Stock Market Efficiency, Non-Linearity, Thin Trading and Asymmetric Information in MENA Stock Markets

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ABSTRACT

The concept of market efficiency has been investigated thoroughly in recent years, with most studies focussing on developed economies. Far fewer investigations have been carried out into emerging markets, and results have been mixed. Some emerging markets appear to be weak form efficient whereas others seem to be inefficient. Emerging markets are typically characterised by thin trading and low levels of liquidity as well as, in some cases, ill-informed investors with access to information that is sometimes less than reliable. This might partly explain why some emerging markets are information inefficient. In this paper we investigate stock market efficiency in a group of emerging markets in the Middle East and North Africa (MENA) region. In particular we test the results of Abdmoulah (2010) who finds that the MENA region markets investigated are inefficient and, despite growth in size and the implementation of reforms designed to improve the operation of markets in the region, they exhibit little evidence of evolving market efficiency. This raises the possibility that further reform is necessary. We test for evolving market efficiency using a methodology that extends the approach adopted by Abdmoulah (2010). However, our results are broadly similar.

1. INTRODUCTION

STOCK MARKET EFFICIENCY has been at the forefront of financial theory for over four decades since the publication of Fama's (1970) seminal work. Although there are three, ever more restrictive, types of market efficiency, the concept of weak form efficiency has figured most prominently in the literature. At its simplest, a market is weak form efficient if past information on asset prices is contained in the current price of the asset. With respect to stock markets, the implication is that stock market returns have no memory and are without systematic tendencies, leaving investors no opportunity for arbitrage. It is therefore impossible for investors to earn above average risk-adjusted returns, or, as Fama (1998, p. 284) puts it 'the expected value of abnormal returns is zero but chance generates deviations from zero (anomalies) in both directions'.

Market efficiency matters for several reasons. It matters to investors because fair pricing encourages confidence to buy stocks that will also be fairly priced at the time of sale. This does not imply that markets neither over nor under-react to news at different times. It simply implies that stock markets are unbiased and few investors would participate in stock market opportunities if they felt their investments would be subject to perverse and biased pricing at the time of sale. Market efficiency also matters to company managers because equity prices in efficient markets will incorporate the effect of decisions aimed at enhancing shareholder wealth. This feedback on managerial decisions provides encouragement to pursue shareholder wealth enhancing strategies. There are also wider implications for the economy as a whole, which implies that stock market efficiency also matters to policy makers. Accurate and reliable price signals from the stock market are crucial in promoting allocative efficiency. The European Bank for Reconstruction and Development (1998, p. 101) has noted that 'Markets tend to provide for an efficient allocation of resources when information about the goods and services being exchanged is widely available and reliable, when entry into the market by alternative providers is free, and when the exchange is not dependent upon an ongoing relationship between buyer and seller. Assuming that these preconditions are met, a securities market, like any other market, can deliver an efficient allocation of resources'. Moreover, as noted by Bekeart and Harvey (1998), informational efficiency provides a crucial link between stock markets and economic growth in emerging economies, which makes it of considerable importance to policy makers in such countries.

Relatively few investigations have been carried out into the emerging markets of the Middle East and North Africa (MENA) region, and results have been mixed. An early study by Gandhi et al (1980) found that the Kuwaiti stock market was inefficient. However, this result was challenged by Butler and Malaikah (1992) who concluded that the Kuwaiti stock market was weak form efficient but that the Saudi stock market was inefficient. El Erian and Kumar (1995) found that the Amman stock market exhibited serial dependence in returns. However, as well as the development of better methodologies to test for market efficiency in emerging markets, a major shortcoming of these early investigations is that they failed to test for evolving market efficiency in the markets investigated.

Emerging markets, by definition, are evolving and, in the early stages of development, are typically characterised by thin trading and low levels of liquidity, as well as, in some cases, ill-informed investors with access to information that is sometimes less than reliable. The former arises partly because in emerging markets, opportunities for market participation are neither well distributed nor well understood by many investors. The latter occurs because, in emerging markets, there typically exist only limited disclosure requirements on firms. As markets develop and reporting requirements are imposed on firms, these characteristics might become less significant and investigations that fail to test for evolving market efficiency might therefore conclude that markets are inefficient over the entire sample period, but fail to note that these markets are becoming more efficient over time (see Harrison and Paton, 2005, for example).

