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Calendar Anomalies: The Case of International Property Shares

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Abstract In this paper we analyze the price dynamics of international property shares for the ten most prominent markets from around the world plus South-Africa. We focus on the presence of calendar effects in daily and monthly price returns and examine these effects both over time and across countries. For the daily returns we find price anomalies for Fridays and Mondays in all markets. Friday returns tend to be the highest of the week, while Mondays are weakest. We find that these patterns were most prominent during the 1980s and early 1990s and in the smaller markets in our sample. For the monthly returns we found little evidence for price irregularities. In most cases January was superior to most other months, but these differences lacked statistical significance. More interesting was the sell in May effect that seemed to be present in ten out of 11 markets. Price returns during the winter season outperformed the summer months and in five countries these difference were both economically and statistically significant. Finally, we looked at firm level returns to isolate the drivers of these infamous calendar effects. The day-of-the-week effect appears to be most pronounced among small and young firms that have little or no institutional investors. Large and long-established listed real estate firms with a large portion of loyal block-holders experience no significant price patterns during the trading week.

Keywords Real estate stocks · Calendar anomalies · Sell in May effect

Introduction

Price anomalies have been intriguing both financial professionals and academics for many years. Academics like to think that asset pricing models have matured sufficiently in that they enable those who use them to price assets according to the

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risks that are being modeled. However, at the same time we continuously observe price behavior that cannot be attributed to the drivers identified in these theoretical frameworks. These repeating price irregularities, anomalies, create puzzles that are in need of a solution, or at least an explanation. Most prominent in this respect are the calendar effects, and more specifically the-day-of-the-week effect, the January effect, and the Halloween effect. For decades various empirical studies have documented remarkable strong stock price performance on Fridays, during January, and during the winter months. Various explanations, ranging from seasonal sentiments to tax-related trading patterns, have been put forward to explain these findings. However, conclusive evidence for what is driving these anomalies is still lacking at a time when recent studies in the mainstream finance literature show that some of these anomalies have even disappeared or been reversed.[1] Hence, it is time to investigate both whether these price anomalies still prevail today, how they have evolved over time, and what factors are causing them. In this study we focus on international listed property markets, because they grant us the rare opportunity to isolate the effects of differing tax regimes, and offer a variety in market size and maturity, which might help us explain the cross-section of anomalous price behavior.

For property shares the issue has been analyzed before by several authors[2]. However, so far the vast majority of these analyses has been limited to US REITs and has not considered potential time variations in price irregularities. Hence, we will study daily price returns of all real estate shares traded on the ten most prominent financial markets in the world: USA, Japan, Hong Kong, UK, Australia, France, Singapore, Canada, The Netherlands, and Austria. In order to explicitly analyze small firms in a young market we also include South Africa into our sample. We analyze a period that dates back to 1987, which enables us to explicitly focus on time variations. For this study we employ the unique GPR General Quoted Database, which offers us complete market coverage free of survivorship bias.

Overall, we find results that vary across countries and over time. Regarding the day-of-the-week effect we find daily returns that are typically highest on Fridays and weakest during Mondays. However, for the largest markets and firms we find that these patterns weakened over time and ran out of significance since the late 1990s. For smaller markets, like South-Africa, Austria, and The Netherlands the Friday effect seemed to strengthen over time. With respect to monthly price patterns we find January to perform better than other months in most countries, but this difference lacks statistical strength and weakened over time. More pervasive was the Sell in May effect that appears to be present in most markets. Price returns during the winter season outperformed the summer months and in five countries this difference is both economically and statistically significant. Finally, we looked at firm level returns to isolate the drivers of the infamous calendar effects. Both the day-of-the-week effect

[1] Dimson and Marsh (1999) reveal that the historical size premium of 6 percent has reversed into a 6 percent discount in the UK and Kamara (1997), Brusa et al. (2000), and Mehdian and Perry (2001) have documented the disappearance of the traditional negative returns on Monday in the USA while Steeley (2001) reports similar findings for the UK stock market.

[2] See Colwell and Park (1990), McIntosh et al. (1991) for empirical analysis of the size effect in REITs and Friday and Peterson (1997), Redman et al. (1997), Friday and Higgins (2000), and Hardin et al. (2005) for a proof of calendar anomalies in REIT prices.

and the January effect appear to be most pronounced among small and young firms that have little or no institutional investors holding their shares. Large and long-established listed real estate firms with a large portion of loyal block-holders experience no significant price patterns during the trading week or across months. For the sell-in-May effect we find no explanation that is related to firm specific characteristics.

The remainder of this paper continues as follows. After an overview of relevant literature we discuss our data and the methodological methods that will be applied in the subsequent analysis. We first discuss our findings regarding the day-of-the-week effect, before focusing on the monthly price patterns. We finish by summarizing our main conclusions.

Literature Review

The literature on calendar anomalies is vast and dates back many decades. Most of the research on anomalies in stock markets has concentrated on the day-of-the-week effect, which is sometime also referred to as the weekend effect, and the January effect, which also referred to as the turn-of-the-year effect. Cross (1973) and Rozeff and Kinney (1976) were the first researchers who exhaustively investigated these two price irregularities, which contradict the efficient market hypothesis. However, in the meanwhile several other researchers provided evidence that these anomalies have either disappeared or even reversed.[3] To offer a clear understanding of these calendar anomalies and the research from both the mainstream and real estate finance literature we organize a brief overview for both anomalies, separately.

The Day-of-the-Week Effect

During the first half of the twentieth century, financial economists generally assumed that the distribution of stock returns was equal for all trading days of the week. However, in the second half of last century many researchers examined the daily distribution of stock returns to discover non-random movements in stock prices. The assertion that certain days of the week are subject to above-average price changes in market indices is called the day-of-the-week effect. This anomaly has been investigated since the 1930s (Kelly 1930) and has been researched intensively ever since. Due to different research methods and sample periods, there is a mixture of evidence about the existence of the day-of-the-week effect.

The relation between common stock prices on Fridays and subsequent Mondays has been analyzed by Cross (1973) for the period 1953 to 1970. By examining the daily returns of the S&P500, he reports findings which contradict the Efficient Market Hypothesis of Fama (1970). During his sample period Cross reported that of all Mondays, the S&P500 rose 333 times (39.5%), while during Fridays stock prices rose as often as 523 times (62.0%). For the majority of years he documented a significant difference in the distribution of price changes on Mondays and Fridays.

[3] See for instance Gu (2003) and Kohers et al. (2004).

Gibbons and Hess (1981) documented strong and persistent negative returns on Mondays and confirmed the results of Cross (1973) by using both the equally weighted and value-weighted market return indices constructed by the Center for Research in Security Prices (CRSP) and the S&P500 over the period 1962 to1978. The weekday effect still remained when they adjusted for the market weights, although the evidence was not as convincing as with the equally weighted returns. Until 1985 the day-of-the-week effect has been primarily explored in the USA. Jaffe and Westerfield (1985) were the first to perform a large-scale investigation into this calendar anomaly outside the USA. They examined daily stock market returns from Japan, Canada, the UK, Australia and the USA for differing periods. All periods end in 1983 but vary from 7 years for Canada (1976–1983) to 33 years for the UK (1950–1983). Like the USA, the other four countries also seem to have daily return patterns in common stock, although these differ from the US pattern. The US, Canada and the UK markets were associated with negative average returns on Mondays and significantly higher average returns on Fridays. In Japan and Australia, Tuesday returns were strongly negative and while their 'time-zone' theory explains some of the Australian results, this did not apply to Japan. More recent studies document the disappearance of the significant negative Monday returns. Kohers et al. (2004) have investigated whether improvements in market efficiency may have caused the day of the week effect to fade away over time. By examining the daily returns for 11 of the largest equity markets over for the period 1980 to 2002, they gain an improved insight into this anomaly. To prevent a distorted view, the data were broken down into several smaller sub-periods ranging from four to 11 years. The results indicate that in the vast majority of developed markets the day of the week effect was observed during the 1980s. However, with the exception of Japan, they conclude that due to improved market efficiency over time, this effect appears to have vanished from the 1990s onwards.

