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RESEARCH ARTICLE

The decline of calendar seasonality in the Australian stock exchange, 1958–2005

Andrew C. Worthington

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Abstract This paper examines calendar effects in Australian daily stock returns from 6 January 1958 to 30 December 2005. Three calendar effects—day-of-the-week, turn-of-the-month and month-of-the-year—are examined using parametric tests and a regression-based approach. The results indicate that the Australian market is characterised by seasonality of all three forms, with Tuesday, September and the second trading day of the month the most significant. However, there is also evidence of parameter instability and structural breaks in these relationships, with day-of-the-week effects becoming less important in the post-1987 crash period.

Keywords Calendar effects · Market anomalies · Market efficiency

JEL Classification C12 · C22 · G14

1 Introduction

A consistent theme in the market efficiency literature has concerned the presence of calendar anomalies or seasonality in stock returns. If, and as hypothesised, readily identifiable seasonal patterns occur there is the possibility of abnormal returns through market timing strategies. Within this burgeoning literature, well-known calendar anomalies concerning security returns include: a weekend effect, where stocks exhibit lower returns between Friday and Monday closing (Agrawal and Ikenberry 1994; Wang et al. 1997; Zainudin et al. 1997); a day-of-the-week effect, where returns on some trading days are higher than others (Chang et al. 1993; Kamara 1997; Chang et al. 1998); a January effect, where returns are much higher than any other month

A. C. Worthington (✉)
Department of Accounting, Finance and Economics, Griffith University, Nathan, QLD 4111, Australia
e-mail: a.worthington@griffith.edu.au

(Haugen and Jorion 1996; Tonchev and Kim 2004; Rosenberg 2004); a holiday effect, where returns are higher on trading days prior to public holidays (Kim and Park 1994; Chan et al. 1996; Brockman and Michayluk 1998; Vergin and McGinnis 1999; Chong et al. 2005; McGuinness 2005); and a turn-of-the month effect, where returns are higher during the first few trading days of each month (Cadsby and Ratner 1992; Tonchev and Kim 2004).

A number of hypotheses have been put forward to explain the presence of such seasonality, especially concerning its three principal forms: (i) the day-of-the-week effect, (ii) the turn-of-the-month effect, and (iii) the month-of-the-year effect. First, the day-of-the-week effect is potentially explained by an *information release hypothesis*, whereby firms delay the release of negative information until late in the week, a *settlement regime hypothesis*, associated with differences in the timing of transactions and settlement, and an *information processing hypothesis* linked with the asymmetry in information costs across small and large investors (see, for example, Keim and Stambaugh 1984; Junkus 1986; Thaler 1987; Rystrom and Benson 1989; Abraham and Ikenberry 1994; Arsad 1997; Keef and Roush 2005). The most commonly reported anomaly in this respect is significantly lower (if not negative) Monday returns. This appears to hold even with allowance for changes in settlement regimes over time, as in Keef and McGuinness (2001) analysis of the New Zealand stock market. However, the Monday effect is not consistent in all contexts. For instance, Jaffe and Westerfield, Finn et al. (1991), Easton and Faff (1994), Agrawal and Tandon (1994) and Davidson and Faff (1999) find a significantly negative Tuesday effect in Australian stock returns, and Jaffe and Westerfield propose a linkage between Tuesdays in the Asia-Pacific and the (negative) Monday effect in the US.

Second, the turn-of-the-month effect is where returns are substantially positive during the first few days in each trading month (see, for instance, Jacons and Levy 1988; Lakonishok and Smidy 1988; Khaksari and Bubnys 1992; Mills et al. 2000; Holden et al. 2005). Three explanations have been put forward: a *portfolio rebalancing hypothesis*, where investors reinvest accumulated dividends at the end of each month; a *month-end cash flow hypothesis* linked with the transfer of income from salaries and other income into long-term financial assets; and a *company announcement hypothesis* reflecting the preference of companies to delay bad news until late in the reporting period. Finally, the month-of-the-year effect is almost always construed in terms of higher January returns (see, for example, Gultekin and Gultekin 1987; Ariel 1987; Arsad 1997; Mehdian and Perry 2002; Al-Saad and Moosa 2005). Once again, three possible explanations have been put forward. These include: the t*ax-loss selling hypothesis* whereby losses on portfolios are fixed for tax purposes at the end of the (US) financial year; a *yearly investor cash flow hypothesis*, where individual investors (and the market) benefit from year-end bonuses, holiday pay and gifts; and a *company announcement hypothesis* whereby January is characterised by the abnormally large release of (positive) firm information.

