELJP	0.000403	0.000654	0.001409	0.001184	–0.000329	0.000411	–0.000766	–0.000293	0.000414	–0.000065	–0.000733	–0.000352	(–0.0026, 0.0029)
UNUS	–0.000097	–0.000453	0.000866	0.001409	0.000168	–0.000198	0.000487	0.000052	–0.000029	–0.000553	–0.000260	0.001210	(–0.0021, 0.0025)
ELUK	–0.000500	0.000761	0.000044	0.001087	0.000181	–0.001262	0.000739	0.000569	–0.000604	–0.000161	–0.000296	0.000684	(–0.0016, 0.0018)
EPFR	0.000569	0.001313	0.000754	0.000138	0.000347	–0.000717	0.000562	0.000308	0.000059	0.000147	–0.000122	0.000807	(–0.0013, 0.0020)
EPGR	0.000617	0.000249	0.000015	0.000985	0.000376	–0.001658	0.000125	–0.000057	–0.001394	0.000676	–0.000913	0.000650	(–0.0022, 0.0021)

Table 5. The test results for the overall calendar effect using Method 1

HSI													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.5376	0.4706	0.4147	0.5066	0.6099	0.4722	0.5739	0.6523	0.5765	0.5386	0.6362	0.5996	(0.4872, 0.6120)
80	0.6946	0.5953	0.4881	0.4580	0.5172	0.4588	0.5032	0.5400	0.6297	0.5837	0.5938	0.5867	(0.4917, 0.6164)
120	0.6213	0.5647	0.6134	0.5863	0.4892	0.4610	0.5246	0.4838	0.6009	0.6052	0.6763	0.6467	(0.5100, 0.6342)
160	0.6688	0.6424	0.5680	0.6615	0.5970	0.5479	0.5268	0.5745	0.5299	0.5579	0.6205	0.6188	(0.5306, 0.6545)
200	0.6258	0.6118	0.6264	0.6549	0.6056	0.5768	0.6445	0.6220	0.6452	0.5815	0.5781	0.6103	(0.5538, 0.6769)
240	0.5419	0.5718	0.5724	0.6084	0.6358	0.6347	0.5717	0.6566	0.6608	0.6288	0.5960	0.6039	(0.5452, 0.6686)
NKY													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.5505	0.5388	0.5572	0.6018	0.5539	0.4766	0.5482	0.4384	0.3614	0.4356	0.5134	0.5418	(0.4471, 0.5726)
80	0.5699	0.5435	0.6436	0.5841	0.5366	0.5479	0.5525	0.3499	0.3636	0.3433	0.4174	0.4625	(0.4306, 0.5548)
120	0.5054	0.4988	0.6156	0.6150	0.5366	0.5278	0.5782	0.4492	0.3459	0.2876	0.4018	0.4582	(0.4230, 0.5471)
160	0.4989	0.6776	0.5421	0.6018	0.5022	0.5612	0.5161	0.4600	0.4523	0.4206	0.3237	0.4004	(0.4171, 0.5424)
200	0.3978	0.4471	0.5637	0.4403	0.4612	0.5056	0.5824	0.5421	0.4812	0.4292	0.4487	0.4347	(0.4152, 0.5410)
240	0.5118	0.4706	0.4320	0.4602	0.4397	0.4143	0.4754	0.4816	0.4922	0.5215	0.5067	0.4861	(0.4113, 0.5376)

Continue of Table 5

SPX													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.6817	0.5694	0.6328	0.6748	0.6918	0.5412	0.5846	0.4816	0.5188	0.5408	0.7321	0.7537	(0.5567, 0.6779)
80	0.7806	0.7153	0.6847	0.6836	0.7112	0.6012	0.6317	0.5054	0.5721	0.5021	0.5580	0.7880	(0.5858, 0.7047)
120	0.7011	0.7082	0.8272	0.7478	0.6765	0.6815	0.7002	0.6328	0.5499	0.5472	0.6674	0.6702	(0.6179, 0.7350)
160	0.6753	0.6659	0.7063	0.7721	0.8297	0.7684	0.7516	0.6717	0.6851	0.5773	0.6384	0.6617	(0.6429, 0.7578)
200	0.6753	0.6565	0.7149	0.7080	0.7457	0.7951	0.7837	0.7689	0.7273	0.6416	0.7031	0.7238	(0.6641, 0.7772)
240	0.6710	0.6965	0.7171	0.7013	0.7069	0.7149	0.7837	0.7797	0.7694	0.7275	0.7321	0.7323	(0.6717, 0.7841)
UKX													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.6839	0.6141	0.6048	0.6327	0.6530	0.4076	0.4861	0.5011	0.5521	0.5601	0.6942	0.6317	(0.5235, 0.6466)
80	0.7462	0.6965	0.6177	0.6925	0.6875	0.4922	0.4839	0.4060	0.5166	0.5172	0.5603	0.6895	(0.5310, 0.6526)
120	0.6366	0.6565	0.7775	0.6858	0.6638	0.5768	0.5632	0.4536	0.4989	0.5365	0.5714	0.5760	(0.5383, 0.6606)
160	0.5763	0.5765	0.6609	0.7389	0.7457	0.6548	0.6424	0.5659	0.6075	0.5386	0.5402	0.5525	(0.5558, 0.6777)
200	0.5785	0.5576	0.6523	0.6261	0.6681	0.6904	0.7516	0.6264	0.6896	0.6030	0.6228	0.5782	(0.5769, 0.6979)
240	0.6323	0.6165	0.5918	0.5863	0.6164	0.6012	0.6724	0.6739	0.6918	0.6438	0.6808	0.6617	(0.5793, 0.7006)
CAC													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.6860	0.6494	0.5788	0.6991	0.6746	0.5033	0.4325	0.4557	0.5809	0.5773	0.6161	0.6403	(0.5293, 0.6520)
80	0.7269	0.6706	0.6998	0.7124	0.6573	0.5768	0.5096	0.4104	0.5078	0.5193	0.5290	0.6188	(0.5335, 0.6555)
120	0.5441	0.6824	0.7646	0.7279	0.6616	0.5635	0.5803	0.5205	0.5011	0.4850	0.5491	0.5396	(0.5315, 0.6539)
160	0.5570	0.6094	0.6436	0.7146	0.7069	0.5947	0.6381	0.6004	0.6475	0.4979	0.5022	0.5332	(0.5423, 0.6650)
200	0.5806	0.6141	0.6177	0.6195	0.6379	0.6325	0.6531	0.6112	0.7007	0.6738	0.6585	0.5931	(0.5717, 0.6936)
240	0.6387	0.6518	0.6264	0.6659	0.6487	0.6392	0.6188	0.6458	0.6829	0.6481	0.6897	0.6702	(0.5917, 0.7123)
DAX													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.7591	0.6635	0.5853	0.6637	0.6616	0.5301	0.5075	0.4665	0.4967	0.5515	0.6741	0.7645	(0.5497, 0.6708)
80	0.7677	0.7365	0.6845	0.6836	0.6810	0.5969	0.5739	0.4514	0.5366	0.5043	0.5558	0.6959	(0.5617, 0.6821)
120	0.5871	0.6541	0.7603	0.7611	0.7392	0.6815	0.6745	0.5659	0.5632	0.5322	0.5960	0.6017	(0.5830, 0.7028)
160	0.6086	0.6165	0.6479	0.7190	0.7974	0.7283	0.7409	0.6436	0.6541	0.5751	0.6339	0.6595	(0.6099, 0.7281)
200	0.6430	0.6165	0.6220	0.6173	0.6509	0.7149	0.7859	0.7214	0.7162	0.6137	0.6585	0.6702	(0.6103, 0.7287)
240	0.6068	0.6659	0.6220	0.6173	0.6185	0.6214	0.6595	0.7149	0.7694	0.7082	0.7478	0.7366	(0.6229, 0.7402)

