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On the Disappearance of Tuesday Effect in Australia

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School of Finance and Business Economics Working Paper Series
September 2001
Working Paper 01.12
ISSN: 1323-9244

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Abstract

Day of the week (DOW) effect has been well known in many markets. The United States, the United Kingdom, Canada, and Switzerland all have been found to exhibit significant average negative Monday returns [Agrawal and Tandon, 1998]. Other developing markets in Indonesia, Malaysia and Thailand are also found to have the same seasonality [Choudhry, 2000]. Australia however displays its DOW effect on Tuesdays rather than on Mondays (Jaffe and Westerfield [1985], Easton and Faff [1994]). Jaffe and Westerfield [1985] suggest that there might be a linkage between the U.S. Monday seasonal and the Asia-Pacific DOW effect as they are one day out of phase due to different time zone. Since then, a few studies have examined the relationship of daily returns among the markets. But to our knowledge, no study has directly investigated the relationship between U.S. Monday and Australia Tuesday effect. We therefore re-examine the anomaly and document that the DOW effect in Australia is Granger caused by the weekend effect in U.S. and not the other way conditional on the weekend effects in the U.K. and Japanese markets. We also find that in the post 1987 period, where the U.S. Monday returns are positively significant, Australia Tuesday returns also reverses its effect. This latter finding provides further evidence that the anomaly in Australia is induced by the weekend effect in the U.S.

Keywords: Day of the week effect; Granger causality; Australian stock returns

JEL Classification No.: G12, G14, G15.

1. INTRODUCTION

Day of the week (DOW) effect has well been documented in the major markets since French [1980] discovered it. The United State, the United Kingdom, Canada, and Switzerland all have been found to exhibit significant average negative Monday returns [Agrawal and Tandon, 1998]. Other developing markets in Indonesia, Malaysia and Thailand are also found with the same seasonalities [Choudhry, 2000]. Although numerous studies have attempted to offer explanations on U.S. evidence such as settlement procedures, institutional trading and delayed announcements of bad news, (see, for example, Keim and Stambaugh [1984], Lakonishok and Smidt [1988], Chang, Pinegar and Ravichandran [1998]) no complete explanation has yet been offered to solve the puzzle.

What's interesting in the Australian stock market is that the DOW effect occurs on Tuesdays rather than on Mondays (see Jaffe and Westerfield [1985], Finn, Lynch and Moore [1991], and Easton and Faff [1994]).[1] While there are few studies that examine the Australian data, Jaffe and Westerfield [1985] suggest that there maybe a linkage between the U.S. Monday seasonal and the Asia-Pacific DOW effect. They find that other major countries do exhibit similar seasonal as the U.S. but due to different time zones, the Far Eastern countries may experience one day out of phase effect. In fact, there is a 14 hours difference between Sydney and New York and that the Australian Stock Exchange opens 3 and half hours on Tuesdays after U.S. markets close on Mondays. Therefore, one could conjecture that the U.S. negative Monday returns potentially cause the negative Tuesday returns in Australia as the average negative performances of the U.S. markets on Mondays have immediate impact on the subsequent performance of the Australian market on Tuesdays. Jaffe and Westerfield, however, find some weak support over the linkage when they test the cross-correlation of non-contemporaneous daily returns between the U.S. and Australia. They conclude that the DOW effect in Australia is independent from the U.S. seasonal. Easton and Faff [1994] extend Jaffe and Westerfield study by incorporating Connolly [1989]'s methodology to adjust for the upward bias in the F-statistics when the sample is large and when the distribution is non-normal. Their empirical results also support the strong independence from the U.S. effect.

Although the DOW effect centres upon Monday returns in the U.S. and Tuesday returns in Australia, these studies examine the overall linkage on each day of the week between the two markets rather than the specific causality relationship between the anomalies. Their

findings therefore may not necessarily provide direct evidence as to whether the Tuesday effect is the result of the weekend effect in the U.S. when other positive weekday returns in the U.S. may not have significant impact on the other weekday returns in Australia. Hence, further examination on the issue is warranted.

With the advances in computer technology and increased integration of the world markets, it is important to consider the effects of other major markets while re-examining the U.S.-Australia linkages. We extend earlier studies and investigate whether U.K. Monday returns and Tuesday returns in Japan may also have any effect on Tuesday returns in Australia since these two major markets also exhibit DOW regularities and have strong economic ties with Australia in trades.

