PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A MATHEMATICAL, PHYSICAL & ENGINEERING SCIENCES

Worldwide Security Market Anomalies

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Worldwide security market anomalies

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Systematic violations of security market efficiency occur in equity markets because of the timing and reaction to cash flows and other information, institutional constraints and policies, and investor behaviour. They lead to significantly different risk-adjusted returns to those expected. Taking these anomalies into account provides opportunity for superior investment performance.

Classifying anomalies as fundamental or seasonal differentiates between individual securities and market timing with indices. Seasonal anomalies include the January small-firm, turn-of-the-month, holiday, and day-of-the-week effects. Seasonality calendars combine the various effects to provide daily return forecasts.

Fundamental anomalies include price to earnings, price to book, market capitalization, dividend yield, earnings trends and surprises, and mean reversion effects. These variables add explanatory power to that from risk measures and yield factor models to separate the best from the worst performing individual securities.

Anomalies are controversial, difficult to measure and variable in time through investor sentiment and futures anticipation. Their study is interesting and challenging, and they are useful in various areas of portfolio management.

1. Introduction

One of the most basic and useful paradigms of modern financial economics is the efficient market hypothesis. In a pure form the hypothesis may be stated as: current security prices reflect all publicly available information. This, surely, is false. More appropriate for actual markets is that current security prices reflect all publicly available information to the point where the marginal profits from acting on the information do not exceed the marginal costs. In other words, current prices are within a transactions cost band. In a wide variety of equity, commodity and other financial markets, this is more or less true. However, rigorous and defensible tests of this version of the hypothesis are difficult to carry out and equally hard to interpret. First there is a messy problem of dealing with transactions costs. Moreover, as stressed by Roll (1977), such a test, if properly undertaken, should be a joint hypothesis concerning market efficiency and the validity of an equilibrium pricing model, such as the Sharpe–Lintner capital asset pricing model or Ross's arbitrage pricing model.

The British statistician, Maurice Kendall, postulated the efficient market hypothesis in 1953. Price changes were assumed to follow a random walk. Kendall (1953) found considerable support for the hypothesis by examining British stock

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prices as well as US commodity prices. Kendall's work ushered in the efficient market era which is well represented by the important early studies by Roberts (1959, 1967), Black *et al.* (1972), Cootner (1964), Fama (1965) and Mandelbrot (1963). The early literature was surveyed by Fama (1970).

Over the years market efficiency has evolved from studying weak, semi-strong and strong form efficiency (in which prices fully reflect price information, all publicly available information and all information respectively) to studies of the predictability of returns based on fundamental variables, event studies of the adjustment of prices to specific public announcements and tests for private information. The evidence is that future returns are predictable from past returns, dividend yields and term-structure variables. This apparent violation of weak form efficiency of the constant expected returns model is confounded by the joint hypothesis problem of whether there is rational variation over time in expected returns or systematic deviations from fundamental value. Various security market regularities or anomalies can then be seriously analysed, as surveyed in Dimson (1988), Thaler (1992) and Ziemba (1988, 1994*a*), and the review articles by Fama (1991), Blume & Siegel (1992), Hawawini & Keim (1994) and Ziemba (1994*b*).

Anomalies that yield higher short-term equity returns seem to occur for six basic reasons: (*a*) increased cash flows just prior to and during the anomalous period, a portion of which is invested in equities; (*b*) institutional constraints and policies such as pension funds investments made on the last day of the month; (*c*) behavioural considerations such as investor sentiment leading to excess purchase or sale of equities in related but different securities; (*d*) the timing of favourable and unfavourable information flows such as the delays in reporting bad news; (*e*) market maker supply–demand balances and bid–ask spread preferences; (*f*) the slowness of the market to react to new information such as earnings changes, favourable and unfavourable publicly available ranking changes. Whereas arguments may be made that increased returns occur because of increased risk, which is difficult or impossible to measure accurately, there is very strong evidence that most or all the gains in equity markets actually occur during a small subset of the year's trading days, namely the seasonally anomalous periods. Ritter & Chopra (1989) and Cadsby (1992) show, for example, that the only periods where higher risk, as measured by the capital asset pricing model's beta, is rewarded with higher equity returns is precisely at the anomalous periods such as the trading day before holidays, at the end of the week, at the turn of the month, in the first two weeks of January for small stocks, etc. Event studies are more straightforward and less controversial as they are able to provide more clear-cut evidence of the effect of the new information. Regarding strong form tests there is considerable evidence that corporate insiders have private information that is not fully reflected in current prices.

In the study of anomalies several key questions must be considered.

1. What are the anomalies, and do they really exist as opposed to their being simply random data perturbations discovered because many data sets have been investigated simultaneously? See Merton (1985), Lo & MacKinlay (1990), Black (1986, 1992) and Markowitz (1992) for discussion of this point.
2. Why do they occur?
3. How reliable are they?
4. How can you tell when the conditions that led to the existence of the anomaly have changed so that the anomaly no longer exists and prices are completely random around some expected value?

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5. Is the anomaly in question anticipated or altered in the futures, options or other derivative security markets?

6. Can investors profit from such anomalies in a speculative sense?

7. Can investors use anomalies in an organized way in portfolio management to achieve superior risk-adjusted performance?