More recent tests for efficiency in MENA markets have used both improved methodologies that take account of non-linearity in stock return processes, and the particular features of emerging markets such as thin trading. Of most relevance to this study is Abdmoulah (2010) who tests for evolving market efficiency in eleven MENA region stock markets. As well as providing an excellent survey of the literature that is consequently not repeated here, Abdmoulah (2010) uses a GARCH-M model to allow for volatility clustering in the data and a Kalman filter state space time varying parameter to test for evolving market efficiency. The results of Abdmoulah (2010) are somewhat surprising in that, despite quite substantial growth in value traded, market capitalisation and number of listed companies in all eleven markets investigated, as well as the implementation of several reforms designed to improve transparency, there is no evidence that any of the markets investigated show signs of increased efficiency. This confirms the results of Lagoarde-Segot and Lucey (2008) who find that the stock markets of Egypt, Morocco, Jordan and Tunisia (among others not included in the investigation reported here) exhibit return predictability. Despite this *prima facie* evidence of inefficiency, Lagoarde-Segot and Lucey also show that market size and corporate governance are important factors in promoting efficiency.

Testing for evolving market efficiency in MENA region stock markets is particularly important because these markets have been subject to reform in recent years with a view to improving performance and efficiency. As the OECD (2005, p. 13) has observed, 'Countries in the MENA region have been making significant attempts to strengthen their regulatory and institutional infrastructure for capital markets. Originally, many countries did not have institutions dedicated to capital market supervision. However, in the past few years, such institutions have been formed and efforts have been launched to enact necessary laws and regulations and to build human resources in the supervisory agencies.'

The present study extends the work of Abdmoulah (2010) and Lagoarde-Segot and Lucey (2008) in several ways. The paper uses a state-space model to account for the relatively thin trading that characterises all MENA stock exchanges (the methodology used by Lagoarde-Segot and Lucey does not incorporate a state space model). In addition to thin trading, stock market returns are also adjusted for a relatively general form of non-linearity that nests threshold models, regime-switching models, Markov-switching models and neural networks approaches. Finally, the study also evaluates the hypothesis of weak form efficiency in the presence of clustering and leverage effects.

The remainder of this paper is structured as follows. In Section 2 we outline our data and summary statistics and in Section 3 we outline our empirical approach. In Section 4 we detail our empirical results and Section 5 provides a summary and conclusions.

2. Data and summary statistics

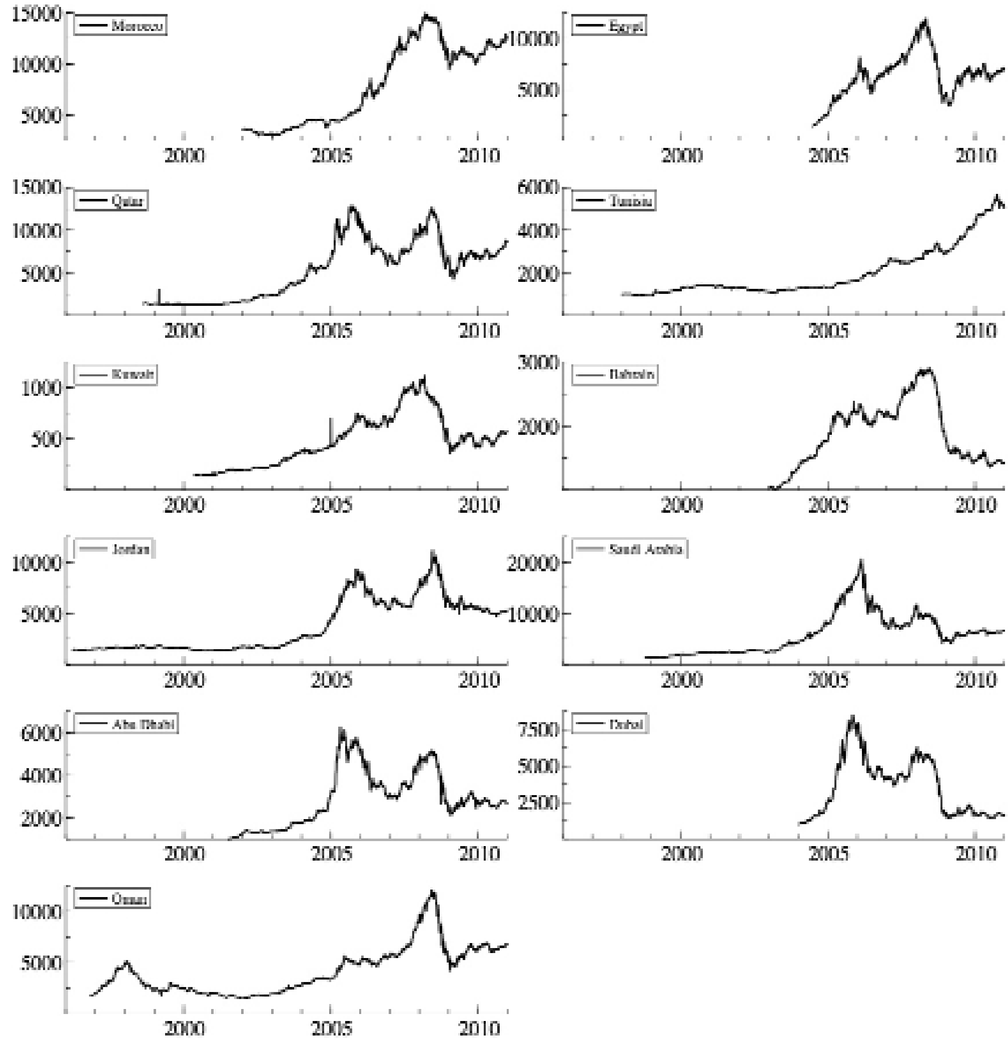
This study uses stock market data for eleven MENA stock markets (Abu Dhabi, Bahrain, Dubai, Egypt, Jordan, Kuwait, Morocco, Oman, Qatar, Saudi Arabia and Tunisia). Table 1 provides some background information. Of the exchanges considered, Saudi Arabia had the largest exchange with market capitalisation of US$318 billion; in Abu Dhabi, Egypt, Kuwait and Qatar, market capitalisation was around US$90 billion. Only in Tunisia did market capitalisation fall below US$10 billion. While Saudi Arabia had the largest market capitalisation, in terms of the number of companies listed, Egypt, Jordan and Kuwait all had over 200 companies listed on their exchanges. In comparison, Saudi Arabia had only 145 companies listed, putting it 4th amongst the MENA exchanges considered. Nevertheless, trading volume and market turnover were highest in Saudi Arabia, with trading volume on this exchange more than double that of the next biggest, Kuwait. In terms of market turnover (as a percentage of GDP), the country's ratio was more than 40 percentage points above that of Dubai. Both Abu Dhabi and Bahrain had relatively low market activity indicators, with market turnover estimated at just 12.7 and 4.5 per cent, respectively.