The purpose of this paper is to add to this intriguing body of work an analysis of calendar effects in the Australian equity market. Although the Australian market has been partially addressed in a number of studies a comprehensive analysis remains, as yet, undone. In particular, it is rare to see a variety of calendar effects analysed in a single study, and as a result their relative strength is unknown. At the same time, it is sometimes assumed that calendar effects are stable over time, and not subject to the usual changes in market efficiency associated with the development and internationalisation found in contemporary equity markets. This is now subject to some debate. For example, in their analysis of the US, UK and Hong Kong markets, Chong et al. (2005) concluded that the typically positive pre-holiday effect reversed and became negative from 1991 to 1997, with its subsequent elimination between 1997 and 2003. An additional objective of this paper is then to assess whether these calendar effects have declined over time.

The remainder of the paper is organised as follows. Section 2 explains the empirical methodology and data employed in the study and provides a brief descriptive analysis. The empirical findings are presented and analysed in Sect. 3. The paper ends with a brief conclusion in the final section.

2 Data and methodology

The data employed in the study are closing prices from the Australian Stock Exchange (ASX) over the period 6 January 1958 to 30 December 2005 encompassing 12,067 trading days. The capitalization-weighted All Ordinaries Price Index is used. This index includes the top ASX-listed stocks by capitalization, covering about 92% of domestic companies by market value. To be included in the index stocks must have an aggregate market value of at least 0.02% of all domestic equities, and maintain an average turnover in excess of 0.5% of quoted shares each month. The long-term market index series is obtained from Global Financial Data (2006). A series of daily market returns are calculated where $R_t = 100 \ln(P_t/P_{t-1})$ where P_t is the index level at the end of day t.

Two approaches are used to test the seasonality hypotheses. The first involves a descriptive analysis of the mean returns and tests of equality of means using parametric analysis. Parametric testing is appropriate because with very large samples like this the sample means will follow the normal distribution, even if the underlying variable is not normally distributed in the population. Moreover, parametric tests have more statistical power than their nonparametric counterparts. The second is a regression-based approach. First, the following model is specified for the day-of-the-week effect:

$$R_t = \alpha_0 + \sum_{i=1}^{4} \alpha_i W_{it} + \varepsilon_t \tag{1}$$

where W_i is a dummy variable taking a value of one for day i and zero otherwise (where $i = 1, 2, 3, 4$) (the reference category is Wednesday), α are parameters to be estimated, ε is the error term and all other variables are as previously defined. Second, the turn-of-the-month effect is described by the following:

$$R_t = \beta_0 + \sum_{j=1}^{3} \beta_j D_{jt} + \phi_t \tag{2}$$

where D_j is a dummy variable taking a value of one for trading day j and zero otherwise (where $j = 1, 2, 3$) (the reference category is all other trading days of the month following the third trading day), β are parameters to be estimated, ϕ is the error term and all other variables are as previously defined. Third, the month-of-the-year effect is specified as:

$$R_t = \chi_0 + \sum_{k=1}^{11} \chi_k M_{kt} + \varphi_t \tag{3}$$

where M_k is a dummy variable taking a value of one for month k and zero otherwise (where $k = 1, 2, \ldots, 11$) (the reference category is July), χ are parameters to be estimated, ϕ is the error term and all other variables are as previously defined. Finally, a calendar effect model is specified:

$$R_t = \delta_0 + \sum_{i=1}^{4} \alpha_i W_{it} + \sum_{j=1}^{3} \beta_j D_{jt} + \sum_{k=1}^{11} \chi_k M_{kt} + \gamma_t \tag{4}$$

where all variables and parameters are as previously described, δ is a constant and γ is the error term. An Augmented Dickey–Fuller test (statistic = −55.4424, p-value = 0.0000) and a Phillips–Peron test (with allowance for autocorrelation) (statistic = −93.1849, p-value = 0.0000) reject the null hypothesises of a unit root and we conclude that the return series is stationary and suitable for regression-based analysis.