It is a large task to survey and discuss all the various anomalous areas, and our space is short. Hence we concentrate on one very important anomaly, namely the turn-of-the-month effect, and trace some of the results in worldwide markets. Along the way, evidence will be presented concerning questions 1–7. We refer the reader to the detailed survey papers mentioned above for specifics of further modelling, fundamental anomalies based on concepts such as price–earnings ratios, earnings surprise, etc., and other seasonal anomalies. The premier seasonal anomaly is the January small firm effect. It has been studied by many authors such as Banz (1981), Reinganum (1981), Blume & Stambaugh (1983), Keim (1983), Clark & Ziemba (1987), Jaffe, Keim & Westerfield (1989), Fama (1991), Prahl (1993) and Ziemba (1994*c*). Some of the turn-of-the-month discussion here will consider separately the unique month of January.

2. The turn-of-the-month effect in US equity markets

Investment advisors such as Fosback (1976) and Hirsh (1986) have argued that US stocks have substantial rises at the turn of the month. Ariel (1987) has documented the effect for small and large capitalization stocks for the 19 years from 1963 to 1981. His data consisted of the equal-weighted and value-weighted indices of all New York Stock Exchange (NYSE) stocks from the Center for Research on Security Prices (CRSP) tape. The turn of the month (TOM) is defined to be the last trading day of the previous month (-1) and the first four trading days of the new month ($+1$ to $+4$). Ariel's research showed there were very high returns during TOM. The rest of the market gains during 1963–1981 occurred in the second week of the month (days $+5$ to $+9$). The first half of the month (FH), namely trading days -1 to $+9$ or TOM plus the second week, had all the gains. The second half of the month (ROM, for the rest of the month), which is trading days $+10$ to -2, had negative returns. Hence, investment in the first half of the month provided more than all the year's stock market gains.

Lakonishok & Smidt (1988) investigated various seasonal anomalies using a 90 year data set on the Dow Jones Industrial Average (DJIA) from 1897 to 1986. The DJIA is a large capitalization price-weighted index of 30 major NYSE stocks. They found that the index rose 0.475% during the four-day period of -1 to $+3$ each month, whereas the average gain for a four-day period was 0.061%. The average gain per month over these 90 years was 0.349%. Hence, aside from these four days at the turn of the month, the DJIA had negative returns.

Ogden (1987, 1990) provides empirical support for the hypothesis about flow of funds into the stock market from cash flows and monetary action of agencies such as the Federal Reserve System. According to Moody's Manuals, 70% of the interest and principal payments on corporate debt (90% on municipal debt) are payable on the first or last days of the month. Furthermore, data in Standard & Poor's Stock Guide indicate that about 45% of dividends on common stock (65% on preferred stock) are payable on the first or last day of the month. The payable dates for interest, principal and dividend payments on corporate and municipal securities have been

consistently on these dates throughout the 20th Century. Ogden's research provides empirical support for the hypothesis that stock prices tend to rise at the beginning of months that are preceded by months in which aggregate, economy-wide liquid profits are large. In particular, year-end bonuses, large Christmas sales (which, according to Schwadel (1988), typically amount to 35% to 55% of annual retail sales) and other cash flows make December the highest economic activity month and seem to provide part of the reason for January's high returns during the FH and throughout the month for small stocks.

The following explanations for the turn-of-the-month effect have also been advanced: inventory adjustments of different traders (Ritter 1988); the timing of trades by informed and uninformed traders (Admati & Pfleiderer 1988) and specialists' strategies in response to informed traders (Admati & Pfleiderer 1989; Prahl 1993); seasonal tax-induced trading (Lakonishok & Smidt 1986); and window dressing induced by periodic evaluation of portfolio managers (Haugen & Lakonishok 1988; Ritter & Chopra 1989).

The issue of data mining discussed by the authors mentioned above is an important one to consider, especially because, even with strong seasonality effects, the average daily magnitudes of these anomalies are typically less than a two-way transactions cost, which is about 0.46% for NYSE stocks according to Berkowitz *et al.* (1988), or the typical bid-ask spread, which at an eighth is 0.31% of the average-priced \$40 NYSE stock.

Perhaps the best remedy against data snooping is new data and convincing reasons for the effects. The reasons for the turn-of-the-month effect are largely cash-flow and institutionally based. Another factor seems to be behavioural. For example, bad news such as that relating to earnings announcements is delayed and announced late in the month, whereas good news is released promptly at the beginning of the month (see Penman 1987).

To investigate this further, Hensel *et al.* (1993) used as a data set the daily closing prices of the Standard & Poor (S&P) 500 Stock Index for the 65-year period from February 1928 to June 1993. This data was supplied by Data Resources Incorporated. The S&P 500 is a value-weighted index of large capitalization US stocks. Since March 1957 this has consisted of the 500 largest stocks weighted by market value (price times number of shares outstanding). Before then it consisted of the 90 largest stocks. This index is called the S&P composite or S&P 500. Index futures contracts on the S&P 500 have been trading since 1982 on the Chicago Mercantile Exchange and futures options are traded at the Chicago Board of Trade. Hensel *et al.* (1994) have studied the turn-of-the-month and monthly return patterns of the S&P 500 and the Value Line Composite small stock index during the period of futures trading from 1982 to 1992. In the sequel we will discuss their results, particularly in light of question 5 on futures anticipation. The S&P 500 is an ideal index to study the turn-of-the-month effect because it has a large number of securities (500), is value-weighted (hence each security adds its true weight), is often used as a market portfolio, and is the most widely used passive portfolio benchmark to represent the US equity market in portfolio performance calculations and as an index portfolio. One weakness of this data set is the omission of dividends. Hence it is possible that there is a slight bias in some of the results that follow because of the unevenness of the dividend stream. However, we believe that this effect, if any, is minor, and does not change any of our conclusions.