Table 1: Selected MENA Stock Markets in 2009

	Market capitalisation US$m	*Number of companies listed*	*Trading Volume US$m*	*Market turnover (% of GDP)*
Abu Dhabi	80,203*	67*	18,931*	12.7*
Bahrain	16,933	49	857	4.5
Dubai	55,492*	88*	47,149*	71.0*
Egypt	89,953	213	52,813	60.1
Jordon	31,865	275	13,645	40.3
Kuwait	95,938	212	69,932	68.9
Morocco	62,910	73	29,417	45.7
Oman	17,308	120	5,832	36.2
Qatar	87,856	42	25,509	31.1
Saudi Arabia	318,765	145	336,977	119.3
Tunisia	9,120	55	1,257	16.2

Source: Standard and Poor's *Global Stock Markets Factbook, 2010* and * Authors' estimates.

Figure 1: Plot of MENA Stock Market Indices



The data used in the study are taken from Datastream. Daily closing index returns, R_t, are calculated using the first log difference for daily price indices for each of the eleven stock markets . The observations are from 28th December 1994 through to 31st December 2010.

Figure 1 provides a plot of the stock market indices for each of the eleven exchanges. Table 2 provides the descriptive statistics for the returns of each of these exchanges. Egypt, Dubai, Tunisia and Morocco had the highest mean average returns, while Bahrain reported negative mean returns over the sample period. The descriptive statistics suggest that in two out of the eleven MENA countries, Abu Dhabi and Kuwait, returns were positively skewed suggesting that the return series in these countries had long right tails, i.e. on most days the returns were positive. The value of the kurtosis was greater than 3 in all countries, implying that returns were peaked relative to normal. As a result, the Jarque-Bera test indicated the null of normally distributed returns could not be accepted in most states.

Given the similarity in language and the relative proximity of MENA exchanges, it is quite likely that returns across the exchanges are correlated. In order to measure this covariation, realised correlation ratios between the returns of the 11 exchanges are calculated. The realised correlation approach attempts to build a measure of the synchronisation of stock market returns using moments of the distribution of financial returns. Following Andersen *et al.* (2003), consistent estimates of volatility can be obtained using the sum of the squared returns:

