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The turn-of-the-month effect still lives: the international evidence

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Abstract

This paper examines 19 country stock market indices for recent evidence of the turn-of-the-month (TOM) pattern in daily stock returns using both parametric and nonparametric measures to address concerns regarding methodologies applied in prior anomalies studies. We find that the 4-day TOM period accounts for 87% of the monthly return, on average, across countries, in the stock markets of 15 countries where the TOM pattern exists. These countries account for 77% of the foreign market capitalization value. The parametric and nonparametric results provide information regarding the degree to which distributional assumption violations may lead to incorrect conclusions.

JEL classification: G14; G15
Keywords: Calendar pattern; Turn-of-the-month; International; Nonparametric

1. Introduction

In the November 2000 issue of *Money*, Zweig (2000) cites recent studies in human behavioral psychology indicating that the tendency to find patterns where none exists may be hardwired into the human brain. That article concludes that "the stock market is far more random than investors like to admit" and supports those who would argue that the patterns identified in the anomalies research are largely based on transitory (and random) patterns and

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erroneous statistical methodology, or the result of collective data snooping of well-traveled databases. However, while predictable patterns in stock prices may be contrary to the efficient market hypothesis, they continue to generate interest in both academic research and the popular press. After years of extensive scrutiny and a fair degree of skepticism, there continues to be too much evidence that such patterns do indeed persist for these claims to be lightly discounted.

The standard argument is that once price patterns are identified and enter the realm of public discourse, the market responds efficiently by trading them out of existence. Numerous studies clearly show that patterns fade as markets incorporate knowledge of the observed patterns into the pricing of securities.[1] Other research works showing that these calendar effects are confined to specific periods, or are driven by a few outliers suggest that calendar anomalies may simply be artifacts of extensive data mining. Many have called into question the test methodologies sometimes used to confirm calendar patterns in stock returns, given the violations of OLS assumptions that have been identified in return distributions.[2]

One response to these criticisms is to appeal to unique data sources and robust methodologies. If an anomaly can be shown to exist in many markets and under test conditions that are robust to violations of the OLS assumptions, it provides greater support for the conclusion that the anomaly exists. In this study, we examine data from 19 countries' stock markets from 1988 to 2000 to determine whether the international market has eliminated a calendar pattern first identified in the 1980s (Ariel, 1987). Using robust tests, we show that the turn-of-the-month (hereafter, TOM) effect persists well beyond any reasonable time period for the market to adapt to and eliminate the pattern. We also show that it exists independent of any US TOM pattern.

Our data include 2153 months from 19 countries from August 1988 through July 2000. We show that the TOM effect persists throughout the 1990s in at least 16 of 19 countries in our study. Our parametric and nonparametric tests indicate a significant TOM pattern that is independent of any monthly seasonal and cannot be explained by outlier observations in a few months. The 4-day TOM period accounts for 87% of the monthly return, on average, and the TOM period return exceeds the average 4-day period return during the rest of the month in approximately 62% of the months. This supports results reported by Agrawal and Tandon (1994) who found that over 70% of the average return for the month was concentrated in the 5 days around the TOM in 6 of 19 countries examined in their study.

2. Literature review

The international evidence provides ample support for the existence of calendar patterns worldwide. While the focus of these studies has been primarily on the January and weekend

[1] Agrawal and Tandon (1994), Chow, Hsiao, and Solt (1997), Fortune (1998), Jordan and Jordan (1991), Kamara (1997), and Riepe (1998).

[2] Alford and Guffey (1996), Connolly (1989), Lindley and Liano (1997), Pearce (1996), Singleton and Wingender (1994), and Sullivan, Timmermann, and White (1998).

effects, recent evidence on US data suggests that the TOM effect may offer opportunities for exploitation.[3]

Jaffe and Westerfield (1985a, 1985b, 1989) find evidence of calendar patterns in a number of foreign stock exchanges in the 1970s and 1980s, including the weekend effect or Monday effect (Jaffe & Westerfield, 1985a) in the exchanges of Australia, Canada, Japan, and the UK; the January effect (Jaffe & Westerfield, 1985b) in the Tokyo Stock Exchange (TSE); and weak evidence of a TOM effect (Jaffe & Westerfield, 1989) in the Australian stock market.

Cadsby and Radner (1992) examine the TOM and holiday evidence in the daily stock market indices of 10 countries between 1962 and 1989 to see whether the effects are independent of, or related to, patterns observed in the US market. They find evidence of a TOM pattern in six countries that is independent of the turn-of-the-year effect. They conclude, based on evidence of a holiday pattern unique to different countries, that the holiday effect is linked to local institutions and practices and is not a spillover from US markets. However, they are unable to directly examine the spillover of the TOM effect since the period occurs simultaneously across countries. Our study is able to show that the pattern is not due to spillover from US markets.