Figure 1 shows the average return pattern by trading day. The average return on

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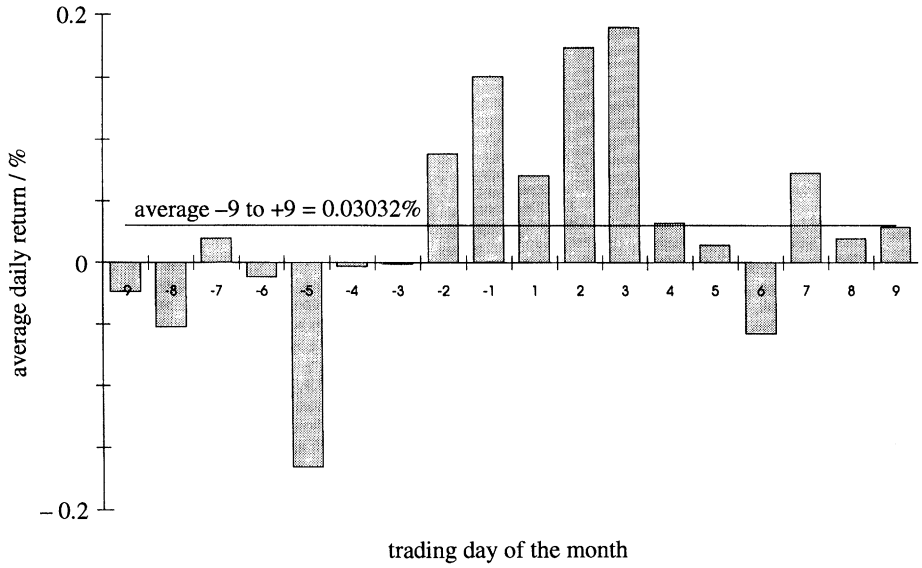

Figure 1. Average daily returns in the S & P 500 cash market by trading day of the month (February 1928 to June 1993). From Hensel *et al.* (1993).

trading days −9 to +9 over the 65-day sample was 0.0303 % per day. Days −9 to −1 are during the previous month and +1 to +9 during the current month. For example, day −6 of December is the day in November that is six trading days before the start of December. Significantly higher returns occurred on trading days −2 to +3. Hence, the bulk of the monthly returns occurred at the turn of the month.

Figure 1 suggests that all the monthly gains occurred in the FH. The ROM had negligible returns. The first row of table 1*a* details these mean returns by trading day of the month. The last three columns have the average daily returns in the −9 to +9 period, the TOM (−1 to +4), and the FM (−1 to +9). The mean daily returns over the 65 years were higher in TOM at 0.1236 % than in the period −9 to +9, at 0.0303 %, with FH having average daily returns of 0.0695 %. The first row of table 1*b* gives the *t*-values for the hypothesis that the mean daily returns on the various trading days −9 to +9 were above the mean of the −9 to +9 trading-day returns, which was 0.0303 % per day. Trading days −1, +2 and +3 had significantly higher returns than average. Trading days −2 and +1 had high average returns. All of the trading days from −9 to −3 had returns below average. Two of these (−8 and −5) were significantly negative.

Tables 1*a* and 1*b* present the mean returns and *t* statistics, respectively, for the hypothesis that the daily returns were greater than the −9 to +9 average by trading day of the month, by decade from the 1930s to the 1990s and by month. Trading days −1, +2 and +3 had significantly higher mean returns than average in most decades and for the entire 65-year period. Every decade had high returns on −1 and +2, and only in the 1980s were the returns on +3 negative. The latter may be the anticipation of the turn-of-the-month effect in the S & P 500 futures market and the associated index arbitrage; see figure 2 and table 2.

The futures market anticipates the TOM on days −4 to +2, and the index arbitrage keeps the ask prices close to the futures prices. Once the futures index moves on day −4 the expensive futures are sold and cash stocks are purchased for the index

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Table 1. (*a*) *Average daily returns in the S & P 500 cash market by decade and month for monthly trading days −9 to +9 (February 1928 to June 1993).* (*b*) *t-values for* (*a*) *and figure 1 for the hypothesis that the mean daily returns are greater than the overall mean for the same time period (for days −9 to +9) by trading day of the month for the S & P 500 cash market by decade and month (February 1928 to June 1993). From Hensel et al. (1993)*

Values significant at the 5% level (two tailed) are in bold. Months are tested against the −9 to +9 mean for the entire period. Specific periods are tested against the mean for the same period.