3 Empirical findings

Table 1 presents the summary of descriptive statistics for the daily returns. These are categorised according to the hypothesised day-of-the-week, turn-of-the-month and month-of-the-year effects. In terms of the day-of-the-week, mean returns are highest on Thursday (0.0811) and lowest on Tuesdays (−0.0386). The volatility of returns (as measured by standard deviation) is also highest on Tuesdays (0.9230) and lowest on Fridays (0.7354). For the turn-of-the-month, the returns on the first, second and third trading days are higher and less volatile than other trading days in the month. Finally, in terms of calendar months, returns are lowest in September (−0.0402) and highest in December (0.1287) and least variable in July (0.6954) and more variable in October (1.3030).

By and large, the distributional properties of the returns series in all categories appear non-normal. Given that the sampling distribution of skewness is normal with mean 0 and standard deviation of $\sqrt{6/T}$ where T is the sample size, then returns on Mondays, Tuesdays, Thursdays and Fridays (Wednesdays) are significantly negatively (positively) skewed indicating the greater likelihood of observations lying below (above) the mean. The turn-of-the-month days are also significantly skewed, with the first and second being positively skewed and the third negatively skewed. The months are also primarily negatively skewed, with January, July and November being positively skewed. The kurtosis or degree of excess across all return categories is

Table 1 Descriptive analysis of daily returns

Variable	Variable category							Reference category			Tests of equality of variances		Tests of equality of means	
	Number	Mean	Standard deviation	Skewness	Kurtosis	JB statistic	JB p-value	Number	Mean	Standard deviation	F-statistic	p-value	t-statistic	p-value
Monday	2258	0.0005	0.9069	−0.5911	14.9106	1.3E+04	0.0000	9810	0.0405	0.8116	20.4010	0.0000	1.9236	0.0545
Tuesday	2458	−0.0386	0.9230	−8.2871	223.7458	5.0E+06	0.0000	9610	0.0513	0.8039	0.2896	0.5905	4.7926	0.0000
Wednesday	2470	0.0398	0.8081	0.4218	10.7877	6.3E+03	0.0000	9598	0.0312	0.8360	0.5772	0.4474	−0.4610	0.6448
Thursday	2467	0.0811	0.7604	−0.3131	9.9222	5.0E+03	0.0000	9601	0.0206	0.8470	2.0094	0.1564	−3.2273	0.0013
Friday	2414	0.0800	0.7354	−0.5551	10.9265	6.4E+03	0.0000	9654	0.0212	0.8521	12.5719	0.0004	−3.4006	0.0007
First trading day	529	0.0495	0.8074	0.3427	8.7646	7.4E+02	0.0000	11538	0.0322	0.8314	0.0100	0.9190	−0.4670	0.6410
Second trading day	529	0.1322	0.7089	0.3786	4.2188	4.5E+01	0.0000	11538	0.0284	0.8352	1.5200	0.2180	−2.8110	0.0050
Third trading day	529	0.0635	0.7917	−0.8008	9.3724	9.5E+02	0.0000	11538	0.0315	0.8320	0.0240	0.8760	−0.8650	0.3870
January	965	0.1015	0.7742	0.5985	7.8368	1.0E+03	0.0000	11103	0.0270	0.8348	0.0390	0.8434	−2.6722	0.0075
February	962	−0.0195	0.8099	−0.3183	4.9638	1.7E+02	0.0000	11106	0.0375	0.8320	3.0314	0.0817	2.0901	0.0368
March	1038	0.0106	0.7529	−0.0438	5.6609	3.1E+02	0.0000	11030	0.0351	0.8373	0.2948	0.5872	0.9086	0.3636
April	915	0.1002	0.7666	−0.4023	8.9872	1.4E+03	0.0000	11153	0.0275	0.8351	0.3237	0.5694	−2.5494	0.0108
May	1062	0.0348	0.7188	−0.0302	5.3423	2.4E+02	0.0000	11006	0.0328	0.8403	3.1802	0.0746	−0.0871	0.9306
June	982	0.0076	0.7171	−0.4423	10.1574	2.1E+03	0.0000	11086	0.0352	0.8396	7.6777	0.0056	1.1388	0.2550
July	1063	0.0657	0.6954	0.0717	5.4641	2.7E+02	0.0000	11005	0.0298	0.8422	6.7212	0.0095	−1.5755	0.1154
August	1040	0.0256	0.7346	−0.3418	6.4766	5.4E+02	0.0000	11028	0.0337	0.8388	2.3241	0.1274	0.3014	0.7631
September	1029	−0.0402	0.8305	−0.5825	16.4350	7.8E+03	0.0000	11039	0.0398	0.8300	0.0014	0.9703	2.9584	0.0031