An examination of seasonal anomalies in the daily stock indices of 18 countries between 1971 and 1987 by Agrawal and Tandon (1994) focuses primarily on the weekend effect but also includes the January, TOM, end-of-the-year, and Friday-the-13th effects. The authors find strong evidence of a January effect throughout the period of their study. They also find evidence of a weekend effect that is separate from that which occurs in the United States and includes negative Monday and Tuesday returns, but this effect disappeared in the 1980s. The authors find that there is a fading of the TOM effect, with 11 countries showing the effect in the 1970s and only seven still showing the TOM effect in the decade of the 1980s. However, their only test for a TOM effect is a *t* test comparison of the cumulative 4-day return around the TOM to an average 4-day return.

Studies of Asian markets have also uncovered seasonal patterns related to the January effect (Aggarwal & Rivoli, 1989; Lee, 1992) and the weekend effect (Kim, 1988; Ko & Lee, 1991; Lee, Pettitt, & Swankowski, 1990), but few studies have addressed the TOM pattern in this market. Lee et al. (1990) find that daily patterns are pervasive in ‘‘second-tier markets’’ but they find no evidence of a TOM effect. However, their study, which covers 648 country months, compares returns generated in the first week relative to the rest of the month, and returns generated in the first 2 weeks relative to the rest of the month. While the identification of the TOM period varies by study, the most likely period seems to be the 4- or 5-day period around the TOM beginning with the last day of the month.[4]

[3] Studies that have identified significant TOM patterns in the US data include Ariel (1987), Lakonishok and Smidt (1988), Ogden (1990), and Pettengill and Jordan (1988). Studies demonstrating exploitation of the pattern include Hensel and Ziemba (1996) and Kunkel and Compton (1998).

[4] The original study by Ariel (1987) defines the TOM period as the first eight trading days of the month plus the last trading day of the previous month. Lakonishok and Smidt (1988) examine this period, and find that the effect is especially strong from days -1 to $+3$, which is the convention followed by others (Agrawal & Tandon, 1994; Cadsby & Radner, 1992; Pettengill & Jordan, 1988).

In this study, we examine the daily closing values from the stock market indices of 19 countries using data drawn primarily from the decade of the 1990s. We then update previous research by testing whether the patterns are robust to different parametric and nonparametric instruments. In this way, we address concerns levied by Connolly (1989), Lindley and Liano (1997), Sullivan et al. (1998), and others regarding the robustness of anomaly research.

3. Data

Our data include daily closing prices from stock market indices of 19 countries from August 1, 1988 to July 31, 2000. The data are obtained from www.yahoo.finance.com and the *Wall Street Journal*, and only countries with at least 6 years of data were included in the sample. There are eight European countries, six Far East countries (Australia, Hong Kong, Japan, Malaysia, New Zealand, and Singapore), two North American countries (Canada and United States), two Latin American countries (Brazil and Mexico), and South Africa. The countries, indices, time periods, weight factors, number of stocks in the index, and market capitalization are reported in Table 1.

Table 1
Countries, indices, time periods, weight factors of indices, number of stocks in each index, and market capitalization of each country's stock market (as of 1998 in US$ billions)

Country	Index	Start date[a]	Weight factor of index	Number of stocks	Market capitalization[b]
Australia	All Ordinaries	August 1, 1988	Market value	330	874
Austria	ATX	December 1, 1992	Market value	22	34
Belgium	BEL-20	May 2, 1993	Market value	20	246
Brazil	Bovespa	May 3, 1993	Market value	49	161
Canada	TSE 300 Composite	August 1, 1988	Market value	300	543
Denmark	KFX	February 1, 1993	Market value	21	99
France	CAC 40	March 2, 1990	Market value	40	991
Germany	Dax	December 3, 1990	Market value	30	1094
Hong Kong	Hang Seng	August 1, 1988	Price weighted	33	343
Japan	Nikkei 225	August 1, 1988	Price weighted	225	2496
Malaysia	KLSE Composite	January 3, 1994	Market value	100	99
Mexico	IPC	December 2, 1991	Market value	35	92
The Netherlands	AEX General	December 1, 1993	Market value	25	603
New Zealand	NZSE 40	October 1, 1992	Market value	40	89
Singapore	Straits Times	August 1, 1988	Price weighted	30	94
South Africa	Johannesburg All Share	July 1, 1992	Market value	523	170
Switzerland	Swiss Market	December 3, 1990	Market value	21	689
UK	FTSE 100	August 1, 1988	Market value	100	2374
United States	S&P 500	August 1, 1988	Market value	500	13,451

[a] The time period ends on July 31, 2000 for each country. Starting dates differ and are shown in the table.
[b] The total capitalization values of the stock markets in the countries in the sample and worldwide are US$24.542 and 27.462 trillion, respectively.