(*a*)

	−9	−8	−7	−6	−5	−4	−3	−2	−1	+1	+2	+3	+4	+5	+6	+7	+8	+9	−9 to +9	TOM	FH
1928–93	−0.02	−0.05	0.02	−0.01	−0.17	0.00	0.00	0.09	0.15	0.07	0.17	0.19	0.03	0.01	−0.06	0.07	0.02	0.03	0.03	0.12	0.07
1928–39	0.08	−0.21	0.12	−0.01	−0.44	−0.14	−0.19	0.08	0.10	−0.01	0.17	0.40	0.24	0.13	−0.25	0.18	0.16	0.07	0.03	0.18	0.12
1940–49	−0.12	−0.03	0.00	0.00	−0.07	−0.07	−0.02	0.25	0.16	0.09	0.21	0.19	−0.14	0.05	0.03	0.01	−0.16	−0.06	0.02	0.10	0.04
1950–59	0.03	−0.02	0.10	0.05	−0.17	0.11	0.10	0.08	0.16	0.20	0.30	0.18	0.02	0.01	−0.20	−0.02	0.06	0.05	0.06	0.17	0.08
1960–69	−0.08	−0.10	−0.04	−0.05	−0.20	−0.05	−0.03	0.07	0.15	0.04	0.14	0.13	0.10	0.02	0.02	0.11	0.02	0.02	0.01	0.11	0.07
1970–79	−0.12	−0.08	−0.03	−0.08	−0.03	0.00	0.08	−0.05	0.09	0.02	0.03	0.21	0.03	0.00	0.01	0.05	−0.01	0.00	0.01	0.07	0.04
1980–93	0.03	0.10	−0.03	0.00	−0.07	0.11	0.06	0.09	0.23	0.10	0.19	0.04	−0.06	−0.10	0.04	0.08	0.02	0.08	0.05	0.10	0.06

1928–1993	−9	−8	−7	−6	−5	−4	−3	−2	−1	+1	+2	+3	+4	+5	+6	+7	+8	+9	−9 to +9	TOM	FH
Jan.	−0.03	−0.15	0.10	0.13	−0.06	0.07	0.05	0.14	0.32	0.01	0.56	−0.01	0.19	−0.17	0.10	0.07	0.08	−0.10	0.07	0.21	0.10
Feb.	0.15	−0.13	−0.10	0.08	−0.28	−0.12	0.09	0.01	0.24	0.07	0.15	−0.16	0.07	−0.09	−0.26	0.12	0.00	0.00	−0.01	0.08	0.02
Mar.	−0.05	0.03	−0.03	−0.18	−0.21	0.00	−0.06	0.09	0.16	0.20	0.22	0.14	0.22	−0.04	−0.12	0.17	−0.10	−0.12	0.02	0.19	0.08
Apr.	0.19	−0.10	−0.04	−0.19	−0.22	0.03	−0.14	−0.13	−0.16	0.08	0.15	0.12	0.10	−0.06	−0.02	0.20	0.24	−0.06	0.00	0.05	0.06
May	−0.17	−0.11	0.04	−0.06	−0.11	0.08	−0.07	0.22	0.31	−0.03	0.20	0.32	0.04	0.25	−0.21	0.11	−0.19	0.04	0.04	0.17	0.08
June	−0.04	0.00	0.18	0.02	−0.21	0.01	−0.15	0.08	−0.04	−0.02	0.14	0.31	0.27	−0.02	−0.18	−0.07	0.16	0.15	0.03	0.13	0.07
July	−0.07	−0.10	−0.13	0.23	−0.17	0.14	−0.05	0.10	0.14	0.28	0.32	0.39	−0.01	0.02	0.21	0.08	−0.05	0.31	0.09	0.23	0.17
Aug.	0.03	0.05	0.14	0.07	−0.06	−0.05	−0.01	0.01	0.15	0.11	0.06	0.21	−0.19	0.13	0.03	0.22	−0.08	0.06	0.05	0.06	0.07
Sept.	−0.09	−0.01	0.24	−0.35	−0.25	−0.19	0.06	−0.22	0.25	−0.17	0.17	0.33	−0.09	−0.31	−0.32	0.11	0.02	−0.22	−0.05	0.10	−0.02
Oct.	−0.15	0.19	−0.11	−0.02	−0.49	−0.12	−0.10	0.30	0.00	0.06	0.26	0.18	−0.23	0.47	−0.07	−0.13	−0.26	0.40	0.01	0.04	0.06
Nov.	−0.03	−0.20	−0.14	0.15	0.02	0.00	−0.03	−0.07	0.21	0.25	−0.17	0.34	−0.06	−0.10	0.04	0.08	0.41	−0.05	0.04	0.11	0.09
Dec.	0.03	−0.13	0.13	−0.01	−0.03	0.10	0.33	0.52	0.27	−0.02	0.10	0.15	0.11	0.12	0.04	−0.09	−0.04	−0.09	0.08	0.12	0.06

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Table 1 (*cont.*)

(*b*)

