Testing the Evolving Efficiency of 11 Arab Stock Markets

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Abstract

A Test of Evolving weak-form Efficiency using GARCH-M (1,1) approach along with state-space time-varying parameters is implemented for 11 Arab stock markets for periods ending in March 2009. All markets show high sensitivity to the past shocks and are found to be weak-form inefficient, as the efficiency does not improve towards the first quarter of 2009 and negatively reacts to contemporaneous crises. This contrasts with developed markets and reveals the ineffectiveness of the reforms undertaken during the last decade and calls for serious reflection to boost the markets, improve their liquidity and counteract the shortcomings of the large individual trading.

ملخص

تم اختبار تطور كفاءة 11 سوق أسهم عربية من خلال استخدام نموذج GARCH-M(1,1)[1] واعتماد معالم متفاوتة زمنياً لفترات تنتهي في مارس 2009. تبين نتائج الورقة حساسية هذه الأسواق للصدمات الماضية وعدم توجهها إلى أكثر كفاءة وارتباطها سلبياً بالأزمات الأخيرة. تناقض هذه النتائج مع حال أسواق الأسهم المتقدمة يكشف عدم فعالية الإصلاحات التي أجريت خلال العقد الأخير ويدعو إلى تعزيز هذه الأسواق وتحسين سيولتها ومواجهة أوجه القصور في التداول الفردي.

JEL classification: G14, G15, O16.

Keywords: GARCH-M(1,1), Kalman Filter, Evolving Efficiency, Arab stock markets.

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[1] نموذج الانحدار الذاتي المعمم المشروط بعدم تجانس الخطأ

1. Introduction

Most of the Arab countries reconsidered the role of stock markets in the early 1990s, by attempting to revitalize dormant existing markets, such Egyptian, Saudi or Kuwaiti stock markets, or launching new ones, such us Dubai and Abu Dhabi stock markets[2]. These actions aimed at developing their financial systems in order to stimulate economic growth and foster international integration. Overall, the pace of changes has been gradual and slow, and capital markets remain dominated by the banking systems. Nonetheless, different steps have made some growth in terms of capitalization and the number of listed companies.

Moreover, the issue of market efficiency, as introduced by Fama (1965, 1970), remains the most important from resource allocation and portfolio investment point of view. Efficient mature markets are generally found to be weak-form efficient. Conclusions for emerging markets are very mixed and generally support the idea of a departure from weak efficiency (as for Arab stock markets see Civelek, 1991, El-Erian and Kumar, 1995, Smith 2004, Lagoarde-Segot and Lucey 2005). Furthermore, conventional efficiency tests[3] are recently seen to be inappropriate in emerging markets for many reasons such us thinness, the nature of the participants, lack of liquidity, the microstructure of markets and for the evolving nature of there markets. Actually, authorities in those markets eager to improve efficiency by enhancing regulatory environment, transparency and liquidity. Mecagni and Sourial (1999) and Hassan et al. (2003) used GARCH processes in order to take into account non-linear and infrequent trading in the Egyptian and Kuwaiti stock markets respectively. Both find evidence for significant departure from the efficient market hypothesis, even though Hassan et al. (2003) show that Kuwaiti stock market efficiency improves towards the last sub-period of the 1990s.

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[2] Syria stock exchange was launched in march 2009. A stock market is under construction in Libya as well. Algeria, Sudan, Lebanon and Palestine stock markets are not included due to unavailable data.

[3] As in Lagoarde-Segot and Lucey (2005) who studied the random-walk properties of the stock exchanges in Egypt, Morocco, Tunisia, Jordan and Lebanon in addition to Israel and Turkey. They used a battery of econometric tests including unit-root analysis, the heteroscedasticity robust Lo and McKinlay (1988) variance ratio framework, the non-parametric Chow and Denning multiple variance ration, a wild bootstrap version of the later and the Wright (2000) non-parametric rank-based methodology. In addition, they used the technical analysis by applying the variable moving average, trading range break levels and breakeven transaction costs method. Results suggested that only the most developed markets – Israel and Turkey- seem to follow a random walk.