Table 1 continued

Variable	Variable category							Reference category			Tests of equality of variances		Tests of equality of means	
	Number	Mean	Standard deviation	Skewness	Kurtosis	JB statistic	JB p-value	Number	Mean	Standard deviation	F-statistic	p-value	t-statistic	p-value
October	1040	−0.0055	1.3030	−7.4288	138.3602	8.0E+05	0.0000	11028	0.0366	0.7709	49.0219	0.0000	1.0262	0.3050
November	1027	0.0007	0.9328	0.5708	13.6128	4.9E+03	0.0000	11041	0.0360	0.8201	6.8415	0.0089	1.1690	0.2427
December	944	0.1287	0.7005	−0.0390	5.3304	2.1E+02	0.0000	11124	0.0248	0.8400	6.3817	0.0115	−4.3012	0.0000

Sample period is Monday 6 January 1958 to Friday 30 December 2005. The reference category is all observations other than the variable category i.e. for Monday returns the reference category is Tuesday, Wednesday, Thursday and Friday returns, for the First day, the reference category is all other trading days in the month; for January the reference category is all other months; number—number of observations in each category. The test for equality of variances is $L = (W-2)\sum_{k=1}^{2} W_k(\bar{Z}_{ki}-\bar{Z})^2 / \sum_{k=1}^{2}\sum_{i=1}^{nk} w_{ki}(\bar{Z}_{ki}-\bar{Z}_k)^2$ where $Z_{ki} = \left|X_{ki}-\bar{X}_k\right|$, $\bar{Z}_k = \sum_{i=1}^{n_k} w_{ki} Z_{ki}/W_k$ and $\bar{Z} = \sum_{k=1}^{2} w_k \bar{Z}_k / W_1 + W_2$. The test for equality of means is $t = D/S_D$, $df' = \frac{1}{Z_1+Z_2}$ (unequal variances) and $t' = D/S'_D$, $df = W_1 + W_2 - 2$ (equal variances) where $Z_k = \left(\frac{S_k^2/W_k}{S_1^2/W_1+S_2^2/W_2}\right)^2 / (W_k - 1) t = D/S_D df' = \frac{1}{Z_1+Z_2}$

also large, indicating leptokurtic distributions with many extreme observations. Given the sampling distribution of kurtosis is normal with mean 0 and standard deviation of $\sqrt{24/T}$ where T is the sample size, then all estimates are once again statistically significant at any conventional level. Finally, the Jarque–Bera statistics reject the null hypotheses of normality at the 0.01 level for all returns by category.