The capitalization value of these 19 countries represented over 86% of the world's equity value as of December 1998 (Eun & Resnick, 2001). All countries have data available for most of the 1990s and seven countries have data beginning August 1, 1988. The time period for our study encompasses the 12 years following the first mention of the TOM pattern in studies by Ariel (1987), Lakonishok and Smidt (1988), and Pettengill and Jordan (1988), and allows us to examine whether there is a fading of the TOM effect internationally and whether markets have responded efficiently to exploit the pattern.

We do not adjust for exchange rates in our study. Previous studies have had mixed results when adjusting for a common numeraire. In their study of the January effect in 19 countries, Alford and Guffey (1996) find that using a common numeraire extinguishes the seasonal pattern in four countries (out of 14 that demonstrate the pattern in local currency) and reveal a seasonal pattern in one country. Ko (1998), however, finds that the effect of exchange rates on the monthly seasonal in 19 countries is not strong enough to influence the results. Lee et al. (1990) argue against an adjustment by showing an absolute difference of only .08 in correlations in international markets after adjusting for exchange rates and those prior to adjustment. They also suggest that attempts to make common numeraire adjustments would require a subjective decision on the choice of a 'home' country currency for the analysis.

Summary statistics for the daily returns on each index are reported in Table 2. The number of daily returns ranges from 1623 for Malaysia to 3038 for Australia. The mean return for all countries was positive except for Malaysia and Japan. The negative Malaysian return is largely driven by the 51% decline in the Kuala Lumpur Composite Index in 1997, when

Table 2
General statistics on each index

Country	Number of observations	Mean (%)	Median (%)	S.D. (%)	Skewness	Kurtosis
Australia	3038	0.0262	0.0283	0.835	− 0.547	6.887
Austria	1897	0.0272	0.0414	1.086	− 0.584	4.347
Belgium	2301	0.0453	0.0360	0.009	0.061	4.771
Brazil	1793	0.4190	0.3377	3.203	0.999	10.540
Canada	3028	0.0402	0.0591	0.771	− 0.569	7.041
Denmark	1883	0.0734	0.0743	0.994	− 0.251	2.319
France	2603	0.0567	0.0466	1.247	− 0.088	2.191
Germany	2422	0.0740	0.0877	1.232	− 0.305	4.131
Hong Kong	2969	0.0730	0.0814	1.757	− 0.604	17.074
Japan	2973	− 0.0093	− 0.0080	1.438	0.398	5.043
Malaysia	1623	− 0.0034	− 0.0650	2.143	1.429	27.624
Mexico	2157	0.0892	0.0090	1.865	0.212	4.865
The Netherlands	1688	0.0870	0.1104	1.198	− 0.249	3.153
New Zealand	1967	0.0245	0.0272	0.986	− 0.691	20.180
Singapore	2994	0.0238	0.0057	1.306	− 0.073	8.333
South Africa	1992	0.0427	0.0546	1.093	− 0.933	10.982
Switzerland	2427	0.0781	0.1074	1.068	− 0.270	4.937
UK	3033	0.0450	0.0536	0.924	0.027	1.982
United States	3033	0.0590	0.0574	0.917	− 0.324	5.176

Malaysia was hardest hit of all Asian countries during the Asian financial turmoil. The negative mean return for Japan's Nikkei 225 Index reflects the bear market in Japan during most of the years covered in the study. Beginning in 1990, when the Nikkei saw a 36% decline, the Japanese market experienced a decline in 7 of 10 years.

The mean returns for the remaining countries ranged from 0.02% for Singapore to 0.42% for Brazil. The standard deviation of the daily returns ranged from 0.01% for Belgium to 3.20% for Brazil. Brazilian returns exhibit a significant degree of volatility, with annual standard deviations ranging from 1.40 in 1996 to 3.97 in 1994. The extremely large and extremely small returns reflect this volatility. In 1 day in January 1999, the Sao Paulo Stock Exchange (Bovespa) gained 33%. The exchange gained over 5% on 285 occasions, and lost more than 5% on 60 occasions, out of the 1793 total observations made on the Bovespa Index. In 1993 and 1994, the returns on Bovespa were 976% and 488%, respectively. During the next 5 years, annual returns range from − 30% in 1998 to 109% in 1999, and 1998 was the only down year for the Brazilian market.