Continue of Table 5

ELHK													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.6172	0.4424	0.4384	0.4469	0.5819	0.4588	0.5567	0.6177	0.5965	0.5043	0.5245	0.5310	(0.4645, 0.5899)
80	0.6258	0.5929	0.4989	0.5111	0.4892	0.3920	0.4540	0.5205	0.6231	0.6438	0.5692	0.5203	(0.4740, 0.5990)
120	0.6473	0.5765	0.5680	0.6128	0.5733	0.5078	0.4518	0.5054	0.6098	0.5515	0.6629	0.6531	(0.5144, 0.6385)
160	0.6602	0.6471	0.5616	0.5155	0.5754	0.5078	0.5289	0.5788	0.5965	0.5901	0.5982	0.6274	(0.5199, 0.6443)
200	0.5871	0.6141	0.6393	0.6084	0.5797	0.4900	0.5246	0.5680	0.6231	0.6073	0.5982	0.5953	(0.5239, 0.6483)
240	0.5785	0.5929	0.5572	0.6460	0.6250	0.5702	0.5696	0.6501	0.6541	0.6373	0.5915	0.6103	(0.5452, 0.6687)
ELJP													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.4774	0.5365	0.6264	0.6836	0.5474	0.4143	0.5139	0.4039	0.4102	0.5687	0.5201	0.3897	(0.4452, 0.5698)
80	0.4753	0.4447	0.5292	0.6239	0.6746	0.5969	0.4411	0.3521	0.3592	0.3734	0.4487	0.4388	(0.4178, 0.5417)
120	0.4237	0.4447	0.5076	0.5597	0.5711	0.5835	0.6424	0.5594	0.3836	0.4034	0.4174	0.4026	(0.4296, 0.5544)
160	0.4473	0.3835	0.4816	0.5619	0.5409	0.5145	0.5867	0.6285	0.5831	0.5408	0.3571	0.3597	(0.4373, 0.5620)
200	0.4215	0.4071	0.4773	0.4292	0.5453	0.5612	0.5503	0.5896	0.5255	0.5901	0.6049	0.4711	(0.4522, 0.5777)
240	0.5247	0.5035	0.4471	0.4270	0.4397	0.4543	0.5931	0.5659	0.4789	0.5644	0.5089	0.5032	(0.4383, 0.5643)
UNUS													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.7462	0.6118	0.6069	0.5907	0.6250	0.5390	0.5782	0.6264	0.5032	0.4700	0.4933	0.6017	(0.5212, 0.6448)
80	0.7011	0.6682	0.7214	0.7301	0.6983	0.6904	0.6167	0.5918	0.5654	0.5129	0.4107	0.5396	(0.5601, 0.6807)
120	0.6000	0.6871	0.7473	0.8031	0.7780	0.7884	0.7088	0.6091	0.6142	0.5172	0.5379	0.5396	(0.6018, 0.7190)
160	0.6000	0.5929	0.7041	0.7655	0.8168	0.7906	0.6981	0.6393	0.6231	0.5837	0.5335	0.5460	(0.5991, 0.7170)
200	0.6215	0.6141	0.6955	0.7212	0.7953	0.8018	0.7816	0.7214	0.6585	0.5794	0.5759	0.6017	(0.6229, 0.7392)
240	0.6280	0.6635	0.6566	0.6814	0.7543	0.7127	0.7816	0.6911	0.6874	0.6803	0.5960	0.5910	(0.6184, 0.7360)
ELUK													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.6323	0.7247	0.6048	0.5929	0.6875	0.4833	0.4454	0.6091	0.6031	0.4506	0.5335	0.4325	(0.5038, 0.6272)
80	0.6000	0.6118	0.6674	0.6615	0.7198	0.6102	0.6231	0.5875	0.4967	0.5966	0.5491	0.4946	(0.5401, 0.6631)
120	0.5763	0.5294	0.6134	0.6261	0.6961	0.7261	0.6188	0.5572	0.5610	0.5536	0.5513	0.6317	(0.5423, 0.6654)
160	0.5978	0.5835	0.6026	0.6084	0.6703	0.6860	0.7024	0.6566	0.6075	0.5858	0.5491	0.5203	(0.5531, 0.6757)
200	0.6108	0.6118	0.6069	0.6659	0.6465	0.6682	0.6296	0.6652	0.6319	0.5974	0.6138	0.5803	(0.5645, 0.6869)
240	0.6237	0.6306	0.6199	0.6261	0.6681	0.6526	0.5663	0.6026	0.5765	0.5494	0.5893	0.5760	(0.5445, 0.6679)

End of Table 5

EPFR													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.6645	0.6824	0.7538	0.6770	0.6142	0.4855	0.4647	0.5421	0.5543	0.5386	0.5647	0.5096	(0.5256, 0.6485)
80	0.6817	0.6471	0.7063	0.8319	0.7931	0.5857	0.5096	0.5227	0.4989	0.5451	0.5156	0.5567	(0.5560, 0.6761)
120	0.6538	0.6965	0.8121	0.7677	0.7953	0.7439	0.6809	0.6134	0.5233	0.4292	0.4799	0.5739	(0.5887, 0.7058)
160	0.5548	0.6729	0.6911	0.7633	0.7845	0.7216	0.7388	0.6998	0.6430	0.5730	0.5692	0.5246	(0.6021, 0.7201)
200	0.6280	0.6000	0.6523	0.6836	0.7220	0.7617	0.7752	0.7581	0.7494	0.7039	0.6518	0.6253	(0.6351, 0.7510)
240	0.7290	0.6871	0.6955	0.6527	0.7543	0.7528	0.7902	0.7991	0.8226	0.7017	0.7455	0.7216	(0.6826, 0.7933)
EPGR													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.5075	0.5976	0.5616	0.5044	0.6379	0.5212	0.4133	0.5356	0.5632	0.4206	0.5223	0.4176	(0.4533, 0.5788)
80	0.4839	0.4353	0.6436	0.6350	0.6724	0.5590	0.4839	0.5140	0.4302	0.4807	0.5134	0.4475	(0.4629, 0.5878)
120	0.5118	0.4776	0.5918	0.5730	0.7091	0.6169	0.5246	0.5443	0.4967	0.5086	0.5022	0.5482	(0.4884, 0.6134)
160	0.5075	0.5529	0.6285	0.5642	0.6358	0.6102	0.5953	0.5594	0.5188	0.5794	0.5446	0.5011	(0.5014, 0.6291)
200	0.5097	0.4612	0.5724	0.6128	0.6272	0.5345	0.5118	0.5529	0.5322	0.5579	0.5513	0.5289	(0.4837, 0.6094)
240	0.4753	0.5412	0.6479	0.5686	0.5948	0.5924	0.5439	0.4881	0.4590	0.5665	0.5625	0.5396	(0.4857, 0.6111)