In this paper, we document that the Tuesday effect in Australia is Granger caused by the weekend effect in U.S. and not the other way conditional on the returns in the U.K. and Japanese markets. We also find that in recent years where the U.S. Monday effect has reversed, the Tuesday effect in Australia also turns into significantly positive. This latter finding provides further evidence in the causality relationship between these two countries. Finally, we also found a two-way Granger causation between returns in the Australian and U.K. markets, but no causation was found between the Australian and Japanese markets.

The plan of the study is structured as follows. Section 2 describes the data and methodology for various tests conducted. Section 3 reports the empirical results. Some concluding remarks are given in Section 4.

2. DATA AND METHODOLOGY

The data for this study are daily total market return indices of Australia, Japan, U.K. and U.S. obtained from DATASTREAM. These indices have been adjusted for dividends and provide the longest sampling period we can find from the same database dating back from January 1973 through December 2000. The daily returns are calculated from the first difference of the log of indices multiplied by 100.

In this paper, simple t-tests are first conducted to examine the significance of the DOW effects in Australia U.S., U.K. and Japan. As financial time series data are typically non-

stationary, it is important to test whether each return series contains a unit root using the augmented Dickey-Fuller test. Finally, Granger causality tests are conducted to test the significance and direction of causality between the market returns.

According to Granger [1969], a variable *X* is said to 'Granger-cause' *Y* if the past values of *X* help in the prediction of *Y* after controlling for past values of *Y*, or equivalently if the coefficients on the lagged values of *X* are statistically significant. We extend the definition of Granger causality to test if U.S. returns Granger cause the Tuesday effect in Australia conditional on the returns in the U.K. and Japanese markets. The equations for two-way causality tests are given by

$$X_t = a_t + \sum_{i=1}^{n} b_i X_{t-i} + \sum_{i=0}^{n-1} c_i Y_{t-i} + \sum_{i=0}^{n-1} d_i W_{t-i} + \sum_{i-1}^{n} e_i Z_{t-i} + u_t \quad (1)$$

$$Y_t = a_t^* + \sum_{i=2}^{n+1} b_i^* X_{t-i} + \sum_{i=1}^{n} c_i^* Y_{t-i} + \sum_{i=1}^{n} d_i^* W_{t-i} + \sum_{i-2}^{n+1} e_i^* Z_{t-1} + u_t^* \quad (2)$$

where X_t and Z_t are Tuesday returns in Australia and Japan, Y_t and W_t are Monday returns in U.S. and U.K., repectively, X_{t-i}, Y_{t-i}, W_{t-i} and Z_{t-i} are their respective lagged returns, and u_t is a random disturbance with zero mean and finite variance. Equations (1) and (2) will be estimated using ordinary least squares (OLS) method. A test of the null that U.S. Monday returns do not Granger cause the Tuesday effect in Australia is obtained using an F-test for joint significance of lagged *Y* in equation (1) that also depends on lagged *X*, lagged *W* and lagged *Z*.

Evidence suggests that stock returns have time-varying volatility and error terms from OLS regressions involving stock returns are also not normally distributed. Thus, the generalised autoregressive conditional heteroscedasticity (GARCH) model developed by Bollerslev [1986] which incorporates heteroscedasticity and distinguishes between non-normal conditional and unconditional errors is also used to examine the DOW effect. For the GARCH(1,1) model, the conditional variance of the unconditional shock u_t in equation (1) is given by

$$u_t = \eta_t \sqrt{h_t} \tag{3}$$

$$h_t = \omega + \alpha u_{t-1}^2 + \beta\, h_{t-1} \tag{4}$$

where η_t is a sequence of normally, independently and identically distributed random variables with zero mean and unit variance, $\omega > 0$, $\alpha > 0$, and $\beta \geq 0$.