4. Methodology

The validity of standard parametric tests used in early anomalies research has been called into question due to the violations of OLS assumptions observed in many stock return series. The sensitivity of inferences about calendar effects to mild violations has led some researchers to include adjustments that may not be appropriate (Connolly, 1989). It is generally agreed that parametric tests like OLS regression and analysis of variance (ANOVA) are fairly robust to mild violations of assumptions, especially in large samples. They are also more sensitive to small differences in the magnitudes of returns that are being measured. However, nonparametric methods have been demonstrated to be almost as powerful as parametric methods in detecting differences in ANOVA procedures and, when OLS assumptions are not met, can be even more powerful (Bradley, 1978; Hunter and May, 1993). One study comparing four parametric and nonparametric ANOVA procedures found the patterns of significance and statistical power to be almost identical in three of the four approaches, and the nonparametric multivariate ANOVA procedure showed a slight advantage over the other techniques.[5] Nonparametric tests have been applied in anomaly studies, including Agrawal and Tandon (1994), Alford and Guffey (1996), Gultekin and Gultekin (1983), and Ko (1998).

Examination of the data in Table 2 reveals excess kurtosis in the returns of all of the countries, and positive skewness in the returns of 13 of the countries. Heavy tails are commonly found in daily return distributions. Durbin–Watson test results from our regressions in Tables 3 and 5 show no evidence of first-order autocorrelation in the residuals of any of the countries. We test for normality using the Kolmogorov–Smirnov and Bowman–Shelton tests. The Kolmogorov–Smirnov test compares the observed cumulative return distribution of the raw return data to a hypothesized cumulative distribution. The Bowman–

[5] See Ittenbach, Chayer, Bruininks, Thurlow, and Beirne-Smith (1993).

Table 3
Mean percentage rates of return on common stock indices by trading day of the month

Country	Trading day of the month												T test P value[a]
	– 6	– 5	– 4	– 3	– 2	– 1	1	2	3	4	5	6	
Australia[b]	– 0.053	– 0.028	– 0.024	0.130*	0.012	0.202***	– 0.052	0.214***	0.064	– 0.043	– 0.069	0.091	.0180
Austria[c]	0.004	0.060	0.185	0.061	0.009	0.166	0.198*	0.201**	– 0.005	0.038	0.131	0.046	.0730
Belgium[c]	– 0.173**	– 0.120	0.061	0.069	– 0.005	0.124	0.319***	0.167**	0.089	– 0.054	0.076	0.085	.0157
Brazil[c]	0.587*	0.048	0.562*	0.348	0.524	0.176	0.846**	0.835**	0.219	0.544*	0.506	0.382	.4941
Canada[c]	0.076	0.025	0.087	– 0.054	– 0.008	0.135**	0.121*	0.199***	0.065	0.154**	0.056	– 0.082	.0061
Denmark[c]	0.138	0.040	0.134	0.117	– 0.030	0.102	0.349***	0.292***	– 0.052	0.085	0.085	0.031	.0733
France[c]	0.091	0.397***	0.205**	0.046	0.081	0.234**	0.160	0.263**	– 0.039	0.067	0.226**	– 0.044	.1160
Germany[c]	0.068	0.042	0.153	0.079	– 0.060	0.085	0.232**	0.175	0.224**	0.085	0.162	0.114	.0770
Hong Kong[c]	– 0.013	0.118	0.045	0.337**	– 0.124	0.338**	0.040	0.275*	0.032	0.006	0.102	0.133	.1779
Japan[c]	– 0.176	0.100	0.175	– 0.113	– 0.042	0.176	– 0.050	0.159	0.047	– 0.283**	0.069	– 0.007	.0589
Malaysia	– 0.082	– 0.305	– 0.057	– 0.206	– 0.128	0.210	0.063	– 0.039	0.108	0.308	– 0.157	– 0.154	.4674
Mexico[c]	0.337*	– 0.303*	0.072	0.052	0.122	0.108	0.200	0.453**	0.275	0.224	0.042	– 0.296	.0737
The Netherlands[c]	0.080	0.148	0.110	0.044	– 0.090	0.063	0.331**	0.260*	0.202	0.093	0.229*	0.042	.1311
New Zealand[c]	– 0.154	– 0.056	– 0.054	0.287***	– 0.0297	0.114	0.048	0.272***	0.043	0.063	– 0.040	– 0.143	.0549
Singapore[c]	– 0.226**	0.102	0.115	0.034	– 0.013	0.222**	0.049	0.138	0.060	– 0.084	– 0.062	– 0.031	.0770
South Africa[c]	– 0.054	– 0.025	– 0.171	0.084	– 0.022	0.242**	0.182	0.328***	0.168	0.169	0.178	– 0.136	.0015
Switzerland[c]	0.073	– 0.007	0.107	0.122	0.136	0.084	0.328***	0.271***	0.065	0.235**	0.138	– 0.130	.0584
UK[c]	– 0.020	– 0.082	0.141*	0.139*	– 0.011	0.166**	0.156**	0.115	0.116	0.020	0.145*	0.054	.0250
United States[c]	0.041	0.033	0.034	0.088	0.109	0.071	0.279***	0.114	0.048	– 0.007	0.107	– 0.027	.0591

[a] The *t* statistic in the last column tests the difference in return for the 4-day TOM return vs. the average 4-day return during the ROM.