	−9	−8	−7	−6	−5	−4	−3	−2	−1	+1	+2	+3	+4	+5	+6	+7	+8	+9	−9 to +9	TOM	FH
1928–93	−1.21	**−1.99**	−0.29	−0.12	**−4.82**	−0.86	−0.78	1.52	**3.31**	1.07	**3.66**	**4.04**	0.04	−0.38	**−2.42**	1.05	−0.27	−0.04	0.00	**5.15**	**3.00**
1928–39	0.26	−1.41	0.69	−0.21	**−3.11**	−1.02	−1.33	0.35	0.50	−0.29	0.86	**2.33**	1.08	0.59	−1.91	0.93	0.88	0.25	0.00	**2.10**	1.77
1940–49	−1.51	−0.74	−0.22	−0.25	−1.18	−0.97	−0.57	**3.07**	**2.22**	0.86	**2.52**	**2.52**	−1.88	0.37	0.12	−0.09	**−2.01**	−0.93	0.00	**2.57**	0.74
1950–59	−0.38	−1.15	0.65	−0.11	**2.50**	0.88	0.72	0.37	1.77	**2.18**	**4.46**	1.68	−0.72	−0.92	**−4.01**	−1.21	−0.04	−0.19	0.00	**4.21**	0.76
1960–69	**−2.07**	**−2.07**	−1.04	−1.13	**−3.88**	−1.14	−0.48	0.84	**2.21**	0.34	**2.00**	**2.28**	1.50	0.11	0.14	1.71	0.16	0.02	0.00	**3.34**	**2.75**
1970–79	**−1.63**	−1.05	−0.50	−1.20	−0.43	−0.12	0.88	−0.69	1.09	0.12	0.35	**2.38**	0.35	−0.11	0.10	0.52	−0.21	−0.12	0.00	1.67	1.28
1980–93	−0.24	0.48	−1.10	−0.69	−1.42	0.93	0.16	0.59	**2.53**	0.67	**2.06**	−0.10	−1.43	−2.01	−0.20	0.41	−0.47	0.38	0.00	1.40	0.47

1928–1993	−9	−8	−7	−6	−5	−4	−3	−2	−1	+1	+2	+3	+4	+5	+6	+7	+8	+9	−9 to +9	TOM	FH
Jan.	−0.59	−1.31	0.91	0.96	−0.59	0.34	0.08	1.06	**3.66**	−0.13	**3.33**	−0.39	0.86	−1.35	0.55	0.42	0.59	−1.09	1.28	**3.03**	1.78
Feb.	0.70	−1.66	−1.00	0.61	**−2.13**	−1.13	0.58	−0.12	**2.31**	0.40	1.26	−1.55	0.46	−1.19	**−2.44**	0.59	−0.20	−0.33	−1.26	1.02	−0.36
Mar.	−0.69	0.03	−0.62	−1.60	**−2.08**	−0.24	−0.63	0.45	1.49	1.85	1.58	1.01	0.73	−0.61	−1.10	1.30	−1.33	−1.22	−0.34	**2.04**	1.16
Apr.	0.81	−0.92	−0.63	**−2.48**	**−2.09**	0.05	−1.38	−1.23	−1.26	0.29	1.02	0.91	0.45	−0.74	−0.19	1.41	1.35	−0.70	−0.77	0.32	0.54
May	−1.48	−0.89	0.22	−0.82	−1.06	0.42	−0.44	1.57	1.80	−0.55	1.49	**2.70**	0.02	1.40	**−2.22**	0.74	**2.11**	−0.07	0.21	**2.34**	1.27
June	−0.68	−0.16	1.28	−0.14	−1.50	−0.16	−1.68	0.32	−0.43	−0.31	0.78	1.53	1.44	−0.60	−1.63	−0.60	0.93	0.71	0.04	1.89	0.97
July	−0.56	−0.74	−1.62	1.28	−1.22	0.75	−0.61	0.60	1.11	**2.11**	**2.55**	**2.83**	−0.33	−0.06	1.85	0.43	−0.80	**2.02**	1.71	**3.58**	**3.96**
Aug.	−0.02	0.12	0.87	0.36	−0.65	−0.70	−0.40	−0.26	**0.95**	0.69	0.21	1.04	−1.89	0.68	0.00	1.28	−0.91	0.26	0.43	0.61	0.74
Sept.	−0.48	−0.28	1.15	**−2.19**	−1.47	−1.58	0.24	−1.79	**2.04**	−1.24	0.98	1.53	−1.31	**−2.00**	**−3.18**	0.67	−0.08	−1.39	**−2.40**	1.12	−0.93
Oct.	−1.01	0.72	−0.80	−0.35	**−2.83**	−0.64	−0.58	1.17	−0.21	0.15	1.92	0.83	−1.21	1.85	−0.62	−0.92	−1.68	**2.18**	−0.62	0.18	0.62
Nov.	−0.36	−1.68	−1.27	0.89	−0.10	−0.18	−0.34	−0.84	1.17	1.48	−0.92	**2.07**	−0.46	−0.71	0.10	0.24	1.78	−0.61	0.21	1.17	1.08
Dec.	0.14	−1.35	1.02	−0.42	−0.51	0.55	**2.44**	**4.50**	**1.64**	−0.39	0.47	0.94	0.78	0.68	0.17	−0.88	−0.56	−1.45	**2.08**	1.51	0.66