The returns of Real Estate Investment Trusts (REITs) were first examined for evidence of the day-of-the-week effect by Redman et al. 1997. For the period 1986 to 1993 they documented both significant negative returns on Mondays and a gradual increase in the returns as the week progresses, with the highest returns occurring on Friday. Although the returns on Mondays for the common stock portfolios are the lowest of the week too, the patterns are different from the REIT returns. Given the similarities between the equally weighted portfolio and the REIT index they conclude that the-day-of-the-week effect seems to be most prominent among small firms. Friday and Higgins (2000) examined the pattern of REIT returns around the weekend from 1970 to 1995 and also reported the average return on Mondays to be negative. To find out whether returns on certain days are dependent on other days, they looked at autocorrelations between pairs of days. Their results corroborate with the findings of Cross (1973) on common stocks; returns on Mondays were positive when returns on the preceding Friday were positive and returns on Monday were negative when returns on the preceding Friday were negative. The relation between Monday returns of REITs and the changes in REIT structures in the late 1980s is investigated by Chan et al. (2005). The two major changes in REIT industry were the switching away from the use of external advisors and the shift towards more operating-oriented companies. By looking at the Monday returns from 1981 through 1999 they found that from the early 1990s the Monday

seasonal pattern has started to fade away and completely disappeared by the late 1990s. The disappearance of the lower and negative returns on Mondays coincides with an increase in the number of institutional investors in the REIT market. They also find that the level of institutional holdings affects Monday returns only for REITs that went public in the 1990s. Finally, in a recent by study Lenkkeri et al. (2006) the-day-of-the-week effect is examined for securitized real estate indices of 11 individual European countries for the period 1990 to 2003. Instead of the earlier reported Monday anomaly, Lenkkeri et al. (2006) document a different pattern in the price behavior of real estate shares. In 8 of the 11 countries as well as for the two Pan-European indices they find significant higher returns on Friday. These remarkable results fit to the results found by Chan et al. (2005) and bring the debate on the day of the week anomaly back to life.

The January Effect

In 1919 the Harvard Committee on Economic Research reported a comprehensive study of stock prices from 1897 to 1914 that revealed no evidence of seasonal tendencies. Research in later years documented that rates of return were not equal for all months, and particularly January returns were deviating from returns in other months. This anomaly therefore is called the January effect. The first comprehensive study on seasonality in stock returns in the month of January has been performed by Rozeff and Kinney (1976). Using data from the New York Stock Exchange for the period 1904 to 1974, they observe that stock returns for January are significantly higher than for the other 11 months. One of the explanations they suggest is the hypothesis that there is considerable tax-loss selling by investors towards the end of the year. Research by Keim (1983) shows that from 1963 to 1979 the high January returns are concentrated within a narrow window that extends from the last trading day in December to the first few days in January of the following year. Furthermore, he also found that the January effect is most pronounced among small firms. Gultekin and Gultekin (1983) investigated monthly stock returns of 18 major industrialized countries over a period 1959 to 1979. For 12 of these countries they documented significant differences in the January mean returns, which were remarkably high. Additional research on the tax-loss selling hypothesis indicates a relation between the January effect and the turn of the tax year, but the evidence is not satisfactory. A decline of the January effect has been stated by Gu (2003), who used over 70 years of monthly return data from the major US stock indices. Although the existence of the January effect is generally confirmed, the effect seems to fade away since 1988. In contrast to earlier studies, this study shows that the January effect is most pronounced in large firm stock indices which may indicate that this anomaly is not related to the size of a firm.

The first study on the existence of the January effect in the returns of real estate related stocks was by Colwell and Park (1990), who constructed an equally weighted return index based on monthly CRSP data for the period from 1964 through 1986 to examine whether the January effect was also present in the REIT market. The main conclusion of their research is that the average rate of return on REITs is highest in January, but this is more apparent among small REITs. Similar research with comparable results was performed by Friday and Peterson (1997) for US REITs over

the period 1974 to 1993. In this study the authors find evidence, which indicates that the January effect is caused by tax-loss selling and not by information-related explanations. More recently, Hardin et al. (2005) re-examined the January effect in US REITs after the changes in REIT structure. Over a period of 8 years, from 1994 through 2002, they constructed equally and value-weighted daily return indices from CRSP data. The results from these two indices are contradictory. While the results from the equally weighted index confirm the results found by Friday and Peterson (1997), results based on the value-weighted index do not, again indicating that if tax-loss selling is explaining our results it is most common among the smaller firms in the market.

The Halloween Indicator

Finally, we will be examining one last price anomaly, which was first documented in popular press when on May 30, 1964 the Financial Times stated "The stock exchange world is in a sort of twilight state at the moment. The potential buyers seem to have "sold in May and gone away"....This saying refers to a stock market slump that starts in May and continues over summer. Often the saying continues with: "But remember, come back in September", indicating that after summer stock returns typically strengthen again until next May. O'Higgins and Downes (1990) were first to simulate investment strategies that were based on these seasonal patterns, which they referred to as the Halloween indicator, because it would have you in the stock market starting October 31 (Halloween) through April 30 and out of the market for the other half of the year. More recently, Bouman and Jacobsen (2002) tested this Halloween indicator internationally over time spans that dated as far back as 1694 and found this Sell in May effect in 36 out of 37 countries. This calendar anomaly is typically explained by market trading seasonality, which is thin during summer when many investors take their holidays and builds up as soon as summer break is over. Kamstra et al. (2003) and Garrett et al. (2005) attribute this seasonal return pattern to a time-varying equity premium influenced by the seasonal affective disorder (SAD) effect, the so-called winter depression. During the shorter days in the fall and winter SAD symptoms (sadness and fatigue) strengthen. Evidence taken form psychological literature shows that depression lowers one's willingness to take risk, resulting in a higher risk premium. Until today, however, this Sell in May effect has not been analyzed for listed real estate investments, hence we will include it into our research.

Data and Methodology

Table 1 presents the total aggregate market value and the mean market value of firms at the year-end of 2006. One can see that the US market is the largest in aggregate terms, while the mean market value of individual firms is not. Property firms listed on the Hong Kong exchange turn out to be the largest in size, on average, while at the same time we can see that South-Africa is the smallest and least developed listed real estate market in our sample. For the remainder of our paper we discuss results in the order of market size, starting with the largest market and finishing with South-Africa.

Table 1 Sample statistics

Country	Total market value (year-end 2006; bn)	Mean market value (year-end 2006; bn)	Average annual return (1987–2007; %)	Average risk (1987–2007; %)
USA	385.17	3.00	12.33	15.01
Japan	132.31	2.49	6.56	28.32
Hong Kong	126.23	4.85	22.37	37.67
UK	113.57	2.06	13.52	19.38
Australia	105.66	2.35	16.81	12.16
France	67.61	2.60	11.05	13.12
Singapore	47.11	2.14	21.91	36.97
Canada	37.61	1.30	−1.11	22.13
The Netherlands	32.34	3.59	8.80	22.13
Austria	23.99	2.99	5.52	7.23
South-Africa	8.95	0.45	32.03	18.37

This presents the market values of both the individual firms and the aggregated national listed real estate markets. Values are stated in billion US dollars at year-end of 2006. The return and risk statistics are annualized and relate to total returns series for the period 1987–2007 and are in local currencies

Furthermore, we can see from Table 1 that returns and risks of listed real estate have varied greatly across the globe since 1987. The Austrian property stocks have offered the lowest and most stable returns over our sample period, while returns and risks have been remarkably volatile in the Asian markets.

