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THE DAILY RETURN PATTERN IN THE AMMAN STOCK EXCHANGE AND THE WEEKEND EFFECT

Samer A.M. Al-Rjoub*

This paper examines the robustness of evidence on the weekend anomaly in stock return data after accounting for the impact of possible measurement errors and sample sizes. Consistent with the previous literature, the sample evidence quite often favours the alternative hypothesis of unequal returns across days of the week. The start-of-the-week day's returns are consistently insignificantly negative across different time frames. The average returns for the day right after the beginning of the working week are consistently significantly negative. After controlling for the change of the working week to start on Sunday, results show that Thursday's return (the end of the week) tends to be positive and the highest, while Monday's return is a "downer" (negative and the worst). This result is consistent with previous results documented in the literature. Possible explanations for the high positive significant Thursday return are the possible settlement practices, which imply unusually high closing on Thursdays and consequently lower closing on Mondays. Professional market watchers who are aware of the daily return pattern should adjust the timing of their buying and selling to take advantage of the effect. The new logical implication is "Don't sell stocks on the second day of the week".

1. INTRODUCTION

One of the most puzzling anomalous empirical findings reported in the finance literature is associated with the asymmetric mean return distributions of daily common stock returns during the week. The earliest recording of this phenomenon was by Cross (1973) and French (1980) who observed that stock returns are higher than average on the last trading day of the week and lower than average on the first. Spawned by the work of Cross and French, numerous studies searched for satisfactory explanations to rationalise such puzzling discovery of

* Assistant Professor, Finance Department Chair, Department of Banking and Finance, Hashimite University, Jordan.

the persistent negative Monday (or weekend) returns. To our knowledge, the so-called Monday effect has yet to be explained.[1]

In an effort to search for a satisfactory explanation for the weekend effect, a plethora of recent papers attempts to explain these weekday average returns asymmetries. These explanations include market settlement procedure (Gibbons and Hess, 1981; Lakonishok and Levi, 1982), measurement error in stock prices (Keim and Stambaugh, 1984; Connolly, 1989, 1991), and information release after market close (Damodaren, 1989; Patell and Wolfson, 1982), and a mixture of other seasonality hypotheses (Wang and Erickson, 1997).

This paper enriches the empirical work by accommodating the following issues. First, it adjusts for sample size, changing volatility of time-series shocks, autocorrelation, and/or fat tails in the distribution of average returns.[2] It is well known in the econometrics literature that full information maximum likelihood estimation (FIML), such as the GARCH models, is more efficient than instrumental variables estimators, such as the two-step regression procedures; although both estimators are consistent if the model is correctly specified. Secondly, the paper adds further insight into the empirical regularity regarding the daily return pattern and the weekend effect. Thirdly, it explores the measurement error hypothesis as a possible source of the weekend effect. Fourthly, it will help institutional investors and individuals who are aware of the daily returns pattern to adjust the timing of their buying and selling to take advantage of the new effect. The new logical implication for professional market watchers is “Don’t sell stocks on the day right after the start of the week”. [3]

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[1] An immediate natural reaction to explain this phenomenon is that firms wait until after the closing of the market on Fridays to announce bad news. Another explanation suggests that negative returns are caused by a general “market-closed” effect. Unfortunately, these explanations are unsatisfactory. The problem with the first explanation is that soon people would anticipate such behaviour and discount Friday prices to account for it. The flaw with the second explanation is that for days following holidays, only Tuesday returns are negative. All other days of the week that follow holidays have positive returns (see French, 1980).

[2] My estimated model generates thick tails with both a randomly changing conditional variance and thick-tailed conditional distribution for the time-series’ shocks.

[3] This statement is a reply to the Hirsch (1986) book title “Don’t sell stocks on Monday.”

The remainder of the paper is organised as follows: Section 2 reviews the previous research. The methodology and data are presented in section 3, the empirical results in section 4 and the conclusions in section 5.

2. LITERATURE REVIEW

The weekend effect refers to the abnormally high returns to common stocks on Fridays and negative returns on Mondays. French (1980) notes that the average return on the Standard and Poor's (S&P500) composite portfolio was significantly negative over weekends from 1953 to 77. The findings of French (1980) and Gibbons and Hess (1981) presented a challenge to the efficient markets theory[4]. They are at odds with asset pricing theories that accommodate neither negative risk premia nor such predictable variations in risk premia. According to standard economics theory, stock prices should follow a martingale process and returns should not exhibit systematic patterns [e.g. Samuelson (1965), Leroy (1973), and Lucas (1978)].