3. EMPIRICAL FINDINGS

3.1 Another Look at the Weekend Effect

The summary statistics of day of the week returns for Australia, U.S., U.K., and Japan from January 1973 to December 2000 are presented in Table 1. Consistent with the previous studies, we find that the U.S. and the U.K. markets exhibit negative average returns only on Mondays and with high positive average returns on Fridays. We also find that Japan and Australia have the highest negative average returns on Tuesdays and highest positive returns on Wednesday and Thursdays, respectively. The skewness and kurtosis of the daily returns of each market also show significant non-normality at the 1% level as reported by the Jarque-Bera test. Since many large negative returns centered around Mondays in the U.S. and U.K. markets and around Tuesdays in Australia and Japan, not surprisingly, these returns are the most negatively skewed.

[Insert Table 1 about here.]

Panel A of Table 2 reports the t-statistics of the day of the week returns of the four major markets for the full period from January 1973 to December 2000. Contrary to the earlier findings, the weekend anomalies in the U.S. have all but disappeared. Similarly, Australia and Japan's average negative returns on Tuesdays are not statistically significant. The only exception is the U.K. market where it still exhibits the Monday effect. One reason that our statistical results may differ from others is that earlier studies derive their results from the sampling period in the 80s and earlier whereas ours come from the sampling period that extends to the end of 2000. We therefore look into the difference in the DOW returns further by examining the behaviour in the sub-periods.

[Insert Table 2 about here.]

Panel B documents the t-statistics of the first sub-period from January 1973 to December 1987.[2] All four markets clearly show the anomalies on either Monday or Tuesday at either 1 or 5 percent level. It is thus consistent with the results of the earlier studies which are driven by the first sub-period where the negative Monday and Tuesday returns are the most dominant. The contrast of the t-statistics with those in the second sub-period also supports this finding.

The last panel in Table 2 shows that from January 1988 to December 2000, the Monday and Tuesday effects in the U.S. and Australian markets have reversed themselves from significantly negative to positive, and have disappeared in the U.K. and Japanese markets. From the t-statistics, we find that the reversal or the disappearance of the effects in the sub-period has offset those in the earlier sub-period and attenuates the overall effects of Monday and Tuesdays in the full period. This trend is consistent across all of the four markets and provides indirect evidence that the Tuesday effect in Australia maybe related to the anomalies of the other markets but one day out of phase due to the different time zone. Therefore, we further investigate the linkage directly by examining whether the U.S. weekend effect granger-caused Australia's Tuesday effect conditional on the weekend effects in U.K. and Japan.

3.2 Do the U.S., U.K. and Japan Anomalies Granger-cause Australia's Tuesday Effect?

Before conducting Granger causality tests, augmented Dicky-Fuller (ADF) test is used to determine if each of the return series is stationary. For weekly data, an initial lag length of twelve is used for the unit root test. The t-statistics for the ADF tests reject the null hypothesis of a unit root in each day of week return series for Australia, U.S., U.K. and Japan at the 1% level. We therefore conclude that each series is stationary.

We run the Granger causality tests according to equation (1) and (2). In the week of international markets crash in October 1997, extreme negative returns of 4.5% and 8.4% were recorded for Australia's Tuesday and U.S. Monday, respectively. To control for extreme observations which can adversely affect the estimates of equations (1) and (2), a dummy

variable is included. The dummy variable is set to unity for the week of market crash and to zero for all other weeks. Results of the estimation using EViews 4 program are reported in Table 3. The F-statistics show that the U.S. past returns captures variation in Australia's Tuesday effect at the 1% level, while Australia lagged returns are not statistically significant in explaining the U.S weekend effect.[3] We therefore find at the U.S. past returns Granger caused the Australia's Tuesday effect.

[Insert Table 3 about here.]

In fact, not reported in Table 3, we find that among the lagged returns, the U.S. Monday returns are the most significant factor in explaining the Tuesday returns in Australia based on the t-statistics. Although we have the similar finding that the U.K.'s lagged returns also have significant effect on Australia's Tuesday returns, the same can be said on the returns of Australia on the U.K's. Lastly, we are surprised that Japan's and Australia's returns have no significant effect on each other's anomalies.