In order to gain further insights on the daily behavior of these real estate index returns we perform regression analyses. Following, e.g., Abraham and Ikenberry (1994) and Friday and Higgins (2000), and Lenkkeri et al. (2006) we correct for first-order autocorrelation in daily returns by including a lagged return. The analysis is conducted employing dummy variables; Monday_t, Tuesday_t, Wednesday_t, Thursday_t and Friday_t representing the days of the week. Since we include all five weekdays as dummy variables, we omit the constant term. Thus, the following regression model is used to examine possible day-of-the-week effects:

$$\mathrm{R_t} = \alpha_1 \mathrm{Mon_t} + \alpha_2 \mathrm{Tue_t} + \alpha_3 \mathrm{Wed_t} + \alpha_4 \mathrm{Thu_t} + \alpha_5 \mathrm{Fri_t} + \alpha_6 \mathrm{R_{t-1}} + \varepsilon_t \qquad (1)$$

where R_t is the daily return at time t for the real estate index, Monday_t through Friday_t are the Monday through Friday dummy variables, and ε_t is a random error term. Finally, all estimates are made using OLS, applying White's (1980) heteroskedasticity consistent standard errors. Resulting test statistics are asymptotically appropriate, whether or not the excess returns have a constant variance or are normally distributed.

In a similar fashion we examine the monthly price returns by using the following regression model:

$$\begin{aligned}\mathrm{R_t} = {} & \mathrm{C} + \alpha_1 \mathrm{Feb_t} + \alpha_2 \mathrm{Mar_t} + \alpha_3 \mathrm{Apr_t} + \alpha_4 \mathrm{May_t} + \alpha_5 \mathrm{Jun_t} + \alpha_6 \mathrm{Jul_t} + \alpha_7 \mathrm{Aug_t} \\ & + \alpha_8 \mathrm{Sep_t} + \alpha_9 \mathrm{Oct_t} + \alpha_{10} \mathrm{Nov_t} + \alpha_{11} \mathrm{Dec_t} + \alpha_{12} \mathrm{R_{t-1}} + \varepsilon_t \qquad (2)\end{aligned}$$

here R_t is the monthly return at time t for the real estate index, C is a constant, Feb_t through Dec_t are the February through December dummy variables, and ε_t is a random error term. Here we omitted January in order to facilitate the direct

comparison between January and the other months of the year. Again, all estimates are made using OLS, applying White's (1980) heteroskedasticity consistent standard errors.

Finally, we will test for the existence of a sell in May effect, using the usual regression techniques and by incorporating a seasonal dummy variable S_t in the regression:

$$R_t = \mu + \alpha_1 S_t + \varepsilon_t \quad (3)$$

where μ is a constant and ε_t the usual error term. In the absence of the dummy variable this equation is reduced to the well-known random walk model. The dummy takes the value 1 if months fall on the period November through April and 0 otherwise.[4] We test whether the coefficient of S_t is significantly different from zero. When α_1 is significant and positive, this reject the null hypothesis of no sell in May effect.

The Day-of-the-Week Effect

When trying to identify anomalies in returns among the days of the week, we first have a look at the *F*-statistics that are reported in Table 2. Here the *F*-statistic corresponds to the hypothesis that all coefficients of the day of the week are zero simultaneously. For the equally weighted index 8 countries out of 11 show a significant *F*-statistic at 5% level. Thus, in these cases the statistics suggest a significant weekly seasonal in the return distribution. The next step will be to find out if these anomalies are specific to a certain day.

To examine the 'day of the week' anomalies we need to have a look at the markets and their values. In the equally weighted index all companies are considered to have the same influence on the total market value. This, therefore, does not discriminate between sizes of the companies, a factor we previously identified to have an effect on the anomalies we are researching. Alternatively, the value-weighed indices do discriminate for size. If there will be a significant difference between the outcomes of the analysis for both indexes, we can conclude that our assumption that size affects the 'day of the week' anomaly, is confirmed.

When we look at the equally weighted index we can see that 9 out of 11 countries experienced positive Friday returns. These returns are all significant, and we do not detect a clear trend when looking a sub periods. For the two countries that have insignificant results, the USA and The Netherlands, we also take a closer look at the data for the sub periods. For the USA we can see that the early period (1987–1996) shows significantly positive Friday returns. In the case of The Netherlands, the later sub period (1997–2007) shows positive Friday returns. When we have a first look at results based on the value-weighed indices, we can draw very similar conclusions. There are, again, 9 out of 11 countries which have positive Friday returns. However, the USA is now one of the nine countries with a significant value. For Australia we now find Friday returns to be insignificant. The same holds for The Netherlands,

[4] Summer seasons vary across the globe. We therefore define summer and winter locally and focus on the main holiday brake as summer season.

turning it insignificant for both types of indices. Nevertheless, our results offer proof that in most countries there is a positive Friday effect.

Under the equally weighted index the Monday returns indicate negative Monday returns in 8 out of 11 countries. However, for only three countries these results are significant. Moreover, for France and Australia we even document significantly positive Monday returns. When focusing on the value weighted index results we find no significantly negative Monday returns. All in all, our results so far tell us that for

Table 2 Day of the week effect for daily price returns (1987–2007)

	Monday	Tuesday	Wednesday	Thursday	Friday	R_{t-1}	F-stat
USA							
Equally weighted	−0.016	0.028	0.036	0.021	0.086	0.128	3.460
	−0.77	1.59	2.11**	1.19	4.77***	3.72***	0.01***
1997–2007	0.002	0.049	0.019	0.010	0.092	0.128	1.435
	0.07	1.64	0.69	0.35**	2.98***	4.43***	0.22
1987–1996	−0.046	−0.002	0.055	0.031	0.080	0.122	3.901
	−1.96*	−0.07	2.41**	1.33	3.75***	1.60	0.00***
Value-weighted	0.003	0.024	0.032	0.028	0.077	0.134	1.223
	0.16	1.36	1.77*	1.52	4.26***	9.83	0.30
Japan							
Equally weighted	−0.031	0.021	0.047	0.019	0.086	0.193	1.061
	−0.74	0.53	1.15	0.48	2.07**	13.495***	0.37
1997–2007	0.049	0.045	0.055	0.019	0.034	0.183	0.065
	0.85	0.80	0.99	0.34	0.58	9.075***	0.99
1987–1996	−0.111	−0.001	0.037	0.019	0.142	0.204	2.288
	−1.865*	−0.06	0.63	0.32	2.36**	10.015***	0.06**
Value-weighted	−0.026	0.011	0.031	0.016	0.044	0.101	1.352
	−1.17	0.49	1.40	0.70	1.99**	7.415***	0.25
Hong Kong							
1987–2007	−0.071	0.067	0.132	−0.069	0.185	0.097	4.304
	−0.81	1.43	2.61***	−1.32	3.75***	3.35***	0.00***
1997–2007	0.064	−0.075	0.043	−0.077	0.173	0.169	2.256
	0.69	−1.14	0.56	−1.03	2.49**	4.11***	0.06*
1987–1996	−0.199	0.226	0.227	−0.063	0.185	0.040	4.313
	−1.37	3.23***	3.44***	−0.86	2.68***	1.22	0.00***
Value-weighted	−0.040	0.073	0.159	−0.027	0.202	0.071	3.083
	−0.65	1.18	2.58***	−0.44	3.28***	5.18***	0.02**
UK							
1987–2007	−0.006	0.033	0.026	0.047	0.090	0.211	2.675
	−0.21	1.55	1.21	2.46**	4.82***	4.07***	0.03**
1997–2007	0.046	0.022	−0.006	0.043	0.136	0.186	6.179
	1.96**	0.93	−0.24	1.91*	6.55***	4.36***	0.00***
1987–1996	−0.058	0.044	0.060	0.054	0.046	0.221	1.293
	−1.27	1.25	1.64	1.77	1.45	3.15***	0.27
Value-weighted	−0.031	0.067	0.081	0.016	0.093	0.112	3.206
	−1.04	2.33**	2.61***	0.57	3.42***	3.68***	0.01**
Australia							
1987–2007	−0.086	0.052	0.110	0.045	0.080	0.004	5.013
	−2.61***	1.43	2.92***	1.60	2.69***	0.11	0.00***
1997–2007	−0.042	0.081	0.101	0.067	0.064	−0.033	2.709
	−1.21	2.61***	3.00***	2.16**	2.16**	−0.88	0.03**
1987–1996	−0.131	0.025	0.122	0.023	0.096	0.016	2.785
	−2.26**	0.37	1.77	0.48	1.84*	0.33	0.03**
Value-weighted	−0.048	0.088	0.054	0.073	0.035	0.025	3.979
	−1.81*	2.82***	1.92*	2.90***	1.37	0.57	0.00***