3.1 Parametric tests of mean return differences

At first impression, there appears to be strong evidence of calendar effect in the Australian stock market. Consider the days-of-the-week. Tests of the null hypotheses of equal variances are rejected for Monday and Friday (compared to returns on other days). The tests in Table 1 comparing these mean returns also indicate that the differences in means are statistically significant at the 0.05 level or lower with the exception of Wednesday. With the turn-of-the-month days, in no instance is the null hypothesis of equal variances rejected and only in the case of the second trading day of the month is the null hypothesis of equal means rejected. Finally, return variances are significantly different in February, May, June, July, October, November and December, though significant differences in means at the 0.10 level or lower are only found in January, February, April, September and December.

3.2 Regression-based analysis of seasonality

The estimated coefficients and standard errors of the parameters detailed in Eqs. (1) to (4) are presented in Table 2. Table 2 also includes the R^2 and adjusted R^2, an F-test of the null hypothesis that all slope coefficients are jointly zero and Breusch–Godfrey and White's statistics. Breusch–Godfrey Lagrange multiplier and White's heteroskedasticity tests are used to test for higher-order serial correlation and heteroskedasticity in the least squares residuals, respectively. To start with, the null hypothesis of no serial correlation is rejected for all four models and we may conclude the presence of higher-order serial correlation in the residuals. Then the null hypothesis of no heteroskedasticity in the least squares residuals fails to be rejected for the model based on Eqs. (1) and (2) and we conclude the presence of heteroskedasticity in the least squares residuals. Accordingly, all standard errors in Table 2 incorporate corrections for heteroskedasticity and autocorrelation following Newey–West.

Consider the day-of-the-week model. The estimated coefficient for Tuesday is significantly negative while those for Thursday and Friday are significantly positive. Clearly, the Australian market is characterised by the Tuesday effect observed in earlier studies. With the turn-of-the-month effect, only the estimated coefficient for the second trading is significant. Conventionally, the first trading day of the month is expected to have the higher returns under the turn-of-the-month effect. One possibility is that as the negative Tuesday effect in Australia potentially represents a delayed Monday effect in the US market, the positive second effect may correspond to the delayed transmission of the (positive) turn-of-the-month effect from the US. With the month-of-the-year model, the coefficients for February and September are both significantly negative. The combined model represented by Eq. (4) includes the

Table 2 Estimated coefficients and standard errors of day-of-the-week, day-of-the-month, month-of-the-year and calendar effect models

	Day-of-the-week effect		Turn-of-the-month effect		Month-of-the-year effect		Calendar effect	
	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
Constant	0.0398**	0.0164	0.0256**	0.0102	0.0657**	0.0291	0.0613*	0.0330
Monday	−0.0393	0.0252	–	–	–	–	–0.0354	0.0254
Tuesday	−0.0784***	0.0243	–	–	–	–	–0.0819***	0.0246
Wednesday	–	–	–	–	–	–	–	–
Thursday	0.0412**	0.0209	–	–	–	–	0.0446**	0.0209
Friday	0.0402*	0.0223	–	–	–	–	0.0449**	0.0223
First	–	–	0.0239	0.0366	–	–	0.0437	0.0371
Second	–	–	0.1066***	0.0323	–	–	0.1332***	0.0326
Third	–	–	0.0379	0.0342	–	–	0.0405	0.0341
January	–	–	–	–	0.0358	0.0446	0.0441	0.0445
February	–	–	–	–	−0.0852**	0.0405	−0.0861**	0.0403
March	–	–	–	–	−0.0551	0.0399	−0.0548	0.0398
April	–	–	–	–	0.0345	0.0431	0.0335	0.0430
May	–	–	–	–	−0.0309	0.0419	−0.0308	0.0418
June	–	–	–	–	−0.0581	0.0382	−0.0601	0.0380
July	–	–	–	–	–	–	–	–
August	–	–	–	–	−0.0402	0.0378	−0.0408	0.0375
September	–	–	–	–	−0.1060**	0.0412	−0.1061***	0.0411
October	–	–	–	–	−0.0713	0.0589	−0.0721	0.0588
November	–	–	–	–	−0.0650	0.0419	−0.0651	0.0417
December	–	–	–	–	0.0630	0.0410	0.0604	0.0411