The empirical evidence has shown that the day-of-the-week effect (henceforth the weekend effect) is not limited to the U.S. equity markets. The work of Jaffe and Westerfiel (1985a), Solnik and Bousquet (1990) and Barone (1990) discovered a similar effect in other international equity markets, and very recently Dubois and Louvet (1996), Wang et al. (1997), and Chang, Pingar and Ravichandran (1998) found that the weekend effect still exists in both U.S. markets and other international markets throughout the 1990s[5]. These findings among others confirm that the weekend effect remains after two decades of research.

Despite the substantial efforts of academicians in trying to explain the so-called weekend phenomenon, the peculiar pattern in the weekdays' return remains puzzling. Numerous explanations have been developed to rationalise the discovery of a persistent weekend effect. Lakonishok and Levi (1982) introduced the settlement effect

[4] Keim and Stambaugh (1984), Rogalski (1984), and Aggarwal and Rivoli (1989) draw similar conclusions to those of French (1980).
[5] Though Schwert (2001) reports that the weekend effect has disappeared since it was published in the 1980.

explanation. They attributed 17% of the effect to the delay between trading and settlements in stocks and clearing checks. Keim and Stambaugh (1984) introduced the bid-ask-spread bias as a possible explanation for the effect. Penman (1987) and Damodaran (1989) considered the information release assumption as a possible source. Gibbons and Hess (1981) and Rogalski (1984), on the other hand, introduced measurement error as an explanation.

Lakonishok and Maberly (1990), Sias and Starks (1995) and Kamara (1995) documented that trading behavior, especially selling activity, tends to increase trading activity on Mondays. Sias and Starks (1995) reported that the weekend effect returns and volume patterns are more pronounced in securities in which institutional investors play a great role. Kamara (1995) assumes that increased institutional trading activity is responsible for the Monday seasonal returns. Finally, Wang et al. (1997) proposed the measurement error hypothesis.

What about this effect in Jordan? In Jordan, the story is different. The working week starts on Sundays not on Mondays.

The Jordanian government decided to extend the stock market's holiday one more day to include Saturday, starting from the third of March 1999. Before this date, the working week was six days long and used to start on Saturday and end on Thursday. The major reason for shifting the day off is to try to match the financial institutions' holiday with those of the foreign market. This decision has an effect on our study. Now, we have to change the weekday dummy variable to cover Saturdays beyond this date. To put it differently, the logical solution for such a situation is that we must test for a Saturday effect before 3/3/99 and a Sunday effect after that. In order to do so, daily share price index data were collected for the period from 3/1/1992 to 4/12/2002 from the Amman Stock Exchange (ASE). A detailed description of the data is given in the following section.

3. METHODOLOGY, DATA AND HYPOTHESIS

In this paper, we used a generalised autoregressive conditional heteroskedasticity in mean (GARCH-M) model to test for the weekend effect in Jordan. Whereas previous studies of this effect assume a constant probability distribution of the random residuals, this paper adjusts for measurement errors by assuming a time-varying structure in firm's risk. Values of value-weighted ASE index were collected from the Central Bank and ASE monthly statistical bulletins for the period January 1992-September 2002. To compute stock market returns, R_t, we took the log difference for the daily general price index weighted by market capitalisation as in the following formula:

$$R_t = \ln P_t - \ln P_{t-1},$$

where P_t is the value of the Amman Stock Exchange price index for the period *t* (*t* is time in months). As a result, there are a total of 2682 daily observations ranging from January 1992 to September 2002.

It is important to notice that the name «weekend effect» had been used in the literature interchangeably with the name «Monday effect», since the first working day starts on Mondays in most of the foreign markets. The situation is different in Jordan. The working week starts on Saturdays prior to the third of March 1999 and on Sundays after that date. In order to account for the beginning-of-the-week difference, the sample has been divided into two samples. The first covers the period from 1/3/1992 to 3/3/1999 and the second the period from 7/3/1999 to 4/12/2002.