Following Zalewska-Mitura and Hall (1999), Hall and Urga (2002) and Vit Posta (2008) among others, this paper attempts to capture the changes in weak form efficiency of 11 Arab stock markets. It uses a GARCH-M (1,1) model of the daily indexes returns volatility as well as a Kalman filter state-space in estimating the time-varying dependency of the daily returns on their lagged values. This time-varying dependency is expected to become more stable and infinitely small if the market moves towards more efficiency and traders are learning. Zalewska-Mitura and Hall (1999), Li (2001), Hall and Urga (2002) and Vit Posta (2008) show changing levels of inefficiency in Budapest, China, Russia and Prague stock markets, respectively. The last three markets show however a tendency towards becoming more efficient. Moreover, Jeferis and Smith (2005) focused on seven African stock markets including Egypt and Morocco for periods starting in 19990s and ending in June 2001. In contrast with Kenya and Zimbabwe stock markets, Morocco and Egypt stock markets become weak-form efficient towards the end of the period.

This paper differs from previous, relatively rare, research on Arab stock markets in studying the dynamics of week-form (in)efficiency rather than taking a snap shot of it at a given point of time. Also, this paper uses daily data of a larger number of Arab stock markets that covers a wide time period up to March 2009, allowing us to test for the impact of the current crises besides those of 2001 and 2006.

The paper is organized as follows. In section 2, we present the data. Methodology and empirical results are presented in Section 3. Section 4 concludes.

2. Highlights from data

The data include daily prices of the national indexes of Saudi Arabia, Kuwait, Tunisia, Dubai, Egypt, Qatar, Jordan, Abu Dhabi, Bahrain, Morocco and Oman. In addition, we use data of the AMEX index for comparative purposes.

Table 1 shows a very significant but variable growth from a market to another regarding their size and liquidity. Saudi and Kuwait stock markets are the largest in terms of market capitalization, followed by Egypt and Qatar. The Tunisian market is the smallest. With regards to the number of listed companies Egyptian market is by far the largest market followed by Jordan and Kuwait. Tunisia, Morocco, Dubai, Qatar, Abu Dhabi and Bahrain grew actually little. Furthermore, these markets vary much regarding their liquidity as measured by value and shares traded. Indeed, Tunisian, Moroccan, Qatari, Bahraini and Omani stock markets show the lowest liquidity, contrary to Dubai and Abu Dhabi which have succeeded in few years to increase their liquidity to a level that is close to that of Saudi and Kuwaiti stock markets.

In sum, a market expansion is found in the 11 markets but the group is very heterogeneous. In fact, Saudi and Kuwaiti markets remain superior in terms of size and liquidity. Dubai, Abu Dhabi, Jordan and Egypt markets grew significantly, contrary to Tunisia, Morocco and Oman which are still underdeveloped.

Table 1: Arab Stock markets development

Country	Value Traded ($ million)		Shares Traded (million)		Market capitalization ($ million)				Number of listed companies	
	2003	2008	2003	2008	2003	*%GDP*	2008	*%GDP*	2003	2008
Abu Dhabi	3,336	61,280	652	48,347	55,519	*67*	61,887	*22*	30	65
Jordan	2,598	27,079	997	5,112	10,967	*107*	35,984	*184*	161	243
Bahrain	255	1,905	368	1,480	9,701	*100*	19,954	*101*	44	50
Morocco	2,211	14,231	35	222	11,556	*26*	63,420	*70*	52	80
Qatar	1,646	41,250	68	3,400	40,435	*113*	76,656	*65*	28	43
Dubai	11,628	69,880	4,149	66,066	35,109	*42*	65,217	*24*	13	65
Egypt	4,423	65,167	1,180	21,072	27,909	*32*	83,185	*52*	967	444
Kuwait	53,300	116,023	48,766	75,820	61,311	*124*	113,527	*71*	108	204
Oman	1,224	8,034	276	3,881	6,615	*23*	15,643	*28*	141	127
Saudi Arabia	158,568	483,122	5,531	54,442	157,164	*73*	246,809	*46*	70	127
Tunisia	152	1,425	13	148	2,194	*10*	6,381	*15*	45	53
AMEX	563,433	561,602	17,508	na	96,120	*0.8*	132,367	*0.9*	557	486

From a microstructural point of view, trading evolved in the recent years from a manual to fully-electronic continuous order driven markets. Thus, liquidity is totally provided by limit orders traders. Besides, market authorities are still implementing reforms aiming at increasing the transparency and the efficiency of these markets by imposing disclosure rules, by revealing part of the order book (generally the five best bid and the five best ask prices) and by the registration of brokerage companies.