Table 2 continued

	Day-of-the-week effect		Turn-of-the-month effect		Month-of-the-year effect		Calendar effect	
	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
R^2	0.0031	–	0.0008	–	0.0037	–	0.0080	–
Adjusted R^2	0.0028	–	0.0005	–	0.0028	–	0.0065	–
F-statistic	9.5052***	–	3.1017**	–	4.0258***	–	5.3747***	–
Breusch–Godfrey	183.5907***	–	184.4989***	–	178.6054***	–	175.7259***	–
White	1.3061*	–	0.21288	–	3.1858***	–	2.2903***	–

Asterisks indicate significance at the *0.10 **0.05 ***0.01 levels. Sample period Monday 6 January 1958 to Friday 30 December 2005. The dummy variable reference categories are Wednesday, trading days of the month after the third day and July. F-test is of null hypothesis that all slope coefficients are zero. Breusch–Godfrey—Breusch–Godfrey serial correlation LM test for ordinary least squares regression model, White—White heteroskedasticity test for ordinary least squares regression model. All standard errors and p-values incorporate Newey–West corrections for heteroskedasticity and autocorrelation of unknown form day-of-the-week, turn-of-the-month and month-of-the-year variables with the results being consistent with the earlier findings. In all four models, the null hypothesis of joint insignificance is rejected at the .01 level. The signs on the estimated coefficients in these four models appear to offer support for the posited calendar effects.

In order to examine the long-run stability of the parameters in this model, cumulative sum of squares tests are run and the results plotted (not shown). All other things being equal, movement outside the 5% critical lines is suggestive of parameter instability. Using this approach, some evidence of parameter instability is found, with a significant structural break corresponding to October 1987. Accordingly, a Chow breakpoint test (F-statistic = 2.3111, p-value = 0.0046) is conducted with a break on 20 October 1987 (Australia's largest one-day market fall). Since the null hypothesis of parameter stability is rejected, the refined model is re-estimated for two non-overlapping sub-samples: 6 January 1958 to 19 October 1987 and 20 October 1987 to 30 December 2005. The results for these models are presented in Table 3.

In general, the significance, magnitude and sign of the coefficients in the earlier period (Table 3) are comparable with the entire sample period (Table 2). However, in the post-1987 crash period, only the coefficients for the second and September are still significant and the null hypothesis of the joint insignificance of the slope coefficients fails to be rejected. Interestingly, calendar effects in the pre-1987 period and overall are dominated by day-of-the-week effects (Tuesday, Thursday and Friday). However, in the post-1987 period, there is only the influence of a single month-of-the-year effect (September) and a single day-of-the-month effect (Second). In order to gain further insights into the stability of individual parameters, plots of selected coefficients in the equation for all feasible recursive estimations are estimated (not shown). As a rule, if a coefficient displays significant variation as more data is added to the estimating equation, it is a strong indication of instability. These plots also indicate instability and a decline in the calendar effect coefficients over time.

4 Conclusion

This study examines the presence of calendar effects or seasonality in Australian market returns over the period 1958 to 2005. Three manifestations of calendar effects are examined: namely, the day-of-the-week effect, the turn-of-the-month effect and the month-of-the-year effect. Many of the results are consistent with the established literature in Australia and elsewhere: a negative Tuesday effect and positive Thursday and Friday effects; a negative February and September effect; and a positive market impact on the second trading day of the month. The three most substantive Australian calendar effects over the entire sample period are the negative Tuesday effect, the negative September effect and the positive second of the month effect. There is no evidence, at least in the Australian market, of the January, Monday and first trading day of the month effects sometimes observed in the US market. However, there is some suggestion that the significant Tuesday and second trading day of the month effects may correspond to the lagged influence of the US market.