Table 2: Descriptive Statistics of Market Returns on MENA Exchanges

	Mean	*Max*	*Min*	*Std dev*	*Skew*	*Kurt*	*Obs*
Abu Dhabi	3.998E-04	0.398	-0.365	0.017	1.156	224.100	2480
Bahrain	1.532E-04	0.036	-0.049	0.006	-0.426	6.312	2086
Dubai	2.801E-04	0.102	-0.122	0.020	-0.124	4.676	1827
Egypt	9.401E-04	0.105	-0.180	0.019	-0.744	9.283	1703
Jordon	3.372E-04	0.199	-0.205	0.011	-0.372	55.509	3851
Kuwait	4.891E-04	0.513	-0.503	0.020	0.202	326.940	2775
Morocco	5.245E-04	0.045	-0.068	0.008	-0.624	7.011	2347
Oman	3.499E-04	0.199	-0.148	0.012	0.274	39.478	3703
Qatar	5.837E-04	0.845	-0.858	0.029	-0.500	485.750	3234
Saudi Arabia	4.671E-04	0.164	-0.117	0.016	-0.574	12.395	3184
Tunisia	5.372E-04	0.462	-0.050	0.005	0.155	11.718	3184

$$\sigma_{t,i}^2 = \sum_{d=1}^{D_t} (r_{t,d}^i)^2 \quad (1)$$

The realised covariance between the stock returns of country *i* and country *j* are therefore obtained using:

$$\sigma_t^{i,j} = \sum_{d=1}^{D_t} r_{t,d}^i \bullet r_{t,d}^j \quad (2)$$

By combining these two moments, one can then obtain a time-varying measure of the co-movement between the stock markets in the MENA countries investigated. Realised correlation ($\rho^{i,j}$) is calculated as:

$$\rho_t^{i,j} = \frac{\sigma_t^{i,j}}{\sigma_t^i \bullet \sigma_t^j} \quad (3)$$

Compared to standard coefficients of correlations, the realised correlation approach improves the accuracy of the measure of association between the two exchanges under consideration. Pairwise realised correlations are estimated for each of the eleven countries investigated. Note that the database forms an unbalanced panel since stock market indices are not available for each market over the entire sample period.

The calculated realised correlation ratios are provided in Table 3. With the exception of Bahrain, they are relatively small (less than 0.3 on average), suggesting that stock market returns across the region are not highly correlated. One possible reason for the relatively low correlation could be the restrictions on foreign equity ownership that exist in most of the countries under investigation. Joshi and Al-Mudahki (2003) note that foreign equity is limited to 49 per cent in Kuwait, Qatar, Oman and UAE. Such restrictions could inhibit the degree of financial integration across the region. Unlike many of the other MENA states, restrictions on foreign equity ownership are less stringent in Bahrain. The country allows 100 percent foreign equity ownership and does not currently tax either dividends or capital gains. As a result, the realised correlation ratios for the Bahraini exchange seem to be highly correlated with the other MENA exchanges investigated, in particular the exchanges in Dubai (0.910), Oman (0.965), Jordan (0.834) and, to a lesser extent, Morocco (0.604).

In order to account for the presence of autocorrelation occurring because of relatively thin trading, Miller *et al.* (1994) suggest fitting an AR(1) model to obtain a non-trading adjustment. However, the assumption of a fixed autoregressive coefficient is particularly unlikely to hold in emerging markets as these markets are now maturing. As an alternative, this study uses a state space model of the form:

$$R_t = \alpha + \beta_t R_{t-1} + u_t \quad (4)$$

$$\beta_t = \gamma\beta_{t-1} + v_t \quad (5)$$

where R_t is the stock market return calculated at period t, β_t is an unknown parameter that is assumed to be a first-order autoregressive process, while u_t and v_t are independent white noise processes that are assumed to have mean zero and constant variance. The residuals from Equation (4) are then employed to estimate the adjusted return series (R_t^A):

$$R_t^A = \frac{u_t}{1-\beta_t} \quad (6)$$

Table 3: Realised Correlation between Market Returns on MENA Exchanges

	AD	*Bah*	*Dub*	*Egy*	*Jor*	*Kuw*	*Mor*	*Oma*	*Qat*	*SA*	*Tun*
Abu Dhabi	1.000										
Bahrain	0.713	1.000									
Dubai	0.658	0.910	1.000								
Egypt	0.234	0.485	0.360	1.000							
Jordan	0.269	0.834	0.368	0.307	1.000						
Kuwait	0.119	0.443	0.117	0.033	0.060	1.000					
Morocco	0.102	0.604	0.278	0.468	0.287	0.074	1.000				
Oman	0.297	0.965	0.370	0.283	0.354	0.082	0.198	1.000			
Qatar	0.104	0.231	0.113	0.066	0.097	0.030	0.064	0.125	1.000		
S. Arabia	0.287	0.294	0.305	0.257	0.167	0.083	0.199	0.173	0.047	1.000	
Tunisia	0.191	0.326	0.339	0.129	0.349	0.006	0.568	0.331	0.189	0.261	1.000

Antoniou, Ergul and Holmes (1997), as an alternative, estimate β_t in Equation (4) recursively. Unlike the recursive regression approach, the state-space model estimation approach utilises the entire database to derive the model coefficient estimates and explicitly accounts for the evolution of the unknown parameter in Equation (4).