Table 6. The test results for the overall calendar effect using Method 2

HSI													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.5419	0.4800	0.4190	0.5022	0.6099	0.4788	0.5675	0.6523	0.5809	0.5451	0.6250	0.6039	(0.4887, 0.6135)
80	0.6946	0.6024	0.4881	0.4624	0.5216	0.4610	0.5032	0.5335	0.6297	0.5837	0.5960	0.5974	(0.4937, 0.6183)
120	0.6194	0.5553	0.6069	0.5819	0.5000	0.4588	0.5289	0.4881	0.5987	0.6137	0.6629	0.6510	(0.5101, 0.6344)
160	0.6667	0.6471	0.5702	0.6637	0.5927	0.5457	0.5182	0.5810	0.5255	0.5601	0.6228	0.6146	(0.5300, 0.6539)
200	0.6258	0.6141	0.6242	0.6504	0.6099	0.5768	0.6381	0.6328	0.6497	0.5880	0.5826	0.6124	(0.5557, 0.6787)
240	0.5462	0.5694	0.5810	0.6062	0.6358	0.6370	0.5653	0.6566	0.6630	0.6373	0.5938	0.6103	(0.5469, 0.6702)
NKY													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.5548	0.5435	0.5400	0.5907	0.5603	0.4788	0.5396	0.4514	0.3526	0.4249	0.5156	0.5289	(0.4440, 0.5695)
80	0.5674	0.5341	0.6501	0.5885	0.5323	0.5479	0.5482	0.3542	0.3481	0.3519	0.4107	0.4561	(0.4286, 0.5528)
120	0.5032	0.4894	0.6069	0.6327	0.5366	0.5234	0.5782	0.4536	0.3481	0.2918	0.3973	0.4561	(0.4228, 0.5469)
160	0.5011	0.4847	0.5378	0.6084	0.5108	0.5679	0.5118	0.4536	0.4590	0.4185	0.3259	0.3940	(0.4184, 0.5436)
200	0.3957	0.4376	0.5637	0.4425	0.4547	0.5078	0.5824	0.5529	0.4923	0.4227	0.4397	0.4283	(0.4142, 0.5398)
240	0.5118	0.4729	0.4320	0.4580	0.4440	0.4120	0.4690	0.4730	0.4967	0.5150	0.5134	0.4839	(0.4104, 0.5367)

Continue of Table 6

SPX													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.6882	0.5671	0.6285	0.6726	0.7069	0.5301	0.5846	0.4687	0.5233	0.5343	0.7254	0.7559	(0.5553, 0.6764)
80	0.7806	0.7224	0.6760	0.6814	0.7026	0.6258	0.6403	0.5076	0.5721	0.5021	0.5402	0.7859	(0.5853, 0.7041)
120	0.7011	0.7035	0.8207	0.7522	0.6897	0.6815	0.6938	0.6415	0.5543	0.5429	0.6674	0.6724	(0.6181, 0.7352)
160	0.6753	0.6706	0.6998	0.7655	0.8362	0.7639	0.7537	0.6782	0.6918	0.5773	0.6451	0.6595	(0.6441, 0.7588)
200	0.6817	0.6518	0.7149	0.7035	0.7522	0.7951	0.7794	0.7754	0.7384	0.6395	0.7076	0.7195	(0.6655, 0.7783)
240	0.6753	0.6941	0.7214	0.7035	0.7091	0.7171	0.7816	0.7797	0.7738	0.7318	0.7254	0.7302	(0.6727, 0.7850)
UKX													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.6882	0.6188	0.6112	0.6350	0.6724	0.4209	0.4818	0.4816	0.5543	0.5665	0.6897	0.6338	(0.5263, 0.6492)
80	0.7527	0.7012	0.6091	0.7013	0.6810	0.5145	0.4882	0.3974	0.5078	0.5215	0.5558	0.6874	(0.5319, 0.6535)
120	0.6301	0.6518	0.7775	0.6903	0.6681	0.5813	0.5696	0.4579	0.4946	0.5343	0.5737	0.5739	(0.5389, 0.6611)
160	0.5763	0.5694	0.6544	0.7323	0.7543	0.6414	0.6338	0.5810	0.6098	0.5429	0.5402	0.5525	(0.5549, 0.6769)
200	0.5806	0.5506	0.6523	0.6305	0.6573	0.6904	0.7495	0.6393	0.6918	0.6030	0.6228	0.5760	(0.5769, 0.6979)
240	0.6366	0.6118	0.5961	0.5885	0.6121	0.6080	0.6681	0.6782	0.6984	0.6438	0.6786	0.6617	(0.5797, 0.7010)
CAC													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.6731	0.6588	0.5832	0.6836	0.6681	0.5301	0.4240	0.4536	0.5854	0.5901	0.6183	0.6274	(0.5293, 0.6521)
80	0.7355	0.6753	0.7019	0.7080	0.6616	0.5880	0.4989	0.4147	0.5122	0.5215	0.5313	0.6017	(0.5345, 0.6564)
120	0.5333	0.6824	0.7603	0.7323	0.6616	0.5679	0.5782	0.5119	0.5078	0.4828	0.5469	0.5396	(0.5302, 0.6527)
160	0.5527	0.6094	0.6458	0.7124	0.7112	0.5857	0.6338	0.6026	0.6585	0.4979	0.4978	0.5332	(0.5420, 0.6646)
200	0.5763	0.6141	0.6156	0.6173	0.6358	0.6347	0.6531	0.6069	0.7029	0.6824	0.6652	0.5910	(0.5720, 0.6937)
240	0.6452	0.6565	0.6242	0.6659	0.6530	0.6347	0.6188	0.6479	0.6851	0.6416	0.6875	0.6660	(0.5917, 0.7123)
DAX													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.7634	0.6706	0.5853	0.6637	0.6659	0.5435	0.4989	0.4579	0.5055	0.5472	0.6585	0.7687	(0.5494, 0.6703)
80	0.7570	0.7388	0.6890	0.6925	0.6832	0.5991	0.5717	0.4428	0.5388	0.5107	0.5469	0.6874	(0.5607, 0.6812)
120	0.5806	0.6518	0.7581	0.7611	0.7371	0.6927	0.6852	0.5724	0.5632	0.5322	0.5982	0.6017	(0.5845, 0.7042)
160	0.6108	0.6165	0.6458	0.7146	0.7909	0.7283	0.7430	0.6587	0.6585	0.5751	0.6317	0.6595	(0.6106, 0.7288)
200	0.6409	0.6165	0.6220	0.6173	0.6466	0.7038	0.7816	0.7257	0.7228	0.6116	0.6496	0.6745	(0.6088, 0.7273)
240	0.6968	0.6706	0.6220	0.6173	0.6185	0.6214	0.6488	0.7149	0.7738	0.7189	0.7478	0.7366	(0.6237, 0.7409)