Table 2 displays the summary statistics of the 11 Arab stock markets indexes´ returns in addition to AMEX. We define returns on day *t* as $r_t = \ln(\frac{p_t}{p_{t-1}})$ where p_t is the value of the stock market index at the close of the day. In addition, Table 2 shows the data sources and period

Table 2: Returns summary statistics

	Abu Dhabi	Qatar	Morocco	Tunisia	Bahrain	Egypt	Jordan	Kuwait	Saudi Arabia	Dubai	Oman	Amex
Mean	0.0002	0.0002	0.00030	0.00067	-0.0022	0.0009	0.0004	0.00076	0.00025	0.00031	0.0003	0.00019
Median	0.0002	0.0003	0.00021	0.0004	-0.0011	0.0012	0.00	0.00105	0.00067	0.0007	0.0008	0.0006
Max	0.0725	0.0942	0.05563	0.0361	0.0262	0.183	0.047	0.05047	0.09391	0.1022	0.0804	0.124
Min	-0.0707	-0.1039	-0.0501	-0.05	-0.037	-0.179	-0.047	-0.047	-0.1032	-0.1215	-0.087	-0.104
Std. Dev.	0.0143	0.0180	0.0087	0.0052	0.01	0.0182	0.01	0.01	0.01	0.01994	0.014	0.01
Skewness	-0.0124	-0.5124	-0.133	-0.474	-0.81	-0.353	-0.06	-0.63	-1.02	0.0228	-0.924	-0.5
Kurtosis	7.699	7.9018	8.9713	15.760	5.69	16..32	6.98	7.21	16.71	8.1264	13.65	20.68
Jarque-Bera	1301.35	1347.97	3333.14	8493.29	104.12	13661.4	2756.52	1553.91	34532.1	1545.20	5466.6	30220.5
Prob	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Obs	1414	1290	2239	1245	254	1842	4171	1932	4313	1411	1123	2312
Period coverage	01/04/04 to 2/12/09	01/05/04 to 2/16/09	01/18/00 to 1/13/09	02/05/04 to 1/27/09	2/17/08 to 2/26/09	8/19/01 to 1/26/09	1/1/92 to 1/19/09	6/17/01 to 1/12/09	1/26/94 to 1/13/09	01/04/04 to 2/26/09	08/28/04 to 2/26/09	1/3/00 to 2/27/09
Data source	Market's site and Gulfbase .com	Market's site and Gulfbase .com	Market's site	Market's site	Gulfbase.c om	Market's site	Market's site	Market's site	Market's site	Market's site and Gulfbase .com	Market's site	Yahoo Finance

Finally, ARCH LM test gives strong evidence for the presence of Autoregressive Conditional Heteroskedasticity (ARCH) in the residuals when specifying a mean equation with simple constant, as shown in Appendix B, which supports the use GARCH models as well. In addition, all series show serial correlation in the residuals as measured by the Ljung-Box Q-statistic and the Breusch-Godfrey serial correlation LM test. This diagnostic suggests that GARCH process coupled with AR specification is appropriate for modeling our stock returns.

3. Methodology and results

[4] Further discussion on application of ARCH and GARCH methodology see Bollerslev, Chou, and Kroner (1992), Poon and Granger (2003), Engle (2001), Anderson, Bollerslev, Diebold, and Labys (2003), and McQueen and Vorking (2004).