4. CONCLUSION

In this study, we find that the Australia's Tuesday effect that has been documented in earlier studies has disappeared due to the reversal of the effect in the recent period. We also find similar pattern exists in the anomalies of the U.S. and returns in Japan with the exception of U.K. in the overall period. We examine whether the anomalies of these major markets have influenced the behaviour of the Tuesday returns in Australia and provide evidence of one-way Granger causality from U.S. returns to Australia's Tuesday effect and not the other way conditional on the lagged returns of the U.K. and Japanese markets. Although this paper does not explain the weekend effect in the U.S., the disappearance of the anomalies in the major markets casts doubt on any explanations of microstructure theories on the weekend effect. Furthermore, the evidence we find here suggests that the weekend anomalies in other markets may be first induced by the U.S. Monday effect.

Notes

1. Japan is also found to have Tuesday effect.

2. When the week of October 1987 crash is excluded from the sample, we still find significant negative returns on Mondays and Tuesdays in the four major markets.

3. We incorporate GARCH (1,1) in the tests, and find the results similar to those reported here.

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Table 1: Summary of Day of the Week Returns for Australia, U.S., U.K. and Japan

	Mean	Std Dev	Skewness	Kurtosis	Jarque-Bera
Panel A: Australia					
Monday	-0.0125	1.1661	-0.733	13.85	7297.166*
Tuesday	-0.0522	1.2741	-8.303	197.31	2315187*
Wednesday	0.0907	1.0541	0.305	8.55	1899.1*
Thursday	0.1255	1.005	-0.167	8.83	7297.2*
Friday	0.0909	0.9998	-0.679	11.53	4541.6*
Panel B: U.S.					
Monday	-0.0101	1.1155	-5.043	87.42	440067.6*
Tuesday	0.065	0.9453	0.453	5.64	472.99*
Wednesday	0.0816	0.8839	0.612	9.72	2842.8*
Thursday	0.0358	0.9037	0.118	6.22	636.97*
Friday	0.0631	0.9286	-0.692	9.3	2536.6*
Panel C: U.K.					
Monday	-0.0807	1.0753	-0.548	11.71	4687.8*
Tuesday	0.1068	1.0437	-1.276	21.62	21491*
Wednesday	0.0922	0.9725	0.009	6.46	731.3*
Thursday	0.0452	0.9946	0.49	9.68	2777.4*
Friday	0.1222	0.9935	0.516	10.82	3784.3*
Panel D: Japan					
Monday	-0.0124	1.1338	-0.554	8.81	2128.4*
Tuesday	-0.0349	0.979	-2.182	55.47	168754*
Wednesday	0.0921	0.9444	0.574	12.3	5341.5*
Thursday	0.0242	0.9204	-0.017	7.38	21168.3*
Friday	0.0496	0.9225	0.686	10.86	3876.2*

Std Dev is the standard deviation of the returns.
Jarque-Bera is the normality test.
* denotes significant at the 1% level.

Table 2: t-Statistics for the Average Returns on Each Day of the Week for Australia, U.S., U.K., and Japan

	Australia	U.S.	U.K.	Japan
Panel A: January 1973 to December 2000				
Monday	-0.4111	-0.3469	-2.8673	-0.417
Tuesday	-1.5662	2.6277	3.9097	-1.3618
Wednesday	3.2892	3.5291	3.5459	3.7259
Thursday	4.7719	1.5136	1.7372	1.0068
Friday	3.4766	2.6003	4.7029	2.0565
Panel B: January 1973 to December 1987				
Monday	-1.0309	-2.1906	-3.1964	1.9307
Tuesday	-3.0008	1.5033	2.7475	-3.0965
Wednesday	2.0674	2.9783	2.7241	5.6663
Thursday	5.026	1.857	1.0894	1.5003
Friday	3.7345	1.9723	4.158	3.4887
Panel C: January 1988 to December 2000				
Monday	0.6852	2.5508	-0.3252	-1.9018
Tuesday	2.3545	2.239	2.9718	0.9479
Wednesday	2.8252	1.9263	2.3274	0.7047
Thursday	1.0462	0.2594	1.4855	0.2067
Friday	0.6974	1.7228	2.2928	0.0463

Table 3: F-Statistics on the Granger Causality Test of Equations (1) and (2) from January 1973 to December 2000

	Australia
U.S.	37.308* 1.262
U.K.	11.82* 4.449*
Japan	0.995 1.337

The first row shows the F-statistics of U.S., U.K. or Japan Granger-caused Australia and the second row is of Australia Granger-caused U.S., U.K., or Japan.
* denotes significant at the 1% level.