Table 2 (continued)

	Monday	Tuesday	Wednesday	Thursday	Friday	R_{t-1}	F-stat
France							
Equally weighted	0.052	0.065	0.033	0.056	0.106	−0.031	1.571
	2.17**	2.78***	1.55	2.69***	4.87***	−1.82*	0.18
1997–2007	0.100	0.095	0.086	0.093	0.173	−0.026	1.480
	3.44***	2.67**	3.27***	3.30***	5.76***	−1.47	0.21
1987–1996	0.001	0.033	−0.023	0.015	0.031	−0.044	0.522
	0.001	1.10	–0.71	0.51	0.99	−1.57	0.72
Value-weighted	0.019	0.032	0.042	0.068	0.120	−0.041	3.037
	0.79	1.40	1.83*	3.15***	5.28***	−2.02**	0.02**
Singapore							
Equally weighted	−0.186	0.057	0.132	0.094	0.159	0.161	4.378
	−2.59**	1.08	2.41***	1.65	3.17***	4.20***	0.00***
1997–2007	−0.212	0.071	0.130	0.032	0.133	0.142	1.879
	1.86*	0.90	1.52	0.38	1.78	3.21***	0.11
1987–1996	−0.157	0.039	0.130	0.154	0.185	0.189	3.031
	−1.83***	0.58	1.93*	1.93*	2.81***	2.77**	0.02**
Value-weighted	−0.096	0.079	0.116	0.157	0.150	0.111	2.273
	−1.30	1.33	2.02**	2.51**	2.84***	3.24***	0.06*
Canada							
Equally weighted	0.017	0.036	0.066	0.082	0.215	−0.114	2.174
	0.30	0.67	1.02	1.33	4.10**	−3.21**	0.07*
1997–2007	0.074	0.036	0.061	0.077	0.179	−0.172	1.391
	1.47	0.79	1.15	1.52	3.99***	−4.32	0.23
1987–1996	−0.040	0.037	0.132	0.174	0.230	−0.106	1.297
	−0.41	0.39	1.39	2.05**	2.52**	−2.63**	0.27
Value-weighted	0.075	0.003	0.034	0.038	0.087	−0.071	3.209
	1.72	0.17	1.41	2.07**	5.11**	−2.09***	0.01**
The Netherlands							
Equally weighted	−0.001	0.015	0.033	0.016	0.022	0.046	0.487
	−0.05	0.93	2.07**	0.91	1.25	1.66	0.75
1997–2007	0.020	0.021	0.056	0.019	0.065	0.024	0.689
	0.65	0.75	2.26**	0.61	2.49**	0.64	0.60
1987–1996	−0.024	0.010	0.006	0.017	−0.025	0.098	0.964
	−1.11	0.62	0.34	0.92	−1.12	3.35***	0.43
Value-weighted	0.003	0.010	0.044	0.005	0.015	0.063	0.907
	0.14	0.56	2.56**	0.26	0.85	2.48**	0.46
Austria							
Equally weighted	0.039	0.041	0.042	0.044	0.055	−0.104	0.602
	4.71***	4.96***	4.48***	4.74***	6.39***	−2.49***	0.66
1997–2007	0.040	0.039	0.038	0.048	0.058	−0.087	0.959
	4.71***	4.41***	4.46***	5.12***	6.42***	−2.30***	0.43
1987–1996	0.012	0.097	0.087	−0.017	0.007	−0.267	2.903
	0.47	3.20***	1.28	−0.35	0.38	−1.14	0.02**
Value-weighted	0.022	0.021	0.023	0.022	0.027	0.019	0.254
	4.11***	3.94***	4.61***	4.67***	5.33***	0.50	0.91
South-Africa							
Equally weighted	−0.063	0.089	0.144	0.064	0.107	0.103	6.214
	−1.99**	2.58***	4.43***	2.23**	3.72***	3.52***	0.00***
1997–2007	−0.063	0.102	0.154	0.084	0.113	0.135	5.437
	−1.76*	2.57***	4.29***	2.69***	3.44***	3.99***	0.00***
1987–1996	−0.086	0.028	0.090	0.006	0.086	−0.013	1.107
	−1.24	0.40	1.16	0.084	1.44	−0.207	0.35

Table 2 (continued)

	Monday	Tuesday	Wednesday	Thursday	Friday	R_{t-1}	F-stat
Value-weighted	−0.007	0.042	0.043	0.033	0.064	0.020	2.022
	−0.41	2.12***	2.36**	1.82*	3.41***	0.81	0.09*

This table presents the results of the regression: $R_t = \alpha_1 \text{Mon}_t + \alpha_2 \text{Tue}_t + \alpha_3 \text{Wed}_t + \alpha_4 \text{Thu}_t + \alpha_5 \text{Fri}_t + \alpha_6 \text{R}_{t-1} + \varepsilon_t$, where R_t is the daily return at time t for the real estate index, Monday$_t$ through Friday$_t$ are the Monday through Friday dummy variables, and ε_t is a random error term. In order to capture potential spill-over effects across consecutive trading days we also include R_{t-1} to control for any bias related to serial autocorrelation in the data. All estimates are made using OLS, applying White's (1980) heteroskedasticity consistent standard errors

The F-statistic tests the hypothesis that all coefficients of the five days of the week are zero simultaneously. Regressions are run on both equally weighted and value-weighted market indices. The equally weighted regressions are presented for both the full and split sample periods

*Indicate significance on a 10%-level

**Indicate significance on a 5%-level

***Indicate significance on a 1%-level

the listed real estate markets in our sample the day-of-week effect manifests itself in high Friday returns, which corroborates with earlier findings of Chan et al. (2005) and Lenkkeri et al. (2006).

In general, based on previous literature, we expect to find fewer anomalies among daily returns when the market is bigger and more developed. This expectation is due to the fact that large markets tend to be more efficient with larger companies and bigger investors. When looking at our results in Table 2 we find evidence that confirms this notion, since we do find more anomalous price behavior in the smallest market, South-Africa, while for large markets like the USA and Japan evidence is weaker, and only Friday seem to stand out.

Besides documenting price irregularities, we also would like to offer insights into the drivers behind this price behavior. Therefore, we extend our analysis to firm-level data for the US stocks in our sample and ranked firms according to their size, age and ownership structures. The size of the US market provides us with the rare opportunity to conduct this split sample analysis. For all three firm characteristics we isolated the top and bottom deciles in our sample and compared their daily price dynamics in Table 3.

Results are in line with the assumption that size has an inverse effect on the level of 'day of the week' anomaly. Form Table 3 we see that the average return on Mondays of the largest 10% of all firms is positive. The average Monday return of the smallest 10% of all firms was negative, and the difference in means is significant at a 10% level. For the Friday returns we find positive averages for both ends of the size spectrum, and we find no statistical proof for differences between both values. At the same time, we also use an ANOVA F-statistic to test for the equality of means of all five days of the week, and find significant variation for both the complete sample and the smallest firm decile. For the largest firm in the sample we find no significant variation in returns across the week, indicating that daily price patterns tend to weaken with as firm size increases.