Continue of Table 6

ELHK													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.6280	0.4424	0.4492	0.4358	0.5841	0.4566	0.5439	0.6220	0.6009	0.5107	0.5067	0.5375	(0.4647, 0.5900)
80	0.6237	0.5976	0.5092	0.4956	0.4978	0.3987	0.4411	0.5162	0.6208	0.6438	0.5670	0.5289	(0.4740, 0.5990)
120	0.6473	0.5765	0.5659	0.6062	0.5754	0.5100	0.4518	0.4968	0.6075	0.5494	0.6563	0.6574	(0.5127, 0.6369)
160	0.6602	0.6494	0.5637	0.5133	0.5733	0.5122	0.5225	0.5745	0.5942	0.5944	0.5938	0.6274	(0.5192, 0.6436)
200	0.5914	0.6141	0.6371	0.6128	0.5819	0.4744	0.5203	0.5594	0.6231	0.6137	0.6004	0.5974	(0.5233, 0.6476)
240	0.5806	0.5953	0.5594	0.6460	0.6272	0.5768	0.5632	0.6544	0.6541	0.6416	0.5938	0.6103	(0.5469, 0.6703)
ELJP													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.4796	0.5271	0.6264	0.6858	0.5603	0.4187	0.5246	0.3996	0.3947	0.5644	0.5201	0.3854	(0.4449, 0.5694)
80	0.4710	0.4376	0.5270	0.6239	0.6810	0.5991	0.4561	0.3542	0.3614	0.3755	0.4397	0.4347	(0.4182, 0.5421)
120	0.4194	0.4306	0.5032	0.5597	0.5733	0.5835	0.6445	0.5724	0.3836	0.3970	0.4107	0.4026	(0.4282, 0.5528)
160	0.4516	0.3788	0.4795	0.5575	0.5474	0.5078	0.5824	0.6371	0.5787	0.5536	0.3683	0.3533	(0.4382, 0.5609)
200	0.4237	0.4094	0.4816	0.4270	0.5474	0.5479	0.5546	0.5961	0.5255	0.5858	0.6094	0.4754	(0.4531, 0.5786)
240	0.5204	0.5082	0.4471	0.4314	0.4332	0.4499	0.5910	0.5702	0.4812	0.5665	0.5089	0.5032	(0.4383, 0.5643)
UNUS													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.7484	0.6188	0.6004	0.5774	0.6272	0.5457	0.5632	0.6220	0.5166	0.4571	0.4955	0.5953	(0.5190, 0.6427)
80	0.7011	0.6682	0.7192	0.7279	0.7069	0.6949	0.6188	0.5896	0.5676	0.5172	0.4040	0.5332	(0.5604, 0.6809)
120	0.5935	0.6824	0.7473	0.8119	0.7780	0.7884	0.7002	0.6026	0.6208	0.5236	0.5402	0.5418	(0.6018, 0.7190)
160	0.6043	0.5953	0.6933	0.7611	0.8147	0.7996	0.7002	0.6307	0.6164	0.5773	0.5313	0.5375	(0.5963, 0.7143)
200	0.6215	0.6141	0.6847	0.7257	0.7909	0.8018	0.7816	0.7235	0.6829	0.5815	0.5826	0.6039	(0.6251, 0.7413)
240	0.6280	0.6635	0.6544	0.6770	0.7543	0.7105	0.7816	0.6933	0.6851	0.6824	0.6071	0.5803	(0.6178, 0.7355)
ELUK													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.6215	0.7318	0.6091	0.5907	0.6724	0.5033	0.4304	0.6026	0.6098	0.4528	0.5156	0.4261	(0.5009, 0.6243)
80	0.6022	0.5976	0.6566	0.6704	0.7198	0.6258	0.6231	0.5896	0.4922	0.5987	0.5580	0.4968	(0.5413, 0.6642)
120	0.5806	0.5224	0.6156	0.6217	0.6875	0.7327	0.6231	0.5508	0.5676	0.5515	0.5558	0.6338	(0.5425, 0.6655)
160	0.5957	0.5765	0.6026	0.6062	0.6559	0.6915	0.7002	0.6609	0.6098	0.5815	0.5536	0.5182	(0.5516, 0.6743)
200	0.6129	0.6141	0.6069	0.6615	0.6444	0.6771	0.6231	0.6609	0.6386	0.5815	0.6138	0.5803	(0.5649, 0.6873)
240	0.6280	0.6282	0.6285	0.6217	0.6681	0.6548	0.5610	0.6004	0.5854	0.5451	0.5938	0.5717	(0.5452, 0.6686)

End of Table 6

EPFR													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.6538	0.6659	0.7538	0.7080	0.6013	0.4967	0.4540	0.5400	0.5521	0.5451	0.5603	0.5075	(0.5245, 0.6474)
80	0.6817	0.6400	0.6998	0.8363	0.7909	0.6013	0.4989	0.5205	0.5033	0.5429	0.5179	0.5546	(0.5555, 0.6755)
120	0.6538	0.6824	0.8078	0.7699	0.7866	0.7506	0.6788	0.6242	0.5322	0.4313	0.4732	0.5803	(0.5888, 0.7061)
160	0.5484	0.6729	0.6868	0.7566	0.7888	0.7194	0.7323	0.7019	0.6475	0.5815	0.5737	0.5289	(0.6023, 0.7203)
200	0.6323	0.5976	0.6458	0.6792	0.7198	0.7661	0.7880	0.7538	0.7472	0.7039	0.6540	0.6317	(0.6359, 0.7517)
240	0.7312	0.6847	0.7019	0.6527	0.7478	0.7506	0.7923	0.7991	0.8204	0.6996	0.7545	0.7216	(0.6830, 0.7937)
EPGR													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.4925	0.5953	0.5508	0.5066	0.6293	0.5323	0.4133	0.5248	0.5654	0.4120	0.5246	0.4197	(0.4502, 0.5757)
80	0.4839	0.4306	0.6415	0.6460	0.6659	0.5768	0.4797	0.5097	0.4324	0.4742	0.5089	0.4497	(0.4630, 0.5878)
120	0.5075	0.4706	0.5940	0.5642	0.7047	0.6281	0.5182	0.5400	0.4967	0.5150	0.5000	0.5546	(0.4875, 0.6125)
160	0.4968	0.5529	0.6242	0.5664	0.6272	0.6147	0.6017	0.5659	0.5122	0.5794	0.5379	0.5032	(0.5028, 0.6279)
200	0.5054	0.4659	0.5637	0.6128	0.6315	0.5412	0.5075	0.5529	0.5322	0.5622	0.5402	0.5314	(0.4832, 0.6088)
240	0.4688	0.5341	0.6458	0.5686	0.5970	0.5991	0.5439	0.4946	0.4590	0.5622	0.5625	0.5439	(0.4857, 0.6110)

Table 7. The test results for the overall calendar effect using Method 3

HSI													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.5441	0.4682	0.4104	0.5000	0.5991	0.4989	0.5601	0.6501	0.6009	0.5494	0.6004	0.6381	(0.4900, 0.6148)
80	0.6925	0.6071	0.4924	0.4602	0.5259	0.4744	0.4989	0.5140	0.6386	0.5815	0.5960	0.5974	(0.4941, 0.6187)
120	0.6172	0.5553	0.6048	0.5730	0.5022	0.4477	0.5180	0.4881	0.5831	0.6159	0.6607	0.6510	(0.5060, 0.6305)
160	0.6602	0.6376	0.5832	0.6571	0.5948	0.5546	0.5118	0.5810	0.5322	0.5451	0.6205	0.6103	(0.5283, 0.6523)
200	0.6258	0.6188	0.6264	0.6482	0.6142	0.5880	0.6510	0.6307	0.6452	0.6009	0.5893	0.6103	(0.5594, 0.6822)
240	0.5505	0.5671	0.7502	0.6040	0.6358	0.6370	0.5696	0.6544	0.6630	0.6459	0.6004	0.6103	(0.5475, 0.6708)
NKY													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.5462	0.5506	0.5378	0.5885	0.5603	0.4811	0.5546	0.4536	0.3437	0.4335	0.5268	0.5161	(0.4449, 0.5704)
80	0.5656	0.5412	0.6458	0.5996	0.5453	0.5457	0.5675	0.3629	0.3326	0.3541	0.3951	0.4625	(0.4311, 0.5551)
120	0.5032	0.4847	0.6004	0.6350	0.5431	0.5301	0.5803	0.4536	0.3614	0.2983	0.3906	0.4668	(0.4253, 0.5495)
160	0.5032	0.4871	0.5335	0.6106	0.5129	0.5523	0.5075	0.4536	0.4678	0.4120	0.3304	0.3790	(0.4164, 0.5416)
200	0.3957	0.4471	0.5680	0.4469	0.4591	0.5056	0.5696	0.5421	0.4967	0.4270	0.4464	0.4390	(0.4159, 0.5417)
240	0.5118	0.4894	0.4255	0.4580	0.4418	0.4098	0.4668	0.4687	0.5033	0.5193	0.5156	0.4839	(0.4113, 0.5376)