Following French, Gibbons and Hess, Jaffe and Westerfield, and Keim and Stambaugh, we construct a test to account for differences in the mean returns across the days of the week. With tractability and predictability as a major concern, we start with the following univariate GARCH (1, 1)-M model[6] for the stock market returns R_{it} (the dependent variable):

[6] Engle, Lilien, and Robins (1987) and Bollerslev, Engle, and Wooldridge (1985) extend the basic ARCH framework to allow the mean of a sequence to depend on its own conditional variance. They suggest adding a time-varying intercept to the following basic univariate model: $\eta_{t+1}=\sigma_t\varepsilon_{t+1}$, $\eta_{t+}1 \sim N\ (0,\sigma^2_t\ )$, where η_{t+1} is the non-zero conditional normally distributed mean innovation. This class of model called ARCH-M is particularly suited to the study of asset markets. It provides a close and parsimonious approximation to the form of heteroskedasticity typically encountered with economic time-series data.
The generalized ARCH (*p*,*q*) model-called GARCH (*p*,*q*) allows for both autoregressive and moving average components in the heteroskedastic variance. The GARCH-in-mean or GARCH-M model makes the conditional mean of the return

$$\tilde{R}_{it} = \alpha_{wt}\sum_{t=1}^{5} d_t + \vartheta_{it}\sigma^2{}_{it} + \varepsilon_{it}, \varepsilon_{it} \sim N\left(0, \sigma_{it}^2\right)$$
$$\sigma_{it}^2 = \omega_i + \xi_{it}\varepsilon_{t-1} + \varphi_{it}\sigma_{it-1}^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$
$$i = 1,2,\ldots,10$$
$$t = 1,\ldots,5$$

d_t is a dummy variable for the days of the week, d_t =1 if day t is a Saturday before 7/3/1999 (and Sundays after that), and d_t =0 otherwise. σ^2_{it} is the conditional variance at period *t*. The coefficient of d_t measures the differences in mean returns across the days of the week.

We test the hypothesis that $\alpha_{w1}=\alpha_{w2}= \ldots = \alpha_{w5}$. If Saturdays' (Sundays') returns are significantly lower than other days', α_{w1} should be significantly negative. This GARCH (1, 1) model was chosen because it seems to approximate the time-varying behaviour of the conditional variances.

The results for the maximum likelihood use both Berndt-Hall-Hall-Hausman (BHHH) and Marquardt algorithm for maximisation. The GARCH assumes that the residuals are *iid* even if the distribution of the residuals is not normal, and the estimates are still consistent under quasi-maximum likelihood (QML) assumptions.

Table 1, panel A shows that the mean unconditional Saturday return over the period 1992-1999 is equal to 0.021 percent and the highest among the rest of the weekdays; a finding inconsistent with earlier research in such area. The mean Sunday returns over the sub-period 1999-2002 is (0.0004 %). The t-test for the equality of means across the days of the week is statistically insignificant in the period 1992-1999 and statistically significant in the period 1999-2002. This indicates that the daily mean returns are statistically equal in the first sub-period when the week starts on Saturday and statistically insignificant when the week

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linear in the conditional variance. The key feature of GARCH models is that the conditional variance of the residuals of the dependent variable sequence constitutes an ARMA process. Hence, it is expected that the disturbances from the fitted ARMA model should display the characteristic pattern. It can be estimated straightforwardly by maximum likelihood, although asymptotic normality condition of the maximum likelihood estimator may not be satisfied.

starts on Sunday. These results indicate that the start-of-the-week effect does not exist in Jordan's stock market and suggest that the anomaly does not exist in the first place. More interestingly, the variability of returns happens to be the highest at the beginning of the week; a result that holds across the two sub-periods. The standard deviation is 40% and 37% for Saturday and Sunday for the 1992-1999 and 1999-2002 periods respectively. It is also found that the variability of returns decreases as the week progresses. Based on the standard deviation of returns alone, it is not possible to explain the high Saturday's return as a consequence of the relation between risk and return. The weekend's return is not a "downer" in all cases.

Before testing for the weekend effect using the ARCH family, the time-series properties must be tested. Table 2 reports a summary statistics for the daily returns of the market proxy. The null hypothesis of a Gaussian distribution is rejected; estimates of kurtosis and skewness support the existence of conditional heteroskedasticity, which induces a fat-tailed distribution of index returns. The Ljung-Box statistics for the twenty-fourth serial correlations of the daily return series are significant in almost all cases at the 5% level for the returns of the general share price index. The Ljung-Box statistics are robust across the sample and show no evidence of any indication of temporal dependence. The Jarque-Bera test statistics are strongly significant at 1% level for all the return portfolios, which indicates non-normality. Overall, there is strong evidence of changing risk premia and return volatilities.