The same analysis has been employed for the age factor. In the result we can see that the average return on Monday for the oldest 10% of all firms is positive and significantly different from the negative mean of the youngest decile. Friday returns

Table 3 Isolating size, age and ownership patterns in daily US REIT-returns

	Monday	Tuesday	Wednesday	Thursday	Friday	*F*-stat
Size						
Top 10%	0.01%	0.04%	0.04%	0.05%	0.07%	(1.58)
Sample average	0.01%	0.05%	0.03%	0.03%	0.10%	(17.08)***
Bottom 10%	−0.06%	0.01%	0.05%	0.03%	0.11%	(4.97)***
T-stat of difference	(1.74)*	(1.14)	(0.29)	(0.69)	(0.93)	
Age						
Top 10%	0.02%	0.07%	0.03%	0.05%	0.05%	(2.17)*
Sample average	0.01%	0.05%	0.03%	0.03%	0.10%	(17.08)***
Bottom 10%	−0.04%	0.06%	0.07%	0.00%	0.12%	(5.29)***
T-stat of difference	(2.44)**	(0.37)	(1.49)	(1.97)*	(1.30)	
%Closely held shares						
Top 10%	0.00%	0.04%	0.06%	0.03%	0.04%	(1.45)
Sample average	0.01%	0.05%	0.03%	0.03%	0.10%	(17.08)***
Bottom 10%	−0.02%	0.05%	0.04%	0.03%	0.12%	(4.31)***
T-stat of difference	(0.72)	(0.67)	(1.30)	(0.12)	(1.39)	

This paper compares the average day of the week returns of sub samples of US REITs. Sub samples are selected as the top and bottom deciles of the REIT sample when ranked according to firm size, firm age, and the proportion of closely held shares. The *F*-stat is the ANOVA *F*-statistic that tests for equality of means between the days-of-the-week. The T-stat tests for the equality of means of the day-of-week returns across the top and bottom deciles

*Significant on a 10%-level

**Significant on a 5%-level

***Significant on a 1%-level

are high for both deciles and cannot be distinguished statistically. Again we also document that the variation of returns within the week is highest for the bottom decile, the youngest firms, indicating that both age and size tend to weaken the day-of-the-week effect. However, there is a reason to believe that size and age of a firm are very much correlated. Therefore we have analyzed the correlation between size and age of the firms and we have found that the correlation is 0.16, which is not as strong as we expected. We can see that only three of the oldest firms (34 years) are also present in the decile of the largest firms, indicating that size and age are not synonyms in the listed real estate market.

Finally, when splitting up our US sample according to the ownership structure, we again find interesting result that indicate that beside age and size also this factor might be of influence here. We find the most pronounced return variation, especially for Mondays and Fridays, among the 10% of firms with the smallest proportion of closely held shares. Among firms that enjoy the highest percentages of closely held shares we find no evidence for a day-of-the-week effect at all.

Monthly Price Patterns

When comparing price returns over months we find less compelling evidence for anomalous price behavior. Indeed, we find in Table 4 for both the USA and The Netherlands negative signs for all months in our model, indicating that January yields the highest return in a year. But often this difference in monthly returns lacks statistical significance and in other countries January is even underperforming other

Table 4 January effect for monthly price returns (1987–2007)

	C	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	R_{t-1}	F-stat
USA														
Equally weighted	0.099	−0.037	−0.036	−0.097	−0.038	−0.036	−0.073	−0.089	−0.071	−0.163	−0.067	−0.049	0.219	3.302
	3.18***	−0.97	−0.85	−2.04**	−1.00	−0.95	−1.91	−1.96**	−1.69	−2.94***	−1.74	−1.26	3.36***	0.00***
1997–2007	0.042	−0.028	0.007	−0.034	0.035	0.088	−0.010	−0.056	0.005	−0.070	0.052	0.014	0.077	0.815
	0.78	−0.47	0.11	−0.35	0.51	1.39	−0.13	−0.67	0.07	−0.92	0.82	0.23	0.77	0.63
1987–1996	0.129	−0.038	−0.056	−0.129	−0.069	−0.109	−0.111	−0.098	−0.110	−0.210	−0.140	−0.092	0.301	4.083
	3.64***	−0.82	−1.11	−2.95***	−1.57	−2.55***	−2.75***	−2.18***	−2.27***	−2.58***	−3.13***	−1.87	3.65***	0.00***
Value-weighted	0.010	0.009	0.008	−0.007	0.011	0.014	0.009	−0.01	−0.005	−0.025	0.013	0.016	0.023	1.190
	0.91	0.58	0.52	−0.45	0.69	0.94	0.56	−0.63	−0.34	−1.62	0.88	1.03	0.38	0.29
Japan														
Equally weighted	0.149	−0.026	0.088	−0.092	−0.002	−0.166	−0.149	−0.105	−0.154	−0.174	−0.172	−0.140	−0.058	1.467
	2.25**	−0.26	0.69	−1.10	−0.02	−1.87*	−1.91**	−1.16	−1.45	−2.05**	−1.78*	−1.58	−0.79	0.14
1997–2007	0.217	−0.069	−0.017	−0.120	−0.189	−0.071	−0.284	−0.197	−0.300	−0.202	−0.235	−0.311	−0.002	1.331
	2.01**	−0.47	−0.11	−0.90	−1.37	−0.52	−2.41**	−1.40	−2.05**	−1.63	−1.75	−2.01**	−0.01	0.21
1987–1996	0.097	0.001	0.158	−0.072	0.130	−0.221	−0.055	−0.034	−0.051	−0.148	−0.121	−0.029	−0.050	1.138
	1.17	0.01	0.87	−0.67	0.87	−2.05**	−0.54	−0.29	−0.34	−1.29	−0.91	−0.28	−0.54	0.33
Value-weighted	0.113	−0.037	0.036	−0.104	−0.061	−0.14	−0.088	−0.043	−0.068	−0.094	−0.11	−0.096	−0.029	0.669
	1.93*	−0.46	0.33	−1.42	−0.76	−1.80	−1.24	−0.52	−0.78	−1.20	−1.39	−1.12	−0.39	0.78
Hong Kong														
Equally weighted	0.124	0.162	−0.170	−0.042	−0.082	−0.158	−0.011	−0.153	−0.137	−0.134	−0.044	0.038	0.080	1.046
	0.94	0.99	−1.15	−0.27	−0.50	−1.02	−0.07	−0.96	−0.85	−0.61	−0.29	0.25	1.00	0.41
1997–2007	−0.151	0.478	0.123	0.127	0.126	0.136	0.142	0.288	0.078	0.087	0.297	0.327	0.157	0.777
	−0.63	1.53	0.45	0.47	0.44	0.52	0.53	1.02	0.29	0.24	1.11	1.30	1.14	0.67
1987–1996	0.301	−0.044	−0.350	−0.137	−0.209	−0.342	−0.119	−0.436	−0.271	−0.281	−0.266	−0.130	0.040	0.993
	2.02**	−0.25	−2.19	−0.79	−1.06	−1.84**	−0.60	−2.35***	−1.38	−1.01	−1.46	−0.71	0.43	0.46
Value-weighted	0.092	0.121	−0.167	0.012	−0.096	−0.099	0.058	−0.096	−0.075	−0.073	−0.003	0.107	0.062	0.958
	0.83	0.85	−1.35	0.09	−0.67	−0.75	0.42	−0.71	−0.54	−0.37	−0.02	0.78	0.90	0.49

Table 4 (continued)