Continue of Table 7

SPX													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.7032	0.5529	0.6199	0.6814	0.7263	0.5367	0.5803	0.4795	0.5299	0.5279	0.7031	0.7049	(0.5551, 0.6763)
80	0.7828	0.7388	0.6868	0.6836	0.7134	0.6236	0.6445	0.5076	0.5721	0.5043	0.5402	0.8009	(0.5907, 0.7089)
120	0.6989	0.7035	0.8143	0.7677	0.6961	0.6993	0.7045	0.6393	0.5543	0.5429	0.6652	0.6724	(0.6214, 0.7381)
160	0.6667	0.6729	0.7019	0.7611	0.8384	0.7595	0.7537	0.6911	0.6940	0.5880	0.6272	0.6574	(0.6437, 0.7585)
200	0.6903	0.6588	0.7171	0.7102	0.7522	0.7996	0.7752	0.7819	0.7339	0.6416	0.7165	0.7152	(0.6683, 0.7809)
240	0.6796	0.6918	0.7106	0.7124	0.7134	0.7060	0.7773	0.7840	0.7627	0.7382	0.7478	0.7238	(0.6731, 0.7853)
UKX													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.6989	0.6212	0.5983	0.6726	0.6767	0.4410	0.4839	0.4968	0.5543	0.5451	0.6875	0.6531	(0.5327, 0.6553)
80	0.7570	0.7082	0.6177	0.7080	0.6681	0.5345	0.4882	0.3909	0.4922	0.5322	0.5469	0.6959	(0.5339, 0.6552)
120	0.6301	0.6494	0.7840	0.7013	0.6530	0.5991	0.5696	0.4730	0.4878	0.5279	0.5714	0.5739	(0.5424, 0.6625)
160	0.5634	0.5671	0.6458	0.7323	0.7651	0.6526	0.6445	0.5832	0.6075	0.5451	0.5357	0.5460	(0.5549, 0.6768)
200	0.5935	0.5529	0.6479	0.6327	0.6509	0.6704	0.7323	0.6415	0.6984	0.6030	0.6295	0.5717	(0.5751, 0.6964)
240	0.6387	0.6165	0.5847	0.5863	0.6099	0.5991	0.6638	0.6847	0.6962	0.6545	0.6786	0.6617	(0.5793, 0.7006)
CAC													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.6731	0.6659	0.5832	0.6947	0.6789	0.5590	0.4111	0.4600	0.5632	0.6009	0.6094	0.6403	(0.5331, 0.6556)
80	0.7376	0.6776	0.6847	0.7279	0.6616	0.5991	0.5139	0.4147	0.5011	0.5150	0.5335	0.5974	(0.5356, 0.6574)
120	0.5161	0.6965	0.7495	0.7367	0.6638	0.5679	0.5739	0.5119	0.5144	0.4785	0.5536	0.5353	(0.5295, 0.6519)
160	0.5419	0.6094	0.6415	0.7168	0.7198	0.5913	0.6253	0.6026	0.6608	0.5021	0.5089	0.5289	(0.5418, 0.6644)
200	0.5828	0.6235	0.6112	0.6173	0.6466	0.6303	0.6617	0.6026	0.6984	0.6888	0.6674	0.5931	(0.5744, 0.6960)
240	0.6366	0.6588	0.6220	0.6659	0.6552	0.6325	0.6146	0.6523	0.6829	0.6524	0.6964	0.6660	(0.5925, 0.7130)
DAX													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.7871	0.6706	0.5810	0.6681	0.6681	0.5523	0.4882	0.4579	0.5055	0.5429	0.6563	0.7645	(0.5513, 0.6720)
80	0.7806	0.7412	0.6890	0.6991	0.6961	0.6080	0.5761	0.4406	0.5277	0.5150	0.5379	0.6788	(0.5637, 0.6838)
120	0.5849	0.6518	0.7538	0.7611	0.7371	0.7194	0.6767	0.5637	0.5676	0.5279	0.6004	0.5953	(0.5849, 0.7045)
160	0.6129	0.6165	0.6436	0.7058	0.7888	0.7261	0.7409	0.6587	0.6696	0.5687	0.6250	0.6681	(0.6099, 0.7281)
200	0.6430	0.6165	0.6220	0.6173	0.6444	0.7016	0.7816	0.7408	0.7472	0.6116	0.6696	0.6767	(0.6140, 0.7320)
240	0.6989	0.6682	0.6220	0.6173	0.6185	0.6214	0.6467	0.7063	0.7738	0.7210	0.7478	0.7409	(0.6233, 0.7405)

Continue of Table 7

ELHK												
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.6043	0.4565	0.4384	0.4270	0.5819	0.4588	0.5310	0.6199	0.6120	0.5172	0.5045	0.5482	(0.4630, 0.5884)
80	0.6215	0.5976	0.4989	0.4801	0.4935	0.4076	0.4368	0.5140	0.6075	0.6545	0.5737	0.5375	(0.4725, 0.5975)
120	0.6473	0.5741	0.5594	0.6040	0.5862	0.5145	0.4647	0.4903	0.6208	0.5536	0.6518	0.6617	(0.5151, 0.6393)
160	0.6645	0.6541	0.5680	0.5089	0.5711	0.5212	0.5161	0.5724	0.6031	0.5966	0.5915	0.6253	(0.5203, 0.6446)
200	0.5892	0.6071	0.6436	0.6217	0.5841	0.4900	0.5203	0.5616	0.6142	0.6223	0.5982	0.5974	(0.5253, 0.6495)
240	0.5785	0.5929	0.5551	0.6416	0.6250	0.5724	0.5632	0.6501	0.6563	0.6438	0.5960	0.5974	(0.5443, 0.6678)
ELJP													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.4710	0.5082	0.6285	0.6881	0.5668	0.4187	0.5353	0.4107	0.3814	0.5472	0.5313	0.4004	(0.4443, 0.5688)
80	0.4753	0.4282	0.5292	0.6150	0.6875	0.6058	0.4711	0.3473	0.3659	0.3670	0.4420	0.4325	(0.4188, 0.5426)
120	0.4172	0.4282	0.5101	0.5553	0.5884	0.5746	0.6424	0.5918	0.3969	0.4077	0.4174	0.4047	(0.4320, 0.5567)
160	0.4624	0.3812	0.4773	0.5597	0.5819	0.5033	0.5675	0.6479	0.5698	0.5579	0.3817	0.3448	(0.4415, 0.5661)
200	0.4258	0.4000	0.4838	0.4336	0.5323	0.5546	0.5567	0.5940	0.5322	0.5987	0.6027	0.4754	(0.4537, 0.5791)
240	0.5247	0.5059	0.4471	0.4381	0.4353	0.4454	0.5846	0.5637	0.4656	0.5687	0.5067	0.5032	(0.4365, 0.5625)
UNUS													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.7398	0.6282	0.6004	0.5863	0.6185	0.5367	0.5503	0.6393	0.5299	0.4464	0.4955	0.5867	(0.5181, 0.6418)
80	0.6968	0.6941	0.7171	0.7301	0.7069	0.7105	0.6124	0.5875	0.5698	0.5215	0.4018	0.5161	(0.5616, 0.6818)
120	0.5935	0.6776	0.7451	0.8142	0.7888	0.7862	0.7045	0.6048	0.6160	0.5107	0.5379	0.5503	(0.6018, 0.7190)
160	0.5978	0.5882	0.6825	0.7633	0.8103	0.7951	0.7024	0.6307	0.6186	0.5880	0.5357	0.5375	(0.5953, 0.7135)
200	0.6215	0.6144	0.6782	0.7279	0.7845	0.8018	0.7816	0.7171	0.6785	0.5708	0.5804	0.6060	(0.6223, 0.7387)
240	0.6258	0.6635	0.6458	0.6748	0.7522	0.7171	0.7816	0.6933	0.6940	0.6738	0.6094	0.5782	(0.6170, 0.7348)
ELUK													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.6172	0.7412	0.6199	0.6018	0.6703	0.5212	0.4240	0.5940	0.6208	0.4592	0.5357	0.4347	(0.5070, 0.6302)
80	0.6000	0.6000	0.6501	0.6726	0.7155	0.6459	0.6081	0.5961	0.4945	0.5966	0.5670	0.4968	(0.5422, 0.6651)
120	0.5828	0.5200	0.6134	0.5973	0.6724	0.7416	0.6296	0.5464	0.5654	0.5494	0.5625	0.6317	(0.5399, 0.6630)
160	0.5957	0.5812	0.6134	0.6128	0.6703	0.6860	0.6981	0.6587	0.6053	0.5880	0.5603	0.5096	(0.5539, 0.6764)
200	0.6215	0.6141	0.6069	0.6593	0.6466	0.6478	0.6231	0.6652	0.6475	0.5665	0.6161	0.5803	(0.5655, 0.6878)
240	0.6301	0.6212	0.6328	0.6173	0.6681	0.6592	0.5675	0.5983	0.5920	0.5451	0.5982	0.5675	(0.5462, 0.6695)