4. EMPIRICAL RESULTS

The weekend effect anomaly can be investigated by embedding it into a model of daily return. Tables 3 and 4 present the results from the GARCH-t (1, 1)-M models to test for the weekend effect, which covers the period 1992-2002. Table 3 reports the results for model 1. Several interesting results emerge from Table 3. First, start-of-the-week returns are consistently insignificant over the periods 1992-1999 and 1999-2002. Second, over the period 1992-1999, Sundays', Mondays' and Tuesdays' average returns are statistically significantly negative. The average Sundays', Mondays' and Tuesdays' dummy coefficients are negative (-0.05), (-0.08) and (-0.09) respectively. Wednesdays' return is statistically insignificant. Third, over the period 1999-2002, Mondays' average return is significantly negative at a 10 % level and Thursdays' average return is significantly positive at the same significance level. The average Mondays' dummy coefficient is negative, -0.12, while the average Thursdays' coefficient is positive, 0.08. Other days of the week show insignificant results. The estimates of the GARCH (1, 1) models support the GARCH specification with the GARCH parameter estimates always statistically significant.

Several diagnostic statistics are reported in Table 4. Specification adequacy of the first two conditional moments is verified through serial correlation tests of white noise. We employ the Ljung-Box Q-Test for serial correlation in the raw (ε_t), standardised ($\varepsilon_t/h_t^{1/2}$), and squared-standardised residuals (ε^2_t/h_t). All series are free of serial correlation at the standard 1% level of significance. Consistent with Hsieh (ibid), all excess kurtosis in the non-standardised residuals is larger than the excess kurtosis in the standardised residuals. This, according to Hsieh (1989), indicates a correctly specified conditional variance equation in all of the tested models. A Jarque-Bera LM test also always overwhelmingly rejects the null of normality. Further, we carried out a Lagrange Multiplier test to examine whether the standardised residuals exhibit additional ARCH. We found that in all the cases, the variance equations are correctly specified and that there should be no ARCH left in the standardised residuals. The F-test statistics and their p-values indicate this result. All the F-statistics are insignificant across the two time periods. The coefficients of skewness and kurtosis show severe evidence against the conditional normality assumption in the residuals. The statistics show that returns are negatively skewed although the skewness statistics are not large. However, all the kurtosis values are much larger than 3, significantly different from that of normal distribution. This indicates that much of the non-normality is due to leptokurtosis. Despite these facts, the estimates are still consistent under quasi-maximum likelihood assumptions. The GARCH model encompasses an autocorrelation correction and is robust under non-normality. Overall, results in Table 4 support our model's specification.

Based on the above, the start-of-the-week returns using the Amman Share Price Index market proxy show insignificant anomalies.

5. CONCLUSIONS

It is well documented in the literature that the weekend is an unusual "day" in the stock market. This paper examines the robustness of evidence on the weekend anomaly in stock return data after accounting for the impact of possible measurement errors and sample sizes. Consistent with the previous literature, the sample evidence quite often favours the alternative hypothesis of unequal returns across days of the week. Start-of-the-week day's returns are consistently insignificantly negative across different time frames. While the average return for the second day in the week is consistently significantly negative, the results concerning the end-of-the-week day differ when we adjust for Sunday to be the start of the week. Before this date, results show insignificant end-of-the-week return (Wednesday).

After adjusting the sample to take into account the fact that, after the third of March 1999, Sundays are the start of the week, results show that Thursday's return (the end of the week) tends to be positive and the highest while Monday's return is a "downer" in most of the cases (negative and the worst). This result is consistent with previous results documented in the literature. Possible explanations for the high positive significant Thursday's return and the high negative Monday's return are: (1) the settlement practices which imply unusually high closing on Thursdays and consequently lower closing on Mondays. (2) Ignored aspects of market's microstructure such as uneven trade intervals, bid-ask spreads, and specialist activities, (3) the size of the firm, (4) the frequency of sell against buy orders during the week, and finally (5) the bad news released over the weekend. The bad news is then reflected in low stock prices on Monday. It is also found that the variability of returns decreases as the week progresses.

Our recommendation is that professional market watchers who are aware of the daily return pattern should adjust the timing of their buying and selling to take advantage of the effect. The new logical implication is "Don't sell stocks on the second day of the week".

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Table 1: Daily Return Pattern for the Amman Value-Weighted Share Price Index: 1992-2002

	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday
Panel A: Unconditional mean weekday returns (1992-3/3/1999)						
Mean	0.0208	0.00388	0.00464	-0.00432	0.0114	
S.D	0.4026	0.2856	0.3301	0.2709	0.3117	
t-statistic(1)		1.43	1.29	2.17*	0.76	
t-statistic(2)	1.84*					
n	1757					
Panel B: Unconditional mean weekday returns (7/3/1999-12/4/2002)						
Mean		0.000362	-0.000277	0.00975	0.00370	0.00806
S.D		0.3736	0.3384	0.3152	0.2982	0.2274
t-statistic(1)			1.69*	0.58	0.21	0.53
t-statistic(2)	2.18*					
n	922					

Notes:
* Significant at 5% level.
S.D stands for the standard deviation of index return for the weekday specified.
t-statistic (1): test for equality of mean return between the start-of-the-week day and each of the remaining days.
t-statistic (2): test for equality of mean return between weekdays.