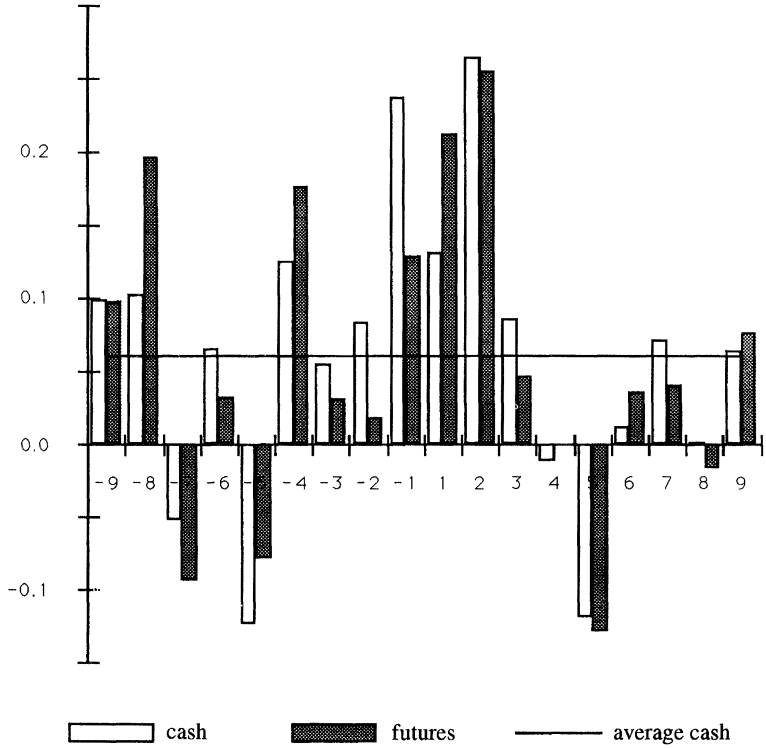

Figure 2. Average daily returns in percent in the cash and futures markets for the S & P 500 by trading day of the month (May 1982 to April 1993) (from Hensel *et al.* 1994).

arbitrage to lock in a nearly riskless profit and increase the level of the stock market. The higher mean returns during TOM and FH and the lower mean returns during ROM were partly an effect of a higher percentage of positive return days as well as a shifting of the conditional means on positive and negative return days. For example, in every decade from 1928 to 1993 the probability of a gain on any of the trading days -2 to $+3$ was always above 50%, and each of these days averaged above 55%. In contrast, trading days in ROM had positive returns on significantly less days which averaged less than 50%. The results are similar for the 65 year sample across months of the year. A table with detailed results appears in Hensel *et al.* (1993). Table 3, which separates the returns in TOM, FH and ROM by month, shows the results clearly. Every month had positive returns in TOM and nearly all had negative returns in ROM. The *t*-statistics for the hypothesis that the mean returns are greater than average appear in table 4. It is highly significant that the returns in TOM and the FH were above average and those in ROM below average.

There is in excess of $500 billion in equity portfolios indexed to various benchmarks of which by far the largest sum is keyed to the S & P 500. The reason for this is low transactions costs and management fees plus the fact that most managers fail to beat these indices; see Ziemba & Schwartz (1991) for some data across the world. Hence a useful strategy may be to invest in the S & P 500 during TOM or during the FH and be in cash the rest of the time. Table 5 shows the results of these strategies. Both of these strategies mean variance dominated the passive S & P 500 strategy during these 65 years. In particular the risk levels were much lower than those of the S & P 500 and small capitalized stocks.

Table 2. *Average daily returns (log values) in the cash and futures markets for the S & P 500 by trading day of the month, along with t-values for the hypothesis that the day's return differs from the mean return (May 1982 to April 1992). Significant values in bold. From Hensel et al. (1994)*

trading day	average S & P 500 cash daily return (%)	S & P 500 cash *t*-value	Average S & P 500 futures daily return (%)	S & P 500 futures *t*-value
−9	0.0992	0.43	0.0973	0.38
−8	0.1025	0.35	0.1959	0.76
−7	−0.0527	−1.28	−0.0932	−1.37
−6	0.0652	0.06	0.0317	−0.28
−5	−0.1239	−1.68	−0.0779	−1.12
−4	0.1246	0.83	0.1757	1.31
−3	0.0548	−0.08	0.0315	−0.31
−2	0.0838	0.27	0.0184	−0.39
−1	0.2361	**2.03**	0.1285	0.72
1	0.1309	0.79	0.2122	1.54
2	0.2637	**2.74**	0.2541	**2.18**
3	0.0852	0.27	0.0467	−0.10
4	−0.0123	−0.79	0.0000	−0.53
5	−0.1181	−1.95	−0.1276	−1.61
6	0.0124	−0.61	0.0354	−0.25
7	0.0716	0.13	0.0410	−0.16
8	0.0003	−0.69	−0.0163	−0.72
9	0.0647	0.05	0.0759	0.18
average −9 to 9	0.0604	—	0.0572	—

Table 3. *Average daily returns in the S & P 500 cash market by month, during* TOM, FH, ROM *and whole month (February 1928 to June 1993). From Hensel et al. (1993)*

S & P 500 index	TOM −1 to +4	FH −1 to +9	ROM +10 to −2	all days −1 to −1
Jan.	0.2061	0.1025	0.0359	0.0651
Feb.	0.0807	0.0170	−0.0214	−0.0024
Mar.	0.1876	0.0768	−0.0212	0.0208
Apr.	0.0503	0.0566	−0.0169	0.0161
May	0.1653	0.0819	−0.0836	−0.0107
June	0.1287	0.0669	0.0033	0.0315
July	0.2258	0.1697	−0.0050	0.0738
Aug.	0.0645	0.0672	0.0129	0.0364
Sept.	0.0976	−0.0175	−0.0978	−0.0605
Oct.	0.0445	0.0632	−0.0787	−0.1780
Nov.	0.1108	0.1038	−0.0821	0.0071
Dec.	0.1217	0.0564	0.0599	0.0584
all months	0.1236	0.0703	−0.0235	0.0186
all except Jan.	0.1162	0.0674	−0.0292	0.0143