[b] For Australia, Day – 9 is positive and significantly different from zero at the 1% level.

[c] None of the returns on Trading Days – 9, – 8, – 7, + 7, + 8, and + 9 are positive and significantly different from zero.

* Denotes statistical significance for a two-tailed *t* test at the 10% level.

** Denotes statistical significance for a two-tailed *t* test at the 5% level.

*** Denotes statistical significance for a two-tailed *t* test at the 1% level.

Shelton test is based on the degree of skewness and kurtosis in the return distributions. The normal distribution assumption is rejected at the 1% level for all 19 countries in both tests.[6] Additionally, visual inspection of the histograms supports the conclusion of non-normal distributions. To address these concerns, we use both parametric and nonparametric tests, the results of which are reported in Table 5.

After demonstrating that a TOM period exists by examining the 18-day period around the TOM, we first run a regression of returns onto a dummy variable for the TOM period as our first parametric test. We then perform a three-way ANOVA, which tests the TOM period while controlling for the interaction effects of months and years. Finally, we perform a nonparametric Wilcoxon signed rank (WSR) test, which is a paired difference test that controls for any seasonal monthly, or January, effect. Examination of the results allows us to examine the degree to which distributional assumption violations may lead to incorrect conclusions.

5. Results

We first examine the 18 trading days around the TOM to determine if any of the mean daily returns is significantly different from zero. The 18-day period includes most of the trading days in any month and is similar to one employed by Lakonishok and Smidt (1988), Pettengill and Jordan (1988), and others. While individual months vary in the number of trading days, the actual number ranges from 18 to 23. To examine the daily mean returns, we estimate the following OLS regression for each country:

$$R_t = \beta_{-9}D_{-9,t} + \beta_{-8}D_{-8,t} + \cdots + \beta_8 D_{8,t} + \beta_9 D_{9,t} + \varepsilon_t \tag{1}$$

where R_t is the return on Day t; $D_{i,t}$ are binary dummy variables for the first and last nine trading days of each month, where $D_{-9,t}$ corresponds to Trading Day -9, $D_{-8,t}$ corresponds to Trading Day -8, continuing through $D_{9,t}$, which corresponds to Trading Day $+9$. The coefficients on the dummy variables, β_{-9} to β_9, are the mean returns for the 18 trading days and ε_t is the error term.

The results of the regression on the 18 days around the TOM are reported in Table 3. To conserve space, we report just the mean returns and t test levels of significance for the 12-day period around the TOM.[7] An examination of the returns shows that most significant positive returns cluster around the TOM period, Trading Days -1 through $+3$. Over this 4-day TOM period, all countries have at least one return that is positive and significantly different from zero, and most countries have two to four returns that are positive and significantly different from zero. Only six countries have negative returns during the 4-day TOM period and none of the returns is significantly different from zero. In the far right column of the table, we show the result of a t test of the difference between the 4-day TOM return and the average 4-day

[6] Results are available from the authors upon request.

[7] None of the remaining 114 days for all countries (-9, -8, -7, 7, 8, and 9) is significantly positive, as reported in the notes. Additionally, since the actual number of trading days in a month varies from 18 to 23, we examine the excluded days and find that none was significantly positive.

return for the month. The test shows that the TOM return is significantly greater than the average 4-day return in 14 countries. We report general statistics for the 4-day TOM period and ROM period in Table 4.

Having established that an apparent TOM pattern exists, we next test for a TOM effect directly by comparing TOM returns to the rest-of-the-month (ROM) returns. Following Lakonishok and Smidt (1988), Pettengill and Jordan (1988), and others, we run the following OLS regression for each country:

$$R_t = \alpha + \beta D_{\mathrm{TOM}} + \varepsilon_t \qquad (2)$$

where R_t is the return on Day t; α is the intercept representing the mean return for the ROM period; D_{TOM} is a binary dummy variable for the TOM period; the coefficient β represents the difference between the mean TOM return and the mean ROM return; and ε_t is the error term.

We report the results of the regression in Eq. (2) in Table 5. The intercepts show that 16 countries have positive ROM returns while three countries (Japan, Malaysia, and South Africa) have negative ROM returns. Furthermore, only six countries have ROM returns that are significantly different from zero. The coefficients on the TOM dummy variables show that every country has positive mean TOM returns including Japan, Malaysia, and South Africa. Additionally, in every country, we find that the mean returns during the TOM period are greater than the mean returns during the ROM period, and the t tests shows that in 16 countries, these returns are significantly greater.