To allow for the possibility of non-linearity, most papers in the literature consider estimating an equation of the form:

$$R_t^A = \varpi_0 + \varpi_1 R_{t-1}^A + \varpi_2 (R_{t-1}^A)^2 + \varpi_3 (R_{t-1}^A)^3 + \varepsilon_t \quad (7)$$

For the efficient market hypothesis to hold, all the coefficients should be equal to zero ($\varpi_0 = \varpi_1 = \varpi_2 = \varpi_3 = 0$). While this test can account for quadratic non-linearity, it is also possible that non-linearity could be driven by an exponential data generation process that nests other types of non-linearity (e.g. threshold models, regime-switching models, Markov-switching models and neural networks). Equation (7) is therefore augmented with $x_t = e^{-|R_{t-1}^A|} R_{t-1}^A$ to account for exponential non-linearity (see Castle & Hendry, 2010 for a similar functional form).

$$R_t^A = \varpi_0 + \varpi_1 R_{t-1}^A + \varpi_2 (R_{t-1}^A)^2 + \varpi_3 (R_{t-1}^A)^3 + \varpi_4 x_t + \varepsilon_t \quad (8)$$

An F-test is employed to evaluate the null hypothesis that $\varpi_0 = \varpi_1 = \varpi_2 = \varpi_3 = \varpi_4 = 0$. To account for the possibility of volatility clustering, a GARCH(1,1) model is estimated. The mean and variance equations for our GARCH(1,1) model are as follows:

$$R_t^A = \varpi_0 + \varpi_1 R_{t-1}^A + \varpi_2 (R_{t-1}^A)^2 + \varpi_3 (R_{t-1}^A)^3 + \varpi_4 x_t + \varepsilon_t \quad (9)$$

$$h_t = \kappa_0 + \kappa_1 \varepsilon_{t-1}^2 + \eta_1 h_{t-1} + \zeta_t \quad (10)$$

In contrast, leverage effects are accounted for using three alternative models: exponential GARCH (EGARCH), GJR model and the APARCH model. The variance equation for the EGARCH model is:

$$h_t = \kappa_0 + \kappa_1 \frac{|\varepsilon_{t-1}|}{h_{t-1}} + \kappa_2 \frac{\varepsilon_{t-1}}{h_{t-1}} + \eta_1 h_{t-1} + \zeta_t \quad (11)$$

where κ_2 captures leverage effects. In contrast, the variance equation for the GJR model is captured using the equation below:

$$h_t^2 = \kappa_0 + \kappa_1 \varepsilon_{t-1}^2 + \kappa_1 S_{t-1}^- \varepsilon_{t-1}^2 + \eta_1 h_{t-1} + \zeta_t \quad (12)$$

where S_{t-1}^- is a dummy variable that takes a value of 1 in the case of negative shocks and 0 when these shocks are positive. The APARCH model encompasses the GJR model and also provides a direct test of leverage effects. In this framework the variance equation is given as:

$$h_t^{\delta} = \kappa_0 + \kappa_1(|\varepsilon_{t-1}| - \kappa_2\varepsilon_{t-1})^{\delta} + \eta_1 h_{t-1}^{\delta} + \zeta_t$$

4. RESULTS

In order to evaluate the efficiency of stock exchanges in the MENA states investigated, Table 4 provides estimates of the linear model, unadjusted and adjusted, for thin trading. Without adjusting for relatively thin trading in the 11 exchanges, the null hypothesis of market efficiency (or uncorrelated lagged returns) could not be accepted in the majority of countries. Only in Dubai and Jordan were returns uncorrelated with previous values. The significance of the Ljung and Box Q-test in the majority of countries also suggests that there was serial correlation between contemporaneous and lagged returns for up to 52 lags. Based on the significance of the Q-test, stock exchanges in the MENA states investigated would therefore appear to be weak-form inefficient.

One of the key characteristics of exchanges in developing countries is thin trading and if this phenomenon is not accounted for, it could lead to leptokurtic distortions in the measurement of portfolio returns. The last three columns of Table 4 therefore also present the results of adjusting the returns for thin trading as presented in Equations 2 and 3. Once the returns are adjusted in this way, the lagged returns were only significant in 7 exchanges compared to the unadjusted return results, though the Q-statistic still remained significant in 9 out of the 11 exchanges. Our results certainly suggest that not accounting for the relatively thin markets in MENA states can bias significantly the findings in relation to stock market efficiency. These results also differ somewhat from those obtained by Abdmoulah (2010) and by Lagoarde-Segot and Lucey (2008) as returns on only some MENA exchanges were predictable using past returns.