The results in table 5 are suggestive. But the reader should note the following: (*a*) the S & P 500 results include dividends; (*b*) the small capitalized index includes dividends and is the value-weighted average of the bottom 20% of NYSE stocks; (*c*) the intermediate-term government bonds are total return for five to 10 year maturities; (*d*) the TOM and FH plus cash returns do not include dividends, hence the mean returns are biased lower by an amount that is probably greater than one might

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Table 4. *t-values for the hypothesis that the mean returns are greater than average in the S & P 500 cash market by month, during* TOM, FH, ROM *and whole month (1928–1993). From Hensel et al. (1993)*

S & P 500 index	TOM −1 to +4	FH −1 to +9	ROM +10 to −2	all days −1 to −1
Jan.	3.11	2.08	0.56	1.87
Feb.	1.31	−0.04	−0.96	−0.77
Mar.	2.61	1.41	−1.22	0.09
Apr.	0.57	0.93	−0.95	−0.09
May	2.84	1.65	−2.56	−1.04
June	1.55	1.02	−0.38	0.42
July	3.96	4.16	−0.59	2.00
Aug.	0.80	1.18	−0.15	0.65
Sept.	1.22	−0.77	−2.33	−2.29
Oct.	0.38	0.84	−1.62	−0.88
Nov.	1.20	1.53	−2.41	−0.33
Dec.	1.79	0.95	1.18	1.52
all months	5.94	4.13	−3.71	0.00
all except Jan.	5.28	3.54	−3.76	−0.47

Table 5. *Comparison of the* TOM *and* FH *plus cash strategies with S & P 500 small capitalized stocks and intermediate term government bonds (1928–1993). From Hensel et al. (1993)*

	yearly average returns (%)	yearly std. dev. of returns (%)
S & P 500	9.5	20.1
Sm. Cap stocks	11.5	30.1
It Gov. bonds	5.1	4.4
TOM (−1 to +4)+0.8 cash	10.1	8.8
FH (−1 to +9)+0.6 cash	11.1	12.6

expect to spend on transactions costs and by market impact using futures trading to implement these strategies.

3. The turn-of-the-month effect in worldwide equity markets

The turn-of-the-month effect seems to occur in most large equity markets around the world. Ziemba (1989, 1991; see also the detailed summary in Ziemba & Schwartz 1991) studied the effect in Japan. By using data on the Nikkei 225 Index for the years 1949–1988, he found that the turn of the month is similar in Japan except that the dates change, with the turn being −5 to +2 and with +3 to +7 being the rest of the first half of the month. All the days −5 to +2 had significantly positive returns, as shown in table 6. The FH trading days −5 to +7 had mean returns of 0.011 42% per day against 0.000 93 for the ROM days +8 to −4. Hence, essentially all the gains were in the FH.

The reasons for the effect in Japan during this period were as follows and added credence to the existence of the effect.

(i) Most salaries were paid between the 20th and the 25th of the month, with the 25th being especially popular.

(ii) There was portfolio window dressing on day −1.

(iii) Security firms could invest for their own accounts based on their capitalization. Since their capitalization usually rose each month and was computed at

Table 6. *Mean returns (%) on the* NSA *by trading day of the month 1949–1988. From Ziemba (1991)*

trading day	sample size	mean return (%)	*t*-statistic	trading day	sample size	mean return (%)	*t*-statistic
−5	471	0.0899	2.75	10	471	0.062	1.58
−4	471	0.1041	2.65	11	471	0.0395	1.05
−3	471	0.1733	3.82	12	471	−0.0196	−0.50
−2	471	0.1334	3.18	13	471	0.0115	0.24
−1	471	0.2255	5.36	14	471	−0.0042	−0.10
1	471	0.0980	2.43	15	471	−0.0306	−0.54
2	471	0.1006	2.47	16	471	0.0716	1.35
3	471	0.0307	0.72	17	471	−0.0498	−1.20
4	471	0.0592	1.15	18	429	−0.0207	−0.49
5	471	0.0358	0.81	19	350	0.0162	0.36
6	471	−0.0005	−0.01	20	229	−0.0286	−0.48
7	471	0.0357	0.09	21	118	−0.0476	−0.46
8	471	−0.0585	−1.34	22	39	0.0562	0.45
9	471	0.1065	2.46				

the end of the month, there was buying on day −3 to account for this. Buying was done as soon as possible.

(iv) Large brokerage firms had a sales push that lasted 7–10 days starting on day −3.

(v) Employment stock-holding plans and mutual funds received money to invest in this period starting around day −3.

(vi) Individual investors buy mutual funds with their pay, which they receive on calendar days 15th–25th of the month; the funds were then invested in stocks with a lag, so most of the buying occurred on days −5 to +2.

(vii) For low liquidity stocks, buying occurred over several days by dealing in accounts to minimize price-pressure effects.