End of Table 7

EPFR													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.6602	0.6706	0.7689	0.7323	0.5970	0.4967	0.4475	0.5486	0.5521	0.5494	0.5536	0.5225	(0.5299, 0.6522)
80	0.6774	0.6471	0.7171	0.8473	0.8060	0.6236	0.5011	0.5205	0.5100	0.5429	0.5179	0.5439	(0.5613, 0.6807)
120	0.6495	0.6753	0.8056	0.7611	0.7823	0.7617	0.6724	0.6242	0.5565	0.4356	0.4665	0.5846	(0.5891, 0.7065)
160	0.5591	0.6635	0.6847	0.7589	0.7888	0.7216	0.7173	0.6998	0.6608	0.5880	0.5826	0.5332	(0.6039, 0.7220)
200	0.6366	0.5953	0.6501	0.6792	0.7112	0.7728	0.7923	0.7538	0.7539	0.7210	0.6563	0.6296	(0.6388, 0.7543)
240	0.7312	0.6776	0.7127	0.6527	0.7414	0.7528	0.7859	0.8056	0.8204	0.6996	0.7388	0.7302	(0.6824, 0.7932)
EPGR													
Moving-window size	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	95% confidence interval
40	0.5054	0.5765	0.5529	0.4956	0.6358	0.5367	0.4133	0.5076	0.5876	0.4227	0.5201	0.4218	(0.4511, 0.5766)
80	0.4817	0.4353	0.6328	0.6549	0.6466	0.5902	0.4946	0.4968	0.4146	0.4785	0.5022	0.4668	(0.4626, 0.5874)
120	0.4989	0.4706	0.5940	0.5730	0.7091	0.6370	0.5203	0.5378	0.5033	0.5107	0.5022	0.5525	(0.4888, 0.6137)
160	0.5140	0.5529	0.6220	0.5730	0.6336	0.6214	0.5996	0.5659	0.5144	0.5794	0.5335	0.5096	(0.5059, 0.6309)
200	0.5032	0.4706	0.5551	0.6173	0.6422	0.5479	0.5032	0.5378	0.5344	0.5601	0.5357	0.5353	(0.4828, 0.6084)
240	0.4667	0.5318	0.6415	0.5796	0.5711	0.6080	0.5439	0.4881	0.4545	0.5536	0.5647	0.5503	(0.4835, 0.6089)

None of the entries in Table 4 are colored, indicating that at 5% level, no significant calendar effects are found for all the 12 stock indices. However, some entries in Tables 5, 6 and 7 are colored, indicating significant calendar effects at 5% level. This reveals that additional channels of calendar effects are found by our methods.

In particular, for the 4 western general equity indices (SPX, UKX, CAC and DAX) with moving-window size 80 or smaller, the entries in the column January are green in color, indicating that the January effect is significant. This is natural because the most of the previous studies on January effect work on equity markets of European and North American countries (see Section 1), so the four western general equity indices behave normally. The small moving-window size means that the "delaying effect" (see Hui and Chan, 2016 for detail explanation) is not so significant that the calendar effect is not distorted.

There are several similarities between our results and Hui and Chan (2016)'s results. Firstly, when the moving-window size increases, there are generally fewer green/red entries in Tables 5, 6 and 7 and they shift rightwards, showing that the overall calendar effect becomes less prevalent and delays. The reason for this result is explained in Hui and Chan (2016). Secondly, for January, there are more green entries than red entries for the six general equity indices, showing significant January effect. However, the numbers of green and red entries are roughly the same for the six securitized real estate indices, showing no clear signs of the January effect. Furthermore, there are more green entries for smaller moving-window sizes, indicating that the January effect is more significant.

Comparing the results in Tables 5, 6 and 7, we can see that the calendar effects shown by Methods 1, 2 and 3 are slightly different. For example, for HSI index with a moving-window size of 40, there is a significant positive calendar effect at 5% level in November for Methods 1 and 2, but not for Method 3. This implies that for both Strategies 1 and 2, we should hold HSI significantly more in November, but this is not the case for Strategy 3. To see the difference in calendar effects shown by the three methods, we compare the number of green and red entries in Tables 5, 6 and 7, find out the differences and list out the differences in the Table 8.

From Table 8, we can see that when one changes from Method 1 to Method 2, the number of green and red entries decreases in general, showing less significant overall calendar effect. This result is expected because for Strategy 1, one has to buy or sell the stock index immediately as soon as $\hat{\mu}_i(n)$ changes sign. However, for Strategy 2, one waits until the sign of $\hat{\mu}_i(n)$ remains unchanged for 2 consecutive days before trading the stock index. This creates a "smoothing effect", reducing the number of times of trading the stock index. Therefore, the dummy variable R_{2i} fluctuates less frequently than R_{1i} does. This explains why Method 2 shows less significant calendar effect than Method 1 does. However, when one changes from Method 2 to Method 3, the number of green and red entries increases in general, revealing that the overall calendar effect

Table 8. Change in number of green and red entries between the three methods for the 12 stock indices

Index	Method 1 → Method 2	Method 2 → Method 3	Method 1 → Method 3
HSI	No color → green/red: 0 Green/red → no color: 0	No color → green/red: 1 Green/red → no color: 2	No color → green/red: 1 Green/red → no color: 2
NKY	No color → green/red: 1 Green/red → no color: 2	No color → green/red: 3 Green/red → no color: 0	No color → green/red: 4 Green/red → no color: 2
SPX	No color → green/red: 0 Green/red → no color: 4	No color → green/red: 5 Green/red → no color: 1	No color → green/red: 2 Green/red → no color: 2
UKX	No color → green/red: 0 Green/red → no color: 0	No color → green/red: 5 Green/red → no color: 2	No color → green/red: 5 Green/red → no color: 2
CAC	No color → green/red: 1 Green/red → no color: 1	No color → green/red: 1 Green/red → no color: 0	No color → green/red: 2 Green/red → no color: 1
DAX	No color → green/red: 2 Green/red → no color: 5	No color → green/red: 5 Green/red → no color: 3	No color → green/red: 4 Green/red → no color: 5
ELHK	No color → green/red: 1 Green/red → no color: 3	No color → green/red: 4 Green/red → no color: 1	No color → green/red: 2 Green/red → no color: 1
ELJP	No color → green/red: 1 Green/red → no color: 6	No color → green/red: 8 Green/red → no color: 2	No color → green/red: 3 Green/red → no color: 2
UNUS	No color → green/red: 1 Green/red → no color: 6	No color → green/red: 6 Green/red → no color: 1	No color → green/red: 2 Green/red → no color: 2
ELUK	No color → green/red: 1 Green/red → no color: 4	No color → green/red: 0 Green/red → no color: 1	No color → green/red: 1 Green/red → no color: 5
EPFR	No color → green/red: 2 Green/red → no color: 1	No color → green/red: 0 Green/red → no color: 7	No color → green/red: 2 Green/red → no color: 8
EPGR	No color → green/red: 1 Green/red → no color: 2	No color → green/red: 4 Green/red → no color: 3	No color → green/red: 4 Green/red → no color: 4

becomes more significant. This result is rather unexpected because for Strategy 3, one waits until the sign of $\hat{\mu}_i(n)$ remains unchanged for 3 consecutive days before trading the stock index. This creates a "smoothing effect", reducing the number of times of trading the stock index. Therefore, the dummy variable R_{3i} fluctuates less frequently than R_{2i} does. By the same reason as before, Method 3 should show less significant calendar effect than Method 2.