Benartzi and Thaler (1995) note that if investors are loss averse, that is, they are more sensitive to losses than gains, their behaviour may appear to be risk neutral or even risk-loving, thus violating one of the assumptions of the efficient market model of rational, or risk averse, investors. Such behaviour might result in non-linear stock price behaviour. The non-linear test results for stock market efficiency are therefore also provided in Table 5. In this instance, the market is weak-form efficient if $\varpi_0 = \varpi_1 = \varpi_2 = \varpi_3 = 0$ is accepted at normal levels of testing. The F-statistics are therefore provided in the final column of the table. The lagged return terms were insignificant at the 5 percent level of testing in 2 countries: Bahrain and Egypt. These markets therefore appear to be weak-form efficient. These two countries are the least restrictive in relation to foreign investment regulation amongst the MENA countries under investigation (World Bank, 2010).

Table 4: Linear Tests for Stock Market Efficiency

	Unadjusted for thin trading			*Adjusted for thin trading*		
	ϖ_0	ϖ_1	*Q-stat*	ϖ_0	ϖ_1	*Q-stat*
Abu Dhabi	0.000	-0.089	105.220	-0.001	-0.155	97.941
	(1.304)	(4.472)**	[0.000]	(1.144)	(-7.815)**	[0.000]
Bahrain	0.000	0.190	108.560	-0.000	-0.008	95.608
	(0.928)	(8.813)**	[0.000]	(-2.881)	(-0.357)	[0.000]
Dubai	0.000	0.033	138.470	-0.000	-0.064	108.800
	(0.577)	(1.401)	[0.000]	(-3.366)**	(-2.751)**	[0.000]
Egypt	0.001	0.072	107.310	-0.001	0.023	99.750
	(1.920)	(2.975)**	[0.000]	(-2.931)**	(0.932)	[0.000]
Jordan	0.000	0.009	121.520	0.000	-0.084	111.83
	(1.836)	(0.560)	[0.000]	(0.107)	(-5.198)**	[0.000]
Kuwait	0.001	-0.275	69.562	-0.000	0.064	113.690
	(1.734)	(-15.035)**	[0.052]	(-0.839)	(3.362)**	[0.000]
Morocco	0.000	0.312	57.392	0.000	0.014	57.565
	(2.226)*	(15.908)**	[0.282]	(0.645)	(0.691)	[0.306]
Oman	0.000	0.185	115.700	-0.000	-0.037	111.460
	(1.486)	(11.434)**	[0.000]	(-0.866)	(-2.267)**	[0.000]
Qatar	0.001	-0.236	129.210	-0.000	-0.142	392.98
	(1.472)	(-13.812)**	[0.000]	(-0.339)	(-8.131)**	[0.000]
Saudi Arabia	0.000	0.057	171.340	-0.001	-0.010	43.706
	(1.572)	(3.198)**	[0.000]	(-1.150)	(-0.557)	[0.787]
Tunisia	0.000	0.230	103.140	0.000	-0.132	88.501
	(4.265)**	(13.762)**	[0.000]	(1.715)	(-7.735)**	[0.000]

Note: t-statistics are provided in parentheses below coefficient estimates and p-values in square brackets. * and ** indicates significance at the 5 and 1 percent level of testing.

As noted earlier, Bahrain has no restrictions on foreign equity ownership, while Egypt is also largely open to foreign investors, with ownership restrictions only imposed on a few industries. In contrast to the findings reported by Abdmoulah (2010), the opening of MENA markets to foreign investment does seem to have had an impact on market efficiency in these countries. For the other 9 MENA states under investigation, however, after accounting for thin trading and non-linearity, the results still suggest that the null hypothesis of efficiency could not be accepted.

Table 5: Non-Linear Tests for Stock Market Efficiency (accounting for thin trading)