Table 4
General statistics on TOM and ROM

Country	TOM				ROM			
	Mean (%)	S.D. (%)	Skewness	Kurtosis	Mean (%)	S.D. (%)	Skewness	Kurtosis
Australia	0.1068	0.8534	0.0366	0.2214	0.0073	0.8297	− 0.7011	8.5979
Austria	0.1399	1.1552	− 0.6494	3.7713	0.0001	1.0672	− 0.5799	4.5690
Belgium	0.1759	1.0188	− 0.2330	3.3439	0.0143	0.8872	0.1327	5.3576
Brazil	0.5193	3.1558	0.0323	1.8438	0.3948	3.2147	1.2204	12.5320
Canada	0.1300	0.8810	− 0.6664	4.9883	0.0191	0.7692	− 0.5500	7.6085
Denmark	0.1730	1.0426	− 0.0916	1.7164	0.0499	0.9815	− 0.3065	2.4900
France	0.1545	1.3422	− 0.1492	1.0329	0.0334	1.2224	− 0.0808	2.5712
Germany	0.1792	1.3047	− 0.4654	2.7946	0.0490	1.2130	− 0.2680	4.5764
Hong Kong	0.1711	1.8600	− 3.1622	34.7763	0.0493	1.7304	0.1509	11.6510
Japan	0.0832	1.5316	1.1575	10.7769	− 0.0316	1.4141	0.1592	3.0658
Malaysia	0.0854	2.4169	2.6580	30.1898	− 0.0248	2.0721	0.9402	25.8153
Mexico	0.2592	1.8965	0.4550	2.0228	0.0486	1.8558	0.1477	5.6063
The Netherlands	0.2138	1.3541	− 0.3898	2.8444	0.0572	1.1575	− 0.2247	3.2171
New Zealand	0.1191	0.9480	0.2509	1.9335	0.0022	0.9934	− 0.8803	23.7334
Singapore	0.1170	1.1889	0.5774	5.4302	0.0015	1.3310	− 0.1729	8.6778
South Africa	0.2300	1.0338	0.4324	4.3075	− 0.0026	1.1029	− 1.2015	12.1348
Switzerland	0.1871	1.1069	− 0.7444	3.4405	0.0524	1.0570	− 0.1496	5.4601
UK	0.1382	0.9427	− 0.3487	1.9477	0.0231	0.9187	0.1180	2.0536
United States	0.1279	0.9245	− 0.7087	6.9683	0.0428	0.9149	− 0.2335	4.8074

Table 5
Tests for the TOM effect 1988–2000

Country	α[a]	β[a]	*F* test *P* value[a]	GLM *P* value[b]	WSR test *P* value[c]
Australia	0.007	0.099***	.0100	.0107	.0219
Austria	0.000	0.140**	.0266	.0268	.0283
Belgium	0.014	0.161***	.0009	.0007	.0005
Brazil	0.395***	0.124	.5153	.5029	.2792
Canada	0.019	0.111***	.0020	.0017	.0004
Denmark	0.050**	0.123**	.0346	.0351	.0282
France	0.033	0.121**	.0510	.0503	.0217
Germany	0.049 *	0.130**	.0407	.0439	.0019
Hong Kong	0.049	0.122	.1351	.1355	.0024
Japan	– 0.032	0.115 *	.0856	.0869	.0360
Malaysia	– 0.025	0.110	.4123	.4431	.6042
Mexico	0.049	0.211**	.0385	.0348	.0864
The Netherlands	0.057 *	0.157**	.0353	.0334	.0014
New Zealand	0.002	0.117**	.0385	.0377	.0572
Singapore	0.002	0.116 *	.0563	.0564	.0347
South Africa	– 0.003	0.233***	.0002	.0002	.0015
Switzerland	0.052**	0.135**	.0145	.0135	.0001
UK	0.023	0.115***	.0071	.0068	.0004
United States	0.043**	0.085**	.0449	.0472	.0113

[a] The α, β, and *F* test are for the following regression: $R_t = \alpha + \beta D_{\mathrm{TOM},t} + \varepsilon_t$.
[b] The GLM controls for both months and years.
[c] The WSR test is a nonparametric paired difference test between the TOM and ROM periods.

The *F* statistic results shown in Table 5 allow us to reject the null hypothesis of equality of mean returns between the TOM period and ROM period for all countries except Brazil, Hong Kong, and Malaysia. Thus, our first test finds a TOM effect in 16 of 19 countries included in the study. This includes the eight European and two North American countries, four of the six Far East countries, one of the two Latin American countries, and South Africa.