Comparing the results of Table 8 between the securitized real estate and general equity indices, we can see that the six securitized real estate indices show a greater change in number of green and red entries between the three methods, indicating that the difference in the overall calendar effect between the three methods is greater for the six securitized real estate indices. One possible reason for this result is that the general equity indices represent the whole market. They consist of stocks of companies of various businesses, so the stock returns are less correlated and hence more risk is diversified. However, the securitized real estate indices represent the property market, which is only a sector of the whole market. Due to similar nature of business (mainly real estate), the stock returns are more correlated, so less risk is diversified and hence their volatility is higher than that of the general equity indices. Therefore, the Shiryaev-Zhou index of the securitized real estate indices fluctuates more frequently than that of the general equity indices. As a result, when we shift from Strategy 1 to Strategies 2 and 3, the overall calendar effect changes by a larger extent. This implies that by investing in the whole market, we not only benefit from broader diversification, but also maintain a stable calendar effect when the trading strategy shifts from one to another, so the trading rules according to the calendar effects are easier to follow.

5.2. Halloween effect

In this part, we apply Methods 1, 2 and 3 described in Section 4 to test the Halloween effect of the 12 stock indices, and use the normal method for comparison. The results are shown in the Tables 9, 10, 11 and 12.

Note that "p-value" in the above tables represents the p-value calculated by performing a two-tailed z-test, but a one-tailed test is conducted in this study, so the cases where $\hat{\beta} < 0$ (or $\hat{\lambda} < 0$) would be treated as the reverse of the Halloween effect. From Table 9, $\hat{\lambda} > 0$ for all 12 stock indices. However, only NKY, CAC and DAX show significant statistics at 5% level. This implies that using linear regression, all 12 stock indices show Halloween effect. However, only the above three indices show significant effect at 5% level. For each economy except Hong Kong, the general equity index has a smaller p-value of $\hat{\lambda}$ than the securitized real estate index does, indicating a more significant Halloween effect.

However, when applying Methods 1, 2 and 3, there are over half of the cases in which the p-value is below 0.05 (see Tables 10, 11 and 12), showing significant Halloween effect (or the reverse, for cases where $\hat{\beta} < 0$) at 5% level.

Table 9. The test results for the Halloween effect using the normal method

Index	HSI	NKY	SPX	UKX	CAC	DAX
$\hat{\lambda}$	0.000284	0.000886	0.000431	0.000470	0.000824	0.000900
p-value	0.513	0.028	0.183	0.136	0.034	0.026

Index	ELHK	ELJP	UNUS	ELUK	EPFR	EPGR
$\hat{\lambda}$	0.000621	0.000577	0.000428	0.000356	0.000493	0.000527
p-value	0.223	0.289	0.349	0.306	0.134	0.224

Table 10. The test results for the Halloween effect using Method 1

HSI						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	−0.1741	0.1244	0.3678	0.3071	0.0225	−0.2048
p-value	0.001	0.022	<0.001	<0.001	0.685	<0.001
NKY						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.3255	0.3539	0.2478	−0.0436	−0.1799	0.0278
p-value	<0.001	<0.001	<0.001	0.420	0.001	0.608
SPX						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.4908	0.5007	0.4024	−0.1287	−0.2291	−0.1953
p-value	<0.001	<0.001	<0.001	0.029	<0.001	0.001
UKX						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.4829	0.6263	0.4260	−0.0762	−0.2967	−0.1004
p-value	<0.001	<0.001	<0.001	0.170	<0.001	0.074
CAC						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.4469	0.5425	0.3392	−0.0883	−0.1629	0.0436
p-value	<0.001	<0.001	<0.001	0.110	0.004	0.442
DAX						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.6362	0.5585	0.1475	−0.1901	−0.2813	−0.0029
p-value	<0.001	<0.001	0.009	0.001	<0.001	0.960
ELHK						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	−0.2094	0.1284	0.3600	0.1581	0.1708	−0.0914
p-value	<0.001	0.018	<0.001	0.004	0.002	0.099
ELJP						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.2446	0.1114	−0.2608	−0.5376	−0.3684	−0.0914
p-value	<0.001	0.039	<0.001	<0.001	<0.001	0.099

End of Table 10

UNUS						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.2139	0.0695	−0.0758	−0.3018	−0.3892	−0.3786
p-value	<0.001	0.212	0.184	<0.001	<0.001	<0.001
ELUK						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.1570	−0.0380	−0.1234	−0.3018	−0.0935	0.0371
p-value	0.004	0.491	0.026	<0.001	0.094	0.503
EPFR						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.4485	0.3415	0.1454	−0.3156	−0.4945	−0.3342
p-value	<0.001	<0.001	0.010	<0.001	<0.001	<0.001
EPGR						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.0097	0.0147	−0.1283	−0.1373	−0.0518	0.0603
p-value	0.858	0.786	0.018	0.012	0.340	0.266

Table 11. The test results for the Halloween effect using Method 2

HSI						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	−0.1771	0.1409	0.3362	0.3176	0.0103	−0.2003
p-value	0.001	0.010	<0.001	<0.001	0.856	<0.001
NKY						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.3091	0.3523	0.2376	−0.0405	−0.2034	0.0409
p-value	<0.001	<0.001	<0.001	0.406	<0.001	0.450
SPX						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.4931	0.4694	0.3941	−0.1464	−0.2460	−0.2049
p-value	<0.001	<0.001	<0.001	0.013	<0.001	0.001
UKX						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.4825	0.6253	0.4124	−0.0962	−0.2999	−0.0973
p-value	<0.001	<0.001	<0.001	0.083	<0.001	0.084
CAC						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.4102	0.5291	0.3312	−0.0974	−0.1708	0.0468
p-value	<0.001	<0.001	<0.001	0.078	0.002	0.410
DAX						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.6391	0.5467	0.1223	−0.2068	−0.2775	−0.0029
p-value	<0.001	<0.001	0.030	<0.001	<0.001	0.960

End of Table 11

ELHK						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	–0.2094	0.1343	0.3580	0.1610	0.1918	–0.0929
p-value	<0.001	0.013	<0.001	0.003	<0.001	0.093
ELJP						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.2358	0.0734	–0.2873	–0.5479	–0.3551	–0.1182
p-value	<0.001	0.175	<0.001	<0.001	<0.001	0.029
UNUS						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.2105	0.0431	–0.0726	–0.3057	–0.4076	–0.3833
p-value	<0.001	0.439	0.203	<0.001	<0.001	<0.001
ELUK						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.1447	–0.0501	–0.1219	–0.3153	–0.0966	0.0402
p-value	0.008	0.364	0.027	<0.001	0.084	0.467
EPFR						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.4542	0.3335	0.1214	-0.3063	-0.5021	-0.3116
p-value	<0.001	<0.001	0.032	<0.001	<0.001	<0.001
EPGR						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.0051	0.0176	–0.1387	–0.1507	–0.0709	0.0456
p-value	0.924	0.745	0.011	0.006	0.191	0.401

Table 12. The test results for the Halloween effect using Method 3

HSI						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	–0.1993	0.1439	0.3472	0.3095	–0.0080	–0.2112
p-value	0.001	0.008	<0.001	<0.001	0.886	<0.001
NKY						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.2901	0.3362	0.2113	–0.0407	–0.1710	0.0483
p-value	<0.001	<0.001	<0.001	0.452	0.002	0.372
SPX						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.4444	0.4959	0.3742	–0.1882	–0.2271	–0.1828
p-value	<0.001	<0.001	<0.001	0.001	<0.001	0.003
UKX						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.5098	0.6481	0.4191	–0.1456	–0.2629	–0.1004
p-value	<0.001	<0.001	<0.001	0.009	<0.001	0.074