	ϖ_0	ϖ_1	ϖ_2	ϖ_3	ϖ_4	*Q-stat*	*F-test*
Abu Dhabi	-0.001	0.053	1.902	-3.174	0.003	169.080	262.076
	(-3.048)*	(2.280)*	(30.631) **	(-20.016)**	(0.111)	(0.000)	[0.000]
Bahrain	-0.000	0.020	-3.308	-114.963	-0.006	83.646	1.684
	(-1.845)	(0.736)**	(-2.200)*	(-2.233)*	(-0.258)	[0.000]	[0.151]
Dubai	-0.001	0.036	-0.981	-27.404	0.050	87.511	9.316
	(-2.115)*	(1.099)	(-2.356)*	(-4.380)**	(1.904)	[0.001]	[0.000]
Egypt	-0.001	0.028	-0.107	-1.805	0.041	93.762	0.947
	(-2.748)**	(1.014)	(-0.217)	(-0.480)	(1.602)	[0.000]	[0.436]
Jordan	-0.000	0.030	2.172	-9.327	-0.012	122.85	106.964
	(-1.672)	(1.723)	(15.306)**	(-13.511)**	(-0.671)	[0.000]	[0.000]
Kuwait	0.000	0.277	-1.845	-1.787	-0.137	75.887	203.140
	(1.202)	(-11.836)**	(-15.408)**	(-4.146)**	(-9.501)**	[0.000]	[0.000]
Morocco	0.000	0.052	-1.553	-34.725	-0.080	75.887	4.034
	(1.475)	(2.036)*	(-2.236)*	(-2.761)**	(-2.776)**	[0.017]	[0.002]
Oman	-0.000	-0.005	0.606	-3.774	-0.069	114.930	8.505
	(-1.283)	(-0.278)	(3.276)**	(-3.614)**	(-3.195)**	(0.000)	[0.000]
Qatar	0.000	-0.338	-0.677	-0.360	0.593	321.110	916.072
	(0.384)	(-7.858)**	(-42.829)**	(-14.443)**	(15.380)**	[0.000]	[0.000]
Saudi Arabia	-0.001	-1.397	-0.346	0.827	1.480	75.931	7.039
	(-2.757)**	(-5.208)**	(-0.814)	(1.847)	(5.138)**	[0.017]	[0.000]
Tunisia	0.000	0.011	1.868	-45.108	-0.086	95.571	50.073
	(0.956)	(0.223)	(4.611)**	(-8.028)**	(-1.276)	[0.000]	[0.000]

Note: t-statistics are provided in parentheses below coefficient estimates and p-values in square brackets.* and ** indicates significance at the 1 and 5 percent level of testing.

The final test for the robustness of the results is to allow for volatility clustering and leverage effects in the market returns. Four models are employed to capture asymmetric leverage effects. The significance of the ν_1

Table 6: Non-Linear Tests for Stock Market Efficiency (accounting for leverage effects and thin trading)

	v_1				Leverage effects			F-test for Stock Market Efficiency			
	GARCH	EGARCH	GJR-GARCH	APARCH	EGARCH	GJR-GARCH	APARCH	GARCH	EGARCH	GJR-GARCH	APARCH
Abu Dhabi	0.786	0.966	0.773	0.794	-0.015	0.026	0.055	10.488	5.778	35.801	9.785
	(99.769)**	(154.970)**	(38.484)**	(51.305)**	[0.554]	[0.472]	[0.285]	[0.000]	[0.000]	[0.000]	[0.000]
Bahrain	0.804	0.926	0.748	0.759	-0.007	0.060	0.093	1.982	1.955	10.113	10.994
	(71.792)**	(112.714)**	(23.798)**	(23.419)**	[0.583]	[1.166]	[0.209]	[0.078]	[0.082]	[0.000]	[0.000]
Dubai	0.866	0.946	0.822	0.824	-0.037	0.065	0.148	6.262	8.603	14.611	17.986
	(106.116)**	(185.123)**	(39.217)**	(39.862)**	[0.000]	[0.082]	[0.025]	[0.000]	[0.000]	[0.000]	[0.000]
Egypt	0.953	0.974	0.904	0.932	-0.077	0.102	0.533	1.579	962.846	827.795	19867.760
	(213.102)**	(96.869)**	(36.143)**	(50.155)**	[0.004]	[0.026]	[0.008]	[0.163]	[0.000]	[0.000]	[0.000]
Jordan	0.856	0.988	0.892	0.917	0.007	-0.087	-0.024	2.797	4729.965	3.591	9.315
	(190.242)**	(221.445)**	(215.464)**	(104.525)**	[0.602]	[0.000]	[-0.419]	[0.016]	[0.000]	[0.003]	[0.000]
Kuwait	0.623	0.907	0.654	0.793	-0.197	0.385	0.211	80.678	137.498	318.299	94.313
	(25.744)**	(113.626)**	(22.576)**	(81.676)**	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Morocco	0.780	0.940	0.742	0.787	-0.006	0.022	0.019	0.881	1.760	3.478	3.227
	(104.207)**	(86.537)**	(37.182)**	(45.015)**	[0.799]	[0.646]	[0.727]	[0.493]	[0.118]	[0.004]	[0.007]
Oman	0.830	0.999	0.834	0.887	-0.013	0.041	0.032	1.009	8290.846	0.742	11781.620
	(104.141)**	(555.883)**	(16.088)**	(71.012)**	[0.192]	[0.247]	[0.589]	[0.411]	[0.000]	[0.592]	[0.000]
Qatar	0.593	0.930	0.600	0.707	-0.406	0.042	0.039	30.954	505.759	25.314	255.966
	(1.058)	(217.926)**	(1.755)**	(49.510)**	[0.000]	[0.905]	[0.328]	[0.000]	[0.000]	[0.000]	[0.000]
Saudi Arabia	0.835	0.956	0.828	0.867	-0.072	0.066	0.173	1.894	3.213	1.244	1.821
	(157.813)**	(161.398)**	(150.388)**	(274.358)**	[0.000]	[0.000]	[0.000]	[0.092]	[0.007]	[0.286]	[0.105]
Tunisia	0.840	0.921	0.846	0.874	-0.004	-0.046	-0.063	11.714	10.742	12.079	23.552
	(167.236)**	(82.507)**	(173.276)**	(0.000)***	[0.829]	[0.000]	(0.011)	[0.000]	[0.000]	[0.000]	[0.000]