Table 2: Summary statistics for weekdays returns

Period	Panel A: Unconditional mean weekday returns (1992-3/3/1999)				
Statistic	RET_SAT	RET_SUN	RET_MON	RET_TUE	RET_WED
Mean	0.0208	0.00388	0.00464	-0.00432	0.0114
Std. Dev.	0.4026	0.2856	0.3301	0.2709	0.3117
Skewness	0.766967	1.005900	2.928176	1.062701	0.755529
Kurtosis	32.10569	38.16712	66.86039	31.77847	38.58476
Jarque-Bera	62190.06	90835.00	301065.4	60961.87	92869.03
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Observations	1757	1757	1757	1757	1757
Q24	27.01	42.3*	66.7*	44.6*	25.9
Period	Panel B: Unconditional mean weekday returns (7/3/1999-12/4/2002)				
Statistic	RET_SUN	RET_MON	RET_TUE	RET_WED	RET_THR
Mean	0.000362	-0.0277	0.00975	0.00370	0.00806
Std. Dev.	0.3736	0.3384	0.3152	0.2982	0.2274
Skewness	-1.221427	-2.572404	3.710612	3.271291	1.554920
Kurtosis	26.42733	47.81700	48.00302	35.23535	17.95280
Jarque-Bera	21313.84	78179.17	79919.98	41563.87	8960.974
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Observations	922	922	922	922	922
Q24	35.2*	15.3	14.1	53.4*	14.8

Notes:
RET_SAT stands for the average daily Saturdays return, RET_SUN is the average daily return for Sundays and so on. The Std.Dev. is the standard deviation of the return each working day.
Q24 is the twenty-fourth lag Ljung-Box Q-Test for the serial correlation in the return series. Probability stands for the power of the normality test, the Jarque-Bera.
* Significant at 5% level.

Table 3: Test for the weekend effect in the Amman Stock Markets daily returns after controlling for seasonality using GARCH (1,1)-M, P-value is in parenthesis. α_i ,ϑ are the coefficients for the mean equation in the GARCH-M, whereas, ω ξ_i φ are the coefficients for the GARCH variance equation.

	GARCH (1,1)-M								
	Mean equation						Variance equation		
Day of the week	Saturday	Sunday	Monday	Tuesday	Wednesday				
Coefficient 1992-1999	α_1 -0.031 (0.24)	α_2 -0.05 (0.08)	α_3 -0.08 (0.01)	α_4 -0.09 (0.00)	α_5 -0.030 (0.32)	ϑ 14.03 (0.00)	ω 0.0003 (0.00)	ξ_1 0.27 (0.00)	φ 0.68 (0.00)
Day of the week	Sunday	Monday	Tuesday	Wednesday	Thursday				
Coefficient 1999-2002	α_1 -0.02 (0.70)	α_2 -0.12 (0.02)	α_3 -0.024 (0.65)	α_4 -0.0046 (0.92)	α_5 0.08 (0.08)	ϑ -0.86 (0.91)	ω 0.0007 (0.00)	ξ_1 0.26 (0.00)	φ 0.60 (0.00)

Table 4: Diagnostic statistics of the residuals

	GARCH (1,1)-M				ARCH LM test for the GARCH model specification	
	$\varepsilon_t/h_t^{1/2}$ – standardised residuals					
	Skewness	Kurtosis	J-B probability	Ljung-Box (24)	F-stat	P-value
1992-1999	0.41	5.2	0.00	195.6	0.21	0.64
1999-2002	0.21	5.1	0.00	70.9	0.002	0.96
	ε_t^2/h_t – squared standardised residuals					
1992-1999	5.1	40.8	0.00	30.32		
1999-2002	4.9	35.3	0.00	23.9		

This table includes a battery of standard specification tests. The Ljung-Box (24) Q statistics on the non-normalised residuals (ε_t), standardised residuals ($\varepsilon_t/h^{1/2}$), and the squared standardised residuals (ε^2_t/h) are reported. J-B probability is the P-value for testing for normality in the GARCH (p,q)-M residuals.

Standard errors are computed using the robust inference procedures developed by Bollerslev and Wooldridge (1988).