End of Table 12

CAC						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.4116	0.5265	0.3249	–0.1210	–0.1696	0.0404
p-value	<0.001	<0.001	<0.001	0.065	0.003	0.476
DAX						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.6499	0.5469	0.1128	–0.2099	–0.2876	0.0072
p-value	<0.001	<0.001	0.046	<0.001	<0.001	0.901
ELHK						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	–0.2256	0.1283	0.3240	0.1581	0.1816	–0.1051
p-value	<0.001	0.018	<0.001	0.004	0.001	0.057
ELJP						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.2460	0.0544	–0.3208	–0.5507	–0.3654	–0.0949
p-value	<0.001	0.314	<0.001	<0.001	<0.001	0.079
UNUS						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.2178	0.0339	–0.0693	–0.3233	–0.3872	–0.3964
p-value	<0.001	0.542	0.224	<0.001	<0.001	<0.001
ELUK						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.1709	–0.0516	–0.1309	–0.3065	–0.0888	0.0265
p-value	0.002	0.350	0.018	<0.001	0.112	0.632
EPFR						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	0.4962	0.3170	0.0831	–0.2987	–0.5204	–0.3093
p-value	<0.001	<0.001	0.142	<0.001	<0.001	<0.001
EPGR						
Moving-window size	40	80	120	160	200	240
$\hat{\beta}$	–0.0226	0.0381	–0.1490	–0.1433	–0.0709	0.0778
p-value	0.676	0.482	0.006	0.009	0.191	0.152

This reveals that additional channels of calendar effects are detected. In addition, Methods 1, 2 and 3 show the following similarities to Hui and Chan (2016)'s results:

1. For the 6 general equity indices, if the moving-window size is small (<=120), then for almost all the cases, $\hat{\beta} > 0$ and the p-value is below 0.05, revealing that the Halloween effect is highly significant. However, if the moving-window size is large (>=160), then $\hat{\beta} < 0$ for more than half of the cases, and the p-value is below 0.05 for slight majority of cases, reflecting that for the majority of the cases, the Halloween effect goes into reverse, but the effect is not so significant.
2. For the 6 securitized real estate indices, there are slight majority of the cases where $\hat{\beta} < 0$, i.e. the Halloween effect goes into reverse. In particular, for larger moving-window sizes (>=160), the cases where $\hat{\beta} < 0$ dominate.

In particular, for the 4 western general equity indices (SPX, UKX, CAC and DAX) with moving-window size 120 or smaller, $\hat{\beta} > 0$ and the p-value is below 0.05, showing that the Halloween effect is highly significant. This is natural because the most of the previous studies on Halloween effect work on equity markets of European and North American countries (see Section 1), so the four western general equity indices behave normally. However, most Asian markets are still at a developing stage, so their calendar effects may not be the same as those of the European and North America markets. Investors should be aware of this phenomenon when investing in those developing markets. The small moving-window size means that the "delaying effect" (see Hui and Chan, 2016 for detail explanation) is not so significant that the calendar effect is not distorted.

However, comparing the results between Tables 8, 9 and 10, we can see that there is only a slight difference in the number of cases where $\hat{\beta} < 0$ between Methods 1, 2 and 3. This reveals that the patterns of Halloween effect shown by the three methods are almost the same. The main reason is that Methods 2 and 3 are based on Strategies 2 and 3 respectively. For Strategies 2 and 3, an investor waits until the sign of $\hat{\mu}_i(n)$ remains unchanged for 2 and 3 consecutive days respectively before trading the stock index. Comparing with Strategy 1, this is a small change only. Hence the difference in the overall calendar effect shown by the three methods in Tables 5, 6 and 7 is not so significant. The Halloween effect concerns with the hypotheses H_{11}, H_{21} and H_{31}, which say that the "holding periods" of Strategy 1, 2 and 3, respectively (i.e. the percentage of time of which $R_{1i} = 1$, $R_{2i} = 1$ and $R_{3i} = 1$ respectively), are significantly longer from November to April than from May to October. Taking the average values of R_{1i}, R_{2i} and R_{3i} in six months, this would lower the standard deviation of the average values of R_{1i}, R_{2i} and R_{3i}. Therefore, the difference in patterns of Halloween effect shown by the three methods is very small.

Conclusion

In this study, we construct two new tests of calendar effects based on Hui and Chan (2018c)'s two new strategies of which after $\hat{\mu}_i(n)$ changes sign, one waits until $\hat{\mu}_i(n)$ remains at the same sign for two or three consecutive days before buying or selling the stock index (called Methods 2 and 3 respectively in this study). we apply these two methods on 12 stock indices during 1996–2016, and compare the results with that using Hui and Chan (2016)'s method (Method 1). The major results are as follows:

(1) When the moving-window size increases, the calendar effects generally diminish.

(2) Significant January and Halloween effects exist in most of the general equity indices (especially for the 4 western economies for smaller moving-window sizes). However, the two effects are less prevalent or even go into reverse sometimes for the securitized real estate indices.

(3) Method 2 shows less significant calendar effect than Method 1 does, but Method 3 shows more significant calendar effect than Method 2 does.

(4) The securitized real estate indices show a greater difference in the overall calendar effect between the three methods than the general equity indices do.

The common advantage of the three methods is that they can show the percentage of time of which the stock index is held in a month according to a trading strategy which outperforms "buy-and-hold" in general. However, Method 1 is based on Strategy 1, of which Hui and Chan (2018c) find that the strategy underperforms "buy-and-hold" for slight majority of the cases. Since Hui and Chan (2018c) find two strategies (Strategies 2 and 3 in this study) which yield greater profit than Strategy 1 does, we construct two new tests of calendar effects which can show the length of "holding periods" of Strategies 2 and 3 respectively. From the results of our new methods (Methods 2 and 3), we can know in which months, the stock indices should be held for a significantly longer period of time than average, according to Strategies 2 and 3. Hence our method is superior to Hui and Chan (2016)'s method. In addition, the result that the securitized real estate indices show a greater difference in the overall calendar effect between the three methods than the general equity indices do has meaningful implications. The general equity indices represent the whole market. Changing the trading strategy does not alter the calendar effect a lot. However, for a certain sector of the whole market like real estate, the volatility is larger (see Sub-section 5.1 for explanation) and hence shifting the trading strategy would alter the calendar effect by a larger extent. Therefore, investors should be aware of this risk when investing on a certain sector of the market. However, for the whole market, the risk is smaller due to broader diversification. Hence it is more suitable for investors who are only able to bear smaller risk. Furthermore, we find that if the moving-window size is small, both January and Halloween effects are significant for the 4 western general equity indices. This reflects that most of the previous studies on Halloween and January effects work on equity markets of European and North American countries (see Section 1), so the four western general equity indices behave normally. The small moving-window size means that the "delaying effect" (see Hui and Chan, 2016 for detail explanation) is not so significant that the calendar effect is not distorted. Therefore, if investors adopt Strategies 1, 2 or 3, and use a small moving-window size to invest in European and North American equity markets, they can still rely on calendar effects to a certain extent. However, for larger moving-window sizes/Asian markets/securitized real estate markets, those traditional calendar effects may not necessarily hold. Larger moving-window sizes increases the "delaying effect" and hence distorts the calendar effect. Most Asian markets are still at a developing stage, so their calendar effects may not be the same as those of the European and North America markets. The securitized real estate market is just a sector of the whole market, so its calendar effect may be different from that of the whole market, too. Investors should be aware of this phenomenon in order to earn more profits. One may construct a trading strategy of which an investor waits until the sign of $\hat{\mu}_i(n)$ remains unchanged for 4 or more consecutive days before trading the stock/stock index, and construct a new test of calendar effect according to this strategy. This is a possible scope of future research.

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