Ziemba (1989) investigated the futures market trading outside Japan on the SIMEX in Singapore during the turn of the month and examined other anomalous effects in Japanese security markets during the period of September 1986 to September 1988 before there was futures trading on the NSA or TOPIX in Japan. The results were that the spot effect was consistent with past data, so the futures market did not alter the effect.

However, the futures market in Singapore totally anticipated the effect on days −8 to −5 with a total average rise of 2.8%; see figure 3. Then, when the effect occurred on days −5 to +2 and the spot market gained 1.7%, the futures market was flat.

The turn-of-the-month effect existed and was strong in Japan from 1949 to 1988. However, the extreme decline in the Japanese stock market of over 60% from January 1990 to August 1992 so shook investor confidence that there was no confidence in equity investments. Hence, one would not expect that the usual cash flows would enter the market in the usual way to generate the TOM and FH high returns. Indeed this was the case, and returns during these periods were not higher than average during 1990–1993. See Bell & Ziemba (1994) for an analysis of Japanese anomalies during 1990–1993 and Stone & Ziemba (1993) for an analysis of this period in Japanese economic history.

Cadsby & Ratner (1991) investigated turn-of-the-month and holiday effects in the US, Canada, the UK, Australia, Switzerland, West Germany, Japan, Hong Kong,

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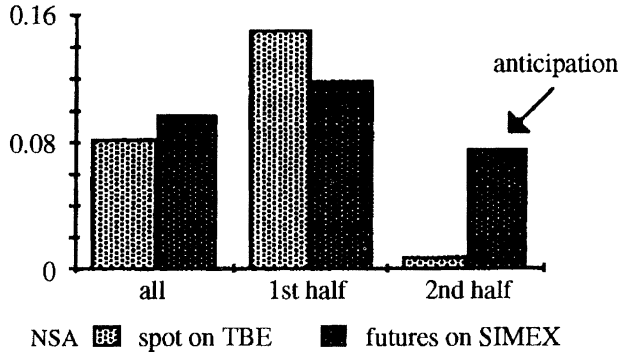

Figure 3. Daily rates of return in percent in the first and second halves of the month in Japan. Cash data, futures market effects September 1986 to September 1988 (from Ziemba 1989).

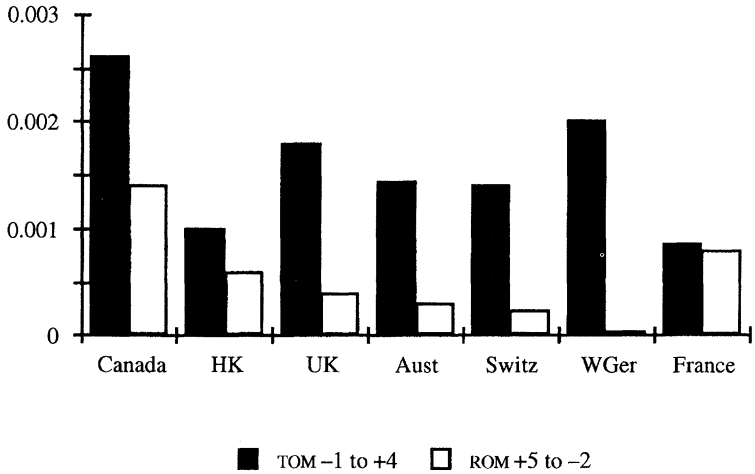

Figure 4. International TOM effects. Daily rates of return in percent for Canada (1/75–12/87), Hong Kong (1/80–1/89), U.K. (8/83–6/88), Australia, Switzerland, West Germany and France (all 1/80–8/89) (from Cadsby & Ratner 1991).

Italy and France. Their use of -1 to $+4$ as the turn of the month in all these countries makes their results hard to interpret since there may be cash flow and institutional constraint date alterations as in Japan. Still they found a significant turn-of-the-month effect in most countries, as shown in figure 4. A good example of a significant turn-of-the-month effect with different dates is that in Italy. The month there essentially starts on the 15th (approximately) and all trades from then up to the following 14th are settled on the last trading date of that calendar month. This system leads to high returns from the 15th to the end of that calendar month and low or negative returns from the $+1$ day to the 14th; see Barone (1990). Not suprisingly, Italy has not had high returns on days -1 to $+4$ and does not appear in figure 4.

4. Concluding remarks

The turn-of-the-month effect seems to be a worldwide phenomenon. The paper by Martikainen *et al.* (1994), although it only considers the brief period from January 1988 to January 1990, shows this with various indices for a variety of regions of the

world. They also found that returns on individual days during TOM, especially −1, were high. The latter averaged 0.41 % per day over 24 countries with a t value of 3.89 and was the only trading day with a mean return different from zero.

The TOM, FH and ROM results are useful for traders and portfolio managers. However, points 1–7 mentioned earlier in this paper must always be considered. One of us (W. T. Ziemba) has used such ideas in several investment accounts with some success. Although there was co-mingling of various anomalous ideas such as those discussed in Ziemba (1994*b*), the ideas discussed here were useful inputs to a diversified strategy that returned 27.0 % per year net of all costs for the 77 months from October 1987 to February 1994, with a yearly standard deviation of 8.0 % during 1991–1994.

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