We also looked for a possible January effect or monthly seasonal pattern as an explanation for the high returns that we found in the TOM period. Studies showing that stock returns are significantly higher in January than the rest of the year have reported that these higher returns were concentrated in the first few days of January. Results on whether the turn-of-the-year or January returns can explain the TOM returns have been mixed. Jordan and Jordan (1991) reject the hypothesis that the turn-of-the-year mean return equals the remaining TOM mean returns for an equally weighted equity index of companies in the Dow Jones Composite Bond Average, but are unable to reject the hypothesis for the S&P 500 Index. In a study of NYSE, AMEX, and NASDAQ stocks, Pearce (1996), finds only weak support for a TOM pattern in the AMEX stocks when controlling for the January effect in the regression model used in that study, and finds that the pattern disappears entirely when the turn-of-the-year period is substituted for January in the regression. However, Pettengill and Jordan (1988) find a highly significant TOM pattern in their study of two US stock return indexes, while simultaneously controlling for the January and turn-of-the-year effects, and Boudreaux (1995) finds that excluding January effects results in a diminished, but still significant, TOM pattern in countries that exhibited the TOM pattern in that study.

To test whether the TOM pattern that we found in 16 of 19 countries exists independent of any January effect, or turn-of-the-year effect, we first ran the regression in Eq. (2) without January effect in the sample, for each of the countries. We find that 14 countries out of 19 now show a significant TOM effect. Two countries, New Zealand and Singapore, no longer show a significant TOM effect, at least at the 10% level. In both cases, the mean return during the TOM period dropped and the mean return during the ROM period rose. For all other countries, the response of the TOM and ROM periods to dropping January effect was mixed. The mean returns during the TOM period dropped in Austria, Brazil, Canada, Denmark, Germany, Hong Kong, Mexico, the Netherlands, New Zealand, Singapore, Switzerland, and United States. The remaining countries saw an increase in TOM returns. The ROM period returns dropped in Australia, Austria, Belgium, Brazil, Canada, Denmark, France, Germany, Japan, South Africa, UK, and United States. The ROM period returns rose in the remaining countries.

Our next test of the TOM pattern is a three-way ANOVA model that directly controls for possible seasonal patterns across months and across years.[8] The general linear model procedure (GLM) that we use is a flexible and powerful technique that allows us to detect interaction effects and examine more complex hypothesis regarding the factors that might be driving the seasonal patterns. We are able to directly examine the influence and interaction of the monthly seasonal (and possible January effect), and the turn-of-the-year influence, on the TOM pattern found in our dummy variable regression in Eq. (2). In addition, Alford and Folks (1996) find that returns across years are affected by the changing price of risk and that it is necessary, when examining seasonalities, to control not only for the month of the returns but also changes across years. The three-way GLM is more robust than a simple regression and allows us to simultaneously examine the monthly seasonal effects such as the January effect, and any influence due to changes in the market risk premium from year to year. The model for the three-way GLM is shown in Eq. (3):

$$R_t = \sum R_{\mathrm{Period},t} + \sum R_{\mathrm{Month},t} + \sum R_{\mathrm{Year},t} + \varepsilon_t \quad (3)$$

where Period represents the TOM and ROM periods, and Month and Year account for any interaction effects due to those influences. The outcome of the model provides four *F* tests of the significance, which test the null hypothesis of no difference in mean returns across periods (TOM vs. ROM) , months, and years, and the null hypothesis of no interaction effect. The results for the *F* test across periods (TOM vs. ROM) are reported in Table 5 and show that the null hypothesis is rejected for all countries, except Brazil, Hong Kong, and Malaysia. These results indicate a strong TOM pattern, even after accounting for differences across months and years. The *F* test is significant at the 1%, 5%, and 10% levels for four, nine, and three

[8] Due to the unbalanced design of the test, we use a general linear model procedure to perform the analysis of variance.

countries, respectively. Not reported in the table, the *F* tests of difference across years are significant at the 1%, 5%, and 10% levels for Brazil, Singapore, and Canada, respectively. Also not reported in the table, the *F* tests of difference across months are significant at the 5% level for South Africa, and at the 10% level for Brazil and Singapore. Thus, we can conclude that the monthly and yearly seasonalities are not driving the TOM effect that we have found. We also examined the data after excluding the turn-of-the-year period, which is the TOM period from December to January, and found very little change in the results. Only Singapore lost significance in the test of a TOM effect. After excluding the turn-of-the-year period, Australia and South Africa were added to the countries that show significant difference in mean returns across years, and Austria was added to the countries showing significant difference in returns across months. Thus, we see that even after considering the January effect and the turn-of-the-year effect in our regression and our ANOVA, the TOM effect shows up in 14 of 19 countries.