Importantly, the estimated parameters in the equations are not structurally stable over the full sample period and there is a statistically significant intertemporal

Table 3 Estimated coefficients and standard errors of calendar effects model

Sample	Monday 6 January 1958 to Monday 19 October 1987		Tuesday 20 October 1987 to Friday 30 December 2005	
	Coefficient	Std. error	Coefficient	Std. error
Constant	0.0386	0.0429	0.1002**	0.0494
Monday	−0.0266	0.0304	−0.0497	0.0443
Tuesday	−0.1007***	0.0233	−0.0526	0.0518
Wednesday	–	–	–	–
Thursday	0.0849***	0.0254	−0.0235	0.0365
Friday	0.0943***	0.0265	−0.0372	0.0390
First	0.0419	0.0439	0.0483	0.0657
Second	0.0983***	0.0378	0.1889***	0.0589
Third	0.0800**	0.0407	−0.0293	0.0603
January	0.0860	0.0614	−0.0264	0.0559
February	−0.0907*	0.0541	−0.0788	0.0567
March	−0.0483	0.0527	−0.0656	0.0584
April	0.0430	0.0569	0.0177	0.0622
May	−0.0302	0.0570	−0.0326	0.0563
June	−0.0605	0.0505	−0.0592	0.0547
July	–	–	–	–
August	−0.0178	0.0493	−0.0790	0.0565
September	−0.1025*	0.0549	−0.1118*	0.0581
October	−0.0133	0.0570	−0.1656	0.1081
November	−0.0637	0.0562	−0.0687	0.0597
December	0.0803	0.0546	0.0303	0.0599
R^2	0.0153	–	0.0055	–
Adjusted R^2	0.0130	–	0.0016	–
F-statistic	6.4428***	–	1.4108	–

Asterisks indicate significance at the *0.10, **0.05 and ***0.01 levels. Sample periods in uppermost row of table. F-test is of null hypothesis that all slope coefficients are zero. All standard errors and p-values incorporate Newey–West corrections for heteroskedasticity and autocorrelation of unknown form

break at the time of the 1987 stock market crash. The calendar effects are then re-examined in the pre-crash period and post-crash periods. In the pre-crash period, the Australian market is strongly characterised by seasonal factors. But in the post-crash period, the market appears to display less and less complex seasonality. Since seasonal anomalies represent unexploited profit opportunities and violate market efficiency, the disappearance of seasonality may imply that the Australian stock market has gradually become more (weak form) efficient in the post-crash period. A number of contributory factors are possible, including the growth in derivative markets, the increasing internationalisation and liberalisation of the domestic capital market, increased trading by institutional rather than individual investors and the dramatic fall in transaction costs, especially those relating to brokerage, taxation and information procurement.

It is also possible that factors not conventionally assigned to improvements in efficiency have had an affect. For example, the substantial changes in settlement regimes over time in Australia may have had a role to play, especially with the day-of-the-week effects, and a useful extension to this work would follow the approach of Keef and McGuinness (2001) and reflect this more fully. Likewise, Connolly (1989) finds that large time series datasets may bias the findings of classical test statistics and concludes that large sample sizes quite often favour the null hypothesis of equal returns across days of the week and bias hypothesis tests in the direction of an anomaly for the weekend effect. Sensitivity analysis in the spirit of Connolly (1989) would then also be useful to place work on calendar effects in the Australian market on a more secure statistical footing.

Finally, there are very many interactions possible between the three calendar effects in this study and yet other calendar anomalies that we could not cover (for reasons of brevity and complexity). For instance, a broader test of the 'turn-of-the-month' effect could incorporate the week-of-the-month effects considered by Ariel (1988) in the US. Similarly, Wang et al. (1997) found that the Monday effect might help in explaining subdued returns in the US in the final and penultimate weeks of each calendar month. It is then possible that week-of-the-month effects are much stronger than any day-of-the-week effect. Lastly, the higher Thursday and Friday returns found in some parts of this analysis may be due, in part, to pre-holiday effects. As elsewhere, a disproportionate (but small) number of holidays in Australia take place before Fridays and/or Mondays. These all provide possible research extensions.

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