	C	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	R_{t-1}	F-stat
UK														
Equally weighted	0.858	0.478	−0.446	0.014	0.066	−0.587	−0.577	−0.554	−0.831	−1.351	−0.355	0.207	0.249	2.637
	1.59	0.63	−0.59	0.02	0.09	−0.78	−0.76	−0.73	−1.09	−1.79	−0.47	0.28	4.33***	0.00***
1997–2007	0.207	1.177	0.065	0.223	0.954	0.098	0.082	0.107	−0.778	−0.248	1.118	1.080	0.248	1.495
	0.31	1.28	0.07	0.24	1.04	0.11	0.09	0.11	−0.85	−0.27	1.22	1.18	2.64***	0.14
1987–1996	1.289	0.013	−0.797	−0.103	−0.535	−1.043	−1.015	−0.993	−0.862	−2.084	−1.337	−0.376	0.251	1.634
	1.62	0.01	−0.72	−0.09	−0.47	−0.93	−0.91	−0.89	−0.76	−1.86**	−1.20	−0.34	3.33***	0.09*
Value-weighted	0.035	0.05	−0.014	0.024	0.052	−0.048	−0.003	−0.021	−0.049	−0.049	0.028	0.058	0.12	1.341
	0.95	0.94	−0.24	0.54	0.94	−0.91	−0.06	−0.42	−0.88	−0.72	0.60	1.09	1.62	0.19
Australia														
Equally weighted	0.085	−0.096	−0.045	0.046	−0.052	−0.072	0.044	−0.101	−0.001	−0.080	−0.087	0.019	0.042	1.305
	1.87*	−1.49	−0.68	0.71	−0.79	−1.10	0.69	−1.56	−0.01	−1.25	−1.35	0.30	0.71	0.21
1997–2007	0.099	−0.046	−0.108	−0.062	−0.085	−0.048	0.012	−0.074	−0.046	−0.058	−0.047	−0.085	−0.006	0.333
	1.76	−0.58	−1.33	−0.78	−1.07	−0.60	0.15	−0.94	−0.58	−0.73	−0.59	−1.07	−0.06	0.98
1987–1996	0.079	−0.135	−0.012	0.119	−0.030	−0.090	0.065	−0.122	0.028	−0.095	−0.120	0.087	0.065	1.584
	1.19	−1.43	−0.12	1.25	−0.31	−0.95	0.69	−1.30	0.30	−1.02	−1.27	0.93	0.84	0.10
Value-weighted	0.038	−0.035	0.031	0.055	−0.029	0.017	0.048	−0.03	0.024	−0.035	0.024	0.046	−0.03	1.092
	1.56	−0.88	0.80	1.47	−0.65	0.42	1.24	−0.77	0.60	−0.62	0.62	1.38	−0.40	0.37
France														
Equally weighted	0.085	0.024	0.041	−0.008	−0.046	−0.102	−0.066	−0.027	−0.079	−0.024	0.025	0.000	0.091	1.906
	2.24**	0.41	0.83	−0.15	−0.90	−2.19	−1.40	−0.54	−1.37	−0.50	0.50	−0.01	1.60	0.03**
1997–2007	0.186	−0.008	−0.040	−0.113	−0.057	−0.149	−0.124	−0.137	−0.117	−0.100	−0.052	−0.050	−0.007	0.910
	2.41**	−0.09	−0.50	−1.47	−0.62	−1.66	−1.52	−1.40	−1.18	−1.12	−0.65	−0.62	−0.07	0.54
1987–1996	0.029	0.043	0.090	0.061	−0.050	−0.077	−0.035	0.040	−0.059	0.023	0.073	0.034	0.103	1.590
	0.81	0.59	1.47	0.95	−0.99	−1.68	−0.64	0.74	−0.87	0.44	1.18	0.66	1.40	0.10*
Value-weighted	0.001	0.085	0.047	0.032	0.036	−0.02	0.007	0.018	−0.016	0.013	0.062	0.044	0.239	3.283
	0.07	2.47**	1.49	1.08	1.22	−0.73	0.27	0.56	−0.40	0.49	2.26**	1.48	3.76***	0.00***

Singapore														
Equally weighted	0.079	0.065	−0.089	0.038	−0.021	−0.007	−0.048	−0.152	−0.153	−0.025	−0.039	−0.008	0.157	1.054
	0.73	0.45	−0.66	0.27	−0.14	−0.05	−0.39	−0.93	−1.10	−0.13	−0.27	−0.06	1.75	0.40
1997–2007	−0.119	0.319	0.160	0.210	−0.037	0.288	0.177	−0.103	0.035	0.258	0.372	0.173	0.159	0.840
	−0.57	1.05	0.61	0.77	−0.14	1.13	0.79	−0.35	0.13	0.67	1.45	0.78	1.06	0.61
1987–1996	0.209	−0.103	−0.252	−0.075	0.001	−0.202	−0.196	−0.184	−0.278	−0.213	−0.312	−0.129	0.162	1.163
	1.94	−0.76	−1.82	−0.53	0.01	−1.18	−1.44	−0.98	−2.01	−0.97	−2.13**	−0.90	2.41***	0.31
Value-weighted	0.052	0.034	−0.058	0.039	−0.051	−0.002	0.022	−0.118	−0.095	−0.001	0.013	0.038	0.169	1.359
	0.69	0.34	−0.60	0.41	−0.50	−0.02	0.27	−1.10	−0.95	−0.01	0.13	0.45	1.80	0.19
Canada														
Equally weighted	−0.137	0.282	0.619	−0.189	0.372	0.625	0.462	0.144	0.312	0.556	0.156	0.596	0.022	0.820
	−0.50	0.73	1.58	−0.48	0.95	1.61	1.19	0.37	0.80	1.43	0.40	1.54	0.37	0.63
1997–2007	−0.051	0.322	0.407	0.156	0.119	1.043	0.688	−0.483	0.483	0.417	0.300	0.325	0.098	1.176
	−0.15	0.68	0.84	0.33	0.25	2.20**	1.44	−1.02	1.02	0.88	0.63	0.69	1.02	0.31
1987–1996	−0.209	0.258	0.757	−0.431	0.507	0.332	0.354	0.553	0.197	0.649	0.067	0.790	0.013	0.676
	−0.52	0.46	1.33	−0.75	0.88	0.59	0.63	0.98	0.35	1.15	0.12	1.40	0.17	0.77
Value-weighted	−0.04	0.16	0.115	0.083	0.098	0.185	0.274	−0.048	0.132	0.139	0.065	0.044	0.077	0.955
	−1.13	1.96**	1.26	1.09	1.29	2.02**	2.43***	−0.24	1.52	1.75	0.88	0.83	1.17	0.49
The Netherlands														
Equally weighted	0.111	−0.067	−0.088	−0.225	−0.090	−0.050	−0.066	−0.132	−0.098	−0.112	−0.107	−0.064	0.155	3.545
	3.92***	−1.56	−2.25***	−5.97***	−2.29***	−1.24	−1.36	−3.81***	−1.61	−2.88***	−3.09***	−1.75	2.53***	0.00***
1997–2007	0.140	−0.055	−0.121	−0.220	−0.118	−0.072	−0.080	−0.199	−0.169	−0.112	−0.118	−0.068	0.080	1.846
	4.14***	−0.81	−2.18**	−5.00***	−1.74*	−1.14	−1.48	−4.66***	−2.31***	−1.84*	−2.75***	−1.23	0.77	0.05**
1987–1996	0.095	−0.078	−0.070	−0.233	−0.073	−0.038	−0.063	−0.094	−0.053	−0.114	−0.100	−0.060	0.187	2.129
	2.20**	−1.35	−1.26	−4.05***	−1.52	−0.68	−0.86	−1.79	−0.59	−2.17***	−1.96***	−1.21	2.34***	0.02**
Value-weighted	0.062	−0.014	−0.071	−0.105	−0.037	−0.039	−0.05	−0.068	−0.091	−0.059	−0.044	−0.028	0.118	2.740
	3.72***	−0.51	−2.68***	−4.53***	−1.27	−1.42	−2.06**	−3.35***	−2.73***	−2.35***	−2.09**	−1.03	1.40	0.00***
Austria														
Equally weighted	0.012	−0.003	−0.005	−0.014	0.001	−0.001	0.004	−0.002	−0.003	−0.007	−0.002	0.013	0.399	6.231
	1.21	−0.31	−0.44	−1.31	0.07	−0.06	0.37	−0.23	−0.29	−0.68	−0.16	1.16	5.48***	0.00***
1997–2007	0.048	−0.024	−0.032	−0.045	−0.016	−0.015	−0.008	−0.023	−0.025	−0.034	−0.011	−0.002	0.191	1.790
	2.63***	−1.23	−1.62	−2.27**	−0.76	−0.68	−0.36	−1.16	−1.14	−1.73	−0.44	−0.09	2.05**	0.06*
1987–1996	−0.008	0.011	0.012	0.009	0.013	0.011	0.012	0.011	0.011	0.014	0.009	0.024	0.245	2.503
	−1.04	1.48	1.47	1.21	1.68	1.42	1.54	1.44	1.43	1.69	1.26	2.47***	3.86***	0.00***
Value-weighted	0.019	−0.016	−0.015	−0.023	−0.017	−0.015	−0.011	−0.013	−0.012	−0.019	−0.015	−0.011	0.549	11.534
	1.61	−1.21	−1.26	−1.89	−1.34	−1.12	−0.82	−0.99	−0.88	−1.56	−1.22	−0.88	4.27***	0.00***