Our last test, the WSR test, is a nonparametric paired differences test, which parallels the layout of the parametric two-way ANOVA, but is free of the distributional assumptions required under regression or ANOVA procedures. The test statistic for the WSR test, which tests the difference in medians rather than means, is based only on the ranks of the paired differences between TOM and ROM returns, and allows us to implicitly control for differences across months. It is more robust than regression or two-way ANOVA when there

Table 6
Tests for the TOM effect 1994–2000

Country	α[a]	β[a]	*F* test *P* value[a]	GLM *P* value[b]	WSR test *P* value[c]
Australia	0.012	0.109**	.0460	.0524	.0981
Austria	– 0.024	0.176**	.0154	.0160	.0200
Belgium	0.021	0.175***	.0087	.0083	.0051
Brazil	0.098	0.218	.2641	.2746	.1195
Canada	0.048*	0.090	.1424	.1410	.0678
Denmark	0.047	0.146**	.0292	.0313	.0081
France	0.047	0.195**	.0207	.0205	.0109
Germany	0.061	0.147*	.0926	.0954	.0061
Hong Kong	0.016	0.175	.1672	.1754	.0732
Japan	– 0.023	0.079	.3948	.4030	.2598
Malaysia	– 0.019	0.139	.3239	.3525	.4261
Mexico	0.039	0.235*	.0700	.0692	.1351
The Netherlands	0.065*	0.142*	.0768	.0774	.0076
New Zealand	– 0.014	0.111*	.0820	.0847	.0947
Singapore	– 0.029	0.141	.1470	.1367	.0870
South Africa	– 0.025	0.263***	.0005	.0004	.0015
Switzerland	0.049	0.171**	.0211	.0188	.0004
UK	0.028	0.131**	.0460	.0446	.0072
United States	0.065**	0.080	.2378	.2434	.1195

[a] The α, β, and *F* test are for the following regression: $R_t = \alpha + \beta D_{\mathrm{TOM},t} + \varepsilon_t$.
[b] The GLM controls for both months and years.
[c] The WSR test is a nonparametric paired difference test between the TOM and ROM periods.

are violations of normality or homogeneous variance in the data because the test statistic only considers the ranks of return differences while ignoring differences in return magnitude. The test consists of sorting the absolute values of the differences from smallest to largest, assigning ranks to the absolute values, and finding the sum of the ranks of the positive differences, which under a true null hypothesis should be about the same as the sum of the ranks of the negative differences. If they are not, then the WSR test will be significant even if the magnitude is minute. The WSR test statistic is asymptotically distributed as a chi-square with $k-1$ degrees of freedom.

The results of this test are reported in Table 5 and show a TOM effect in all countries, except Brazil and Malaysia. In these 17 countries, we find the TOM return is greater than the corresponding ROM return in 62% of the months with a range from 54% for Mexico to 71% for the Netherlands. Even though the WSR test is not significant for Brazil and Malaysia, the TOM return is greater than the ROM return in 55% and 53% of the months for those two countries, respectively.

We ran all of the tests for the most recent 6-year period, from August 1, 1994 to July 31, 2000, to see if the same pattern persists even after a significant period has elapsed from the first published account of the TOM anomaly in 1987 and the numerous early confirmations of the pattern in the US market. We report the results of the regressions in Table 6 and find that that pattern persists in many countries, although not in the United States, which shows that the pattern is not a spillover from US markets. During the 1994–2000 subperiod, the three tests show that 11 of the countries continue to exhibit a TOM effect. However, Japan and the United States no longer exhibit a TOM effect under any of the tests. Additionally, the results for Canada, Singapore, and Mexico are now mixed.

6. Conclusion

We obtain daily closing values on the stock market indexes of 19 countries for the 1988–2000 period. This allows us to determine whether there is a global TOM effect in the 1990s and after the 1987 stock market correction. We test for the TOM effect by employing a battery of parametric and nonparametric statistical tests that address some of the concerns raised in previous studies. The first test we employ is an OLS dummy variable regression model that compares the TOM returns to the ROM returns. The second test is a three-way ANOVA model that examines the TOM period while controlling for both monthly and yearly seasonalities. The third test is a nonparametric WSR test that examines the matched-paired TOM–ROM returns.

All the test results show that a TOM pattern persists in a large number of countries long after it has been identified in US markets. For 16 of 19 countries, all three tests show a TOM effect during the full period from 1988 to 2000. The countries include eight European countries (Austria, Belgium, Denmark, France, Germany, the Netherlands, Switzerland, and UK), four Far East countries (Australia, Japan, New Zealand, and Singapore), Canada, United States, Mexico, and South Africa. We find that the 4-day TOM period accounts for 87% of the monthly return, on average, across countries, with a range from 66% for the United States to 139% for Japan. From a global market perspective, these 16 countries account for 88% of the world's market capitalization value. In the foreign stock markets (excluding the United States), the 15 countries with a TOM effect account for 77% of the foreign market capitalization value. While most countries in our studied experienced a bull market during the time period studied, the Japanese market did not. Yet the Japanese stock market exhibited a TOM effect during this bear market period.

It is clear the TOM effect is an international phenomenon showing up in Europe, the Far East, North America, and South Africa. Additionally, since we no longer find the TOM effect in the United States during the 1994–2000 period, it appears that the TOM effect in other countries is not simply a spillover from the US market.

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