Note: t-statistics are provided in parentheses below coefficient estimates and p-values in square brackets. * and ** indicates significance at the 1 and 5 percent level of testing.

coefficient suggests that in most of the MENA stock markets investigated, there is significant volatility clustering, that is, shocks to the stock market in one period tend to be followed by similar shocks in later periods. In contrast, there was only evidence of asymmetric leverage in five out of the 11 countries under investigation: Dubai, Egypt, Kuwait, Saudi Arabia and Tunisia. In these 5 countries, information tends to have differential effects dependent on whether the shock is negative or positive. Similar to the findings reported earlier, there was some evidence of weak form efficiency in stock market returns in Bahrain, Saudi Arabia, Oman and Morocco.

5. Conclusions

This paper investigates the evolution of stock market efficiency in a group of eleven MENA countries (Abu Dhabi, Jordan, Bahrain, Egypt, Tunisia, Kuwait, Morocco, Qatar, Oman and Saudi Arabia). It builds on the work of Abdmoulah (2010), who tests for evolving market efficiency using a GARCH-M model with a Kalman-filter state space time varying parameter. Somewhat surprisingly, since the markets investigated have grown and have been subjected to reform with a view to improving their performance, Abdmoulah (2010) finds no evidence that any of these markets is evolving towards a more efficient state. This result is worthy of further investigation because, if confirmed, it calls into question the efficacy of the reforms implemented and might imply the need for further reform.

Our sample period extends that used by Abdmoulah (2010) by some twenty one months. Because, in testing for efficiency, we are also assessing the efficacy of stock market reforms in the countries investigated, this will allow more time for stock market reform to impact on market efficiency. We also test for time evolving comovement in stock market returns because, if we cannot reject the null hypothesis of cointegrated returns between stock markets in the region, the possibility exists that one or more markets will lead other markets in the region and, thus, that markets might consequently be inefficient. Like Abdmoulah (2010) we estimate, though using a different methodology, a time varying state space parameter. Furthermore, we allow for non-linearities in the data generating process and use a battery of GARCH models to allow for volatility clustering and leverage effects.

In most cases, our unadjusted results reject overwhelmingly the null hypothesis of efficiency in the markets investigated. Even in Jordan and Tunisia we find evidence of market efficiency only in one of our tests, a finding that is rejected by the other tests. However, because thin trading is a universal feature of emerging markets, our results adjusted to allow for thin trading are of more importance. Allowing for this, we find that lagged returns are significant in only four markets (Abu Dhabi, Bahrain, Kuwait and Oman) while our Q-statistic is significant in only two (Morocco and Tunisia). We cannot therefore conclude that linear tests unambiguously suggest that the

MENA stock markets investigated are inefficient. However, there are sound reasons to believe that the data generating process might, in fact, be non-linear. Once we allow for this, our results are again ambiguous and in this case we find the lagged return terms were insignificant at the 5 per cent level of testing in 4 countries (Bahrain, Egypt, Tunisia and Saudi Arabia). Even after accounting for thin trading, we still cannot reject the null hypothesis of efficiency in half of the countries investigated.

As a final check on the integrity of our results, we test for volatility clustering and leverage effects in the data. In fact, we find significant evidence of volatility clustering in all markets investigated, but evidence of leverage effects in only three markets (Tunisia, Kuwait and Saudi Arabia). Overall our results suggest that most of the markets investigated are inefficient and, while some of our results provide evidence of efficiency in some markets, this finding is not confirmed by our other tests. There is clearly some need for further work in this area, but it does seem clear that the reforms have not significantly improved the performance of all the markets investigated.

The finding that the markets in MENA countries are inefficient suggests that policy makers in these countries should strengthen the institutional structure of price-forming information. In this regard, technologies that enhance the speed with which information is disseminated, the development of business journals and market regulations, are key policy recommendations that would enhance the efficiencies of stock markets in the region.

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Endnotes

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