Table 4 (continued)

	C	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	R_{t-1}	F-stat
South-Africa														
Equally weighted	0.850	−0.266	−0.287	−0.797	−0.982	−1.028	−0.340	−0.139	−0.497	−0.207	−0.458	0.226	0.150	1.540
	2.46***	−0.56	−0.57	−1.67	−2.14***	−1.96**	−0.62	−0.18	−1.05	−0.44	−1.00	0.41	2.30***	0.11
1997–2007	1.260	0.288	−0.349	−1.257	−1.425	−1.780	−0.104	0.541	−1.483	0.487	−0.378	0.657	0.131	1.137
	1.72	0.34	−0.29	−1.18	−1.59	−1.52	−0.08	0.30	−1.55	0.53	−0.38	0.59	1.36	0.34
1987–1996	0.600	−0.630	−0.249	−0.517	−0.708	−0.525	−0.491	−0.583	0.160	−0.669	−0.479	−0.039	0.109	0.987
	1.76	−1.21	−0.64	−1.33	−1.38	−1.23	−1.13	−1.16	0.35	−1.60	−1.24	−0.07	1.11	0.46
Value-weighted	0.053	−0.004	−0.032	−0.045	−0.071	−0.077	−0.026	−0.026	−0.059	−0.014	−0.031	−0.004	0.157	1.746
	2.34***	−0.13	−0.96	−1.36	−2.41***	−2.04**	−0.84	−0.63	−1.63	−0.47	−0.95	−0.09	1.79	0.06*

This table presents the results of the regression: $R_t = C + \alpha_1 \mathrm{Feb}_t + \alpha_2 \mathrm{Mar}_t + \alpha_3 \mathrm{Apr}_t + \alpha_4 \mathrm{May}_t + \alpha_5 \mathrm{Jun}_t + \alpha_6 \mathrm{Jul}_t + \alpha_7 \mathrm{Aug}_t + \alpha_8 \mathrm{Sep}_t + \alpha_9 \mathrm{Oct}_t + \alpha_{10} \mathrm{Nov}_t + \alpha_{11} \mathrm{Dec}_t + \alpha_{12} \mathrm{R}_{t-1} + \varepsilon_t$, where R_t is the daily return at time t for the real estate index, Feb_t through Dec_t are the February through December dummy variables, and ε_t is a random error term. In order to capture potential spill-over effects across consecutive trading months we also include R_{t-1} to control for any bias related to serial autocorrelation in the data. All estimates are made using OLS, applying White's (1980) heteroskedasticity consistent standard errors

The F-statistic tests the hypothesis that all coefficients of the trading months are zero simultaneously. Regressions are run on both equally weighted and value-weighted market indices. The equally weighted regressions are presented for both the full and split sample periods

*Indicate significance on a 10%-level

**Indicate significance on a 5%-level

***Indicate significance on a 1%-level

Table 5 Isolating size, age and ownership patterns in monthly US REIT-returns

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	*F*-stat
Size													
Top 10%	0.08%	0.19%	0.07%	−0.04%	0.07%	0.11%	0.06%	0.02%	0.06%	−0.01%	0.03%	0.13%	(1.34)
Sample average	0.06%	0.05%	0.03%	−0.01%	0.07%	0.11%	0.04%	0.02%	0.03%	−0.02%	0.07%	0.08%	(0.99)
Bottom 10%	0.07%	0.03%	0.01%	0.06%	0.08%	0.09%	0.08%	0.01%	0.05%	−0.03%	0.10%	0.13%	(2.75)***
T-stat of difference	(0.23)	(1.26)	(2.01)*	(1.99)*	(0.08)	(0.34)	(0.32)	(0.37)	(0.21)	(0.21)	(1.04)	(0.06)	
Age													
Top 10%	0.06%	0.07%	−0.04%	0.02%	0.07%	0.09%	0.07%	0.04%	0.05%	0.01%	0.05%	0.06%	(1.28)
Sample average	0.06%	0.05%	0.03%	−0.01%	0.07%	0.11%	0.04%	5.76%	0.03%	−0.02%	0.07%	0.08%	(0.00)
Bottom 10%	0.05%	0.03%	0.05%	−0.01%	0.05%	0.09%	0.03%	0.04%	0.05%	−0.04%	0.09%	0.09%	(2.07)**
T-stat of difference	(0.51)	(1.23)	(1.05)	(1.05)	(0.91)	(0.93)	(0.35)	(1.93)*	(0.35)	(0.89)	(0.65)	(1.30)	
%Closely held shares													
Top 10%	0.03%	0.05%	0.04%	−0.01%	0.04%	0.07%	0.02%	0.03%	0.07%	−0.04%	0.09%	0.07%	(1.85)*
Sample average	0.06%	0.05%	0.03%	−0.01%	0.07%	0.11%	0.04%	5.76%	0.03%	−0.02%	0.07%	0.08%	(0.99)
Bottom 10%	0.04%	0.05%	0.06%	−0.02%	0.06%	0.09%	0.03%	−0.02%	0.02%	−0.06%	0.07%	0.08%	(4.62)***
T-stat of difference	(0.27)	(0.08)	(0.75)	(0.13)	(0.56)	(0.56)	(0.34)	(1.52)	(1.43)	(0.27)	(0.41)	(0.41)	

This paper compares the average monthly returns of sub samples of US REITs. Sub samples are selected as the top and bottom deciles of the REIT sample when ranked according to firm size, firm age, and the proportion of closely held shares. The *F*-stat is the ANOVA *F*-statistic that tests for equality of means between the days-of-the-week. The *T*-stat tests for the equality of means of the monthly returns across the top and bottom deciles

*Significant on a 10%-level

**Significant on a 5%-level

***Significant on a 1%-level

months. Our results in Table 4 also show that in all countries monthly discrepancies have weakened over the years. During the second half of our sample period we find no significant evidence for monthly price irregularities.

Another remarkable finding regarding these monthly prices is that there does not seem to be any pervasive international variation that can be explained by the size or maturity of the market. For instance, we find results for South-Africa that closely resemble the USA, and at the same time differ significantly from markets like Canada. The fact that we find the most convincing results for the Dutch market also contradicts the tax-loss selling hypothesis, since Dutch tax law does not provide any incentives to sell weak performing stocks in December. This is also supported by the fact that we find December months underperforming January only in 4 out of 11 countries, and in each case the difference is statistically insignificant (Table 5).

When focusing on subsections of the US market we find that monthly price patterns are strongest among the smallest firms, the youngest firms and among firms that are associated with the highest free-float rates. Although we find monthly returns to be different from each other for these firms we could not reveal any clear pattern. For instance, for all three subgroups we find December returns to be highest, which can be considered as an end-of-the year rally, but does not support any tax-loss selling hypotheses.

More remarkable are our findings with respect to the seasons in our market. In Fig. 1 we compare the average annualized price returns for all 11 countries for both the winter and summer periods. We find higher returns during the winter season for

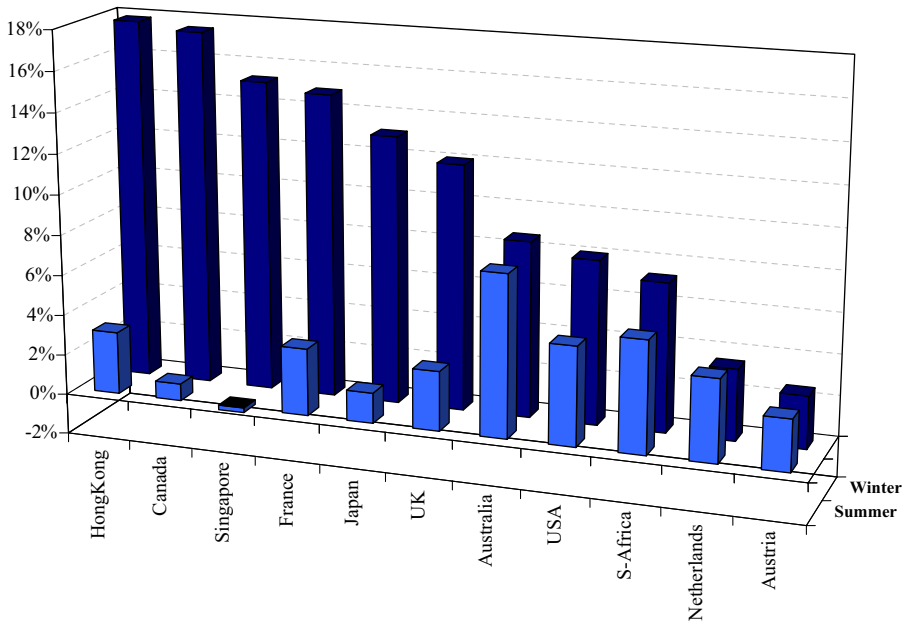

Fig. 1 Annualized returns in summer and winter. This figure presents the annualized average returns of listed real estate during winters and summers for the period 1987 until 2006. Here winter is defined as the months November until April, the remaining months are referred to as summer. Given the variation in seasons across the globe we define the seasons locally as such that summer captures the holiday season

Table 6 The Sell in May effect

	Constant	*t* value	Sell in May coefficient	*t* value
USA	0.052	4.71***	0.021	1.14
1987–1996	0.059	3.91***	0.039	1.78*
Japan	0.079	3.10***	0.074	1.84*
1987–1996	0.082	2.26**	0.076	1.36
Hong Kong	0.099	2.65***	0.089	1.53
1987–1996	0.128	2.75***	0.119	1.55
UK	0.952	4.99***	0.711	2.09**
1987–1996	0.901	3.07***	0.575	1.19
Australia	0.050	2.92***	−0.005	−0.19
1987–1996	0.058	2.29**	0.006	0.17
France	0.095	7.86***	0.074	3.56***
1987–1996	0.069	4.22***	0.070	2.56**
Singapore	0.085	2.34**	0.098	1.65*
1987–1996	0.087	2.15**	0.095	1.34
Canada	0.166	1.89*	0.088	0.48
1987–1996	0.121	0.89	0.031	−0.13
The Netherlands	0.023	2.26**	−0.003	−0.13
1987–1996	0.009	0.69	−0.028	−0.91
South-Africa	0.587	4.69***	0.139	0.52
1987–1996	0.212	1.95*	−0.053	−0.29

This table presents the results of the regression: $R_t = \mu + \alpha_1 S_t + \varepsilon_t$ here R_t is the monthly return at time t for the real estate index, μ is a constant and ε_t the usual error term. In the absence of the dummy variable this equation is reduced to the well-known random walk model. The dummy takes the value 1 if months fall on the period November through April and 0 otherwise

We test whether the coefficient of S_t is significantly different from zero. When α_1 is significant and positive, this reject the null hypothesis of no Sell in May effect

Summer seasons vary across the globe. We therefore define summer and winter locally and focus on the main holiday brake as summer season

*Indicate significance on a 10%-level

**Indicate significance on a 5%-level

***Indicate significance on a 1%-level

all markets in our sample, indicating that investing according to the Halloween indicator would pay of in all countries.[5] Selling in May and returning in September would have generated higher returns, especially in markets like Hong Kong, Canada, Singapore, France, Japan and the UK, where the difference between seasons is statistically significant.

Given that this investment strategy would induce only limited transactions costs, since sales are restricted to only two moments each year, it seems that these results entail interesting arbitrage possibilities. However, except for Singapore we still find positive returns of well over 2% a year during the summer season, which means that leaving the market requires a cost of capital that will be hard to find at current interest rates.

In order to thoroughly test the statistical significance of this Sell in May effect we also ran regressions that isolate the effect. In Table 6 we find that the difference between winter and summer returns often lacks significance. Only in the USA,

[5] We adapted the definition of the 'selling in May' to local standards. Since summer season is not synchronous around the world we define summer as the season when people take their major holiday brake. This means that for Australia and Asian markets we actually do not sell in May.

Table 7 Isolating size, age and ownership patterns in seasonal US REIT-returns

	Winter	Summer	*T*-stat
Size			
Top 10%	7.53%	8.07%	(0.68)
Sample average	7.73%	5.11%	(0.98)
Bottom 10%	5.55%	3.36%	(0.72)
T-stat of difference	(1.10)	(1.94)*	
Age			
Top 10%	8.66%	6.11%	(0.97)
Sample average	7.73%	5.11%	(0.98)
Bottom 10%	7.98%	3.90%	(1.13)
T-stat of difference	(0.79)	(0.41)	
%Closely held shares			
Top 10%	6.45%	6.54%	(0.35)
Sample average	7.73%	5.11%	(0.98)
Bottom 10%	6.32%	5.57%	(0.12)
T-stat of difference	(0.08)	(0.40)	

This paper compares the annualized average seasonal returns of sub samples of US REITs. Sub samples are selected as the top and bottom deciles of the REIT sample when ranked according to firm size, firm age, and the proportion of closely held shares. The *F*-stat is the ANOVA *F*-statistic that tests for equality of means between the seasons. The *T*-stat tests for the equality of means of the season returns across the top and bottom deciles

*Significant on a 10%-level

**Significant on a 5%-level

***Significant on a 1%-level

Japan, the UK, France and Singapore we observe periods in which the difference was compelling. Remarkable in that respect is that we find these significant differences mostly during the second half of our sample period, except for the USA where the reverse appears to be true. For Hong Kong the vast difference between both seasons seems to be clustered over time and caused by a minority of observations, since the regression results lack statistical strength.

Finally, we again split our US sample in order to find out whether this calendar anomaly is related to firm specific characteristics. The results of Table 7 tell us that the sell-in-May appears to be concentrating among the smallest, and to a lesser extend the youngest, firms in the sample. For large and older firms we find hardly any difference between returns of both seasons. Furthermore, we find little evidence that closely held shares percentages are related to the phenomenon. We also have to stress that given the sample restrictions, we can include only the last 20 years of trading, we have little degrees of freedom to analyze phenomena that can be recorded only once a year.

Conclusions

In this paper we analyzed the price dynamics of international property shares for the ten most prominent markets from around the world plus South-Africa. We focus on the presence of calendar effects in daily and monthly price returns and examine these effects over time and across countries. For the daily returns we document a positive

abnormal Friday return in all 11 countries in our sample. We find that this pattern was most prominent during the 1980s and early 1990s and in the smaller markets in our sample. For the monthly returns we found little evidence for price irregularities. In most cases January was superior to most other months, but these differences lacked statistical significance. More compelling was the Sell in May effect that seemed to be present in almost all markets. Price returns during the winter season outperformed the summer months and in five countries these difference were both economically and statistically significant.

Furthermore, we looked for drivers of these calendar effects by comparing results on individual firm levels within our US sample. Both the day-of-the-week effect and the January effect appear to be most pronounced among small and young firms that have the lowest proportions of closely held shares. Large and long-established listed real estate firms with a large portion of loyal block-holders experience no significant price patterns during the trading week or across months. For the sell-in-May effect we find no explanation that is related to firm specific characteristics.

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