3.1. GARCH-M (1,1) estimations

First we use GARCH-M (1,1) (Generalized Autoregressive Conditionally Heteroskedastic in Mean) model allowing the variance of the error term to vary over time, in contrast with classical regressions assuming constant variance. Also GARCH-M allows us to test for the presence of risk premium in the stock markets[5]. Our GARCH-M (1,1) is stated as follows:

$$r_t = \beta_0 + \beta_1 r_{t-1} + \delta h_t + e_t \qquad e_t \sim N(0, h_t) \qquad (1)$$

$$h_t = \alpha_0 + \alpha_1 h_{t-1} + \alpha_2 e_{t-1}^2 \qquad (2)$$

In addition to the intercept (β_0) and slope (β_1) in equation (1), representing an AR(1) model, δ represents the risk premium parameter in the conditional model, when tradeoff between volatility and return prevails. Returns volatility is measured by conditional variance h_t, which is described as a function of the squared values of the past residuals (e_{t-1}^2), presenting the ARCH factor, and an auto regressive term (h_{t-1}) reflecting the GARCH character of the model. The sum $\alpha_1 + \alpha_2$ represents the degree of volatility persistence

Table 3 shows the estimated GARCH-M (1,1) models for the 12 stock exchanges. First of all, Table 3 tells us that β_0 looks insignificant for Morocco, Bahrain, Jordan, Qatar and Dubai. However β_0 is shown to be significant at 1% for Oman, Kuwait, Saudi Arabia, at 5% for AMEX and Egypt, and at 10% for Tunisia and Abu Dhabi.

As for the dependency of the daily returns on their lagged values, β_1 looks very small only in AMEX case, but still different from zero. In Arab markets, β_1 value ranges from 0.102 in Dubai and 0.323 in Oman, indicating a departure from the weak-form efficiency. The time paths of β_1 is discussed in the next sub-section.

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[5] Elyasiani and Mansur (1998) discuss the benefits from GARCH-M model.

Regarding δ, the risk premium parameter, the coefficient appears significant at 10% only in the Bahraini case, giving evidence of a negative risk-premium, given its short data coverage. Further, GARCH-M (1,1) effects (ARCH and GARCH) are very significant for all markets. All series show high sensitivity to the past shocks except AMEX. α_2 varies between 0.43 for Qatar and 0.084 for Bahrain. This latter being the closest to AMEX for which α_2 equals 0.06 (in Zalewska-Mitura and Hall (1999) α_2 equals 0.05 for FTSE 100 index over 01/02/1991-10/15/1997 period).

Furthermore, the measure of volatility persistence given by $\alpha_1 + \alpha_2$ is very close to 1 for all markets indicating that undesirable shocks will persist, except Tunisian market for which the magnitude of persistence is lower (0.94) indicating that undesirable shocks exert their influence for a relatively shorter period.

It is noteworthy that diagnostic statistics based on standardized residuals (Ljung-Box Q(16) and Q^2(16) and ARCH LM(16) test) indicate that serial correlation and heteroskedasticity are dramatically reduced, except in Tunisia and Jordan cases, as expected. Kurtosis and Jung-Box statistics are much lower, even though normality is not fully satisfied.

Table 3: Estimated GARCH-M (1,1) models

		GARCH-M(1,1) Estimations							$\alpha_1 + \alpha_2$	Q(16)	Q^2(16)	ARCH LM (16)	Kurto sis	J-B
Egypt	r_t=	0.00098**	+	0.21546***	r_{t-1}	+	-0.08178	h_t		17.86	24.43	1.55	6.04	724.76
		(0.017)		(0.00)			(0.95)			(0.33)	(0.08)	(0.07)		(0.00)
	h_t=	0.000005***	+	0.85299***	h_{t-1}	+	0.136914***	e^2_{t-1}	0.99					
		(0.003)		(0.00)			(0.00)							
Morocco	r_t=	0.0000363	+	0.3011***	r_{t-1}	+	2.8937	h_t		33.93	6.06	0.37	12.74	9021.82
		(0.82)		(0.00)			(0.32)			(0.006)	(0.98)	(0.98)		(0.00)
	h_t=	0.0000045***		0.68202***	h_{t-1}	+	0.2887***	e^2_{t-1}	0.97					
		(0.00)		(0.00)			(0.00)							
Bahrain	r_t=	-0.000138	+	0.206861***	r_{t-1}	-	21.25502*	h_t		11.5	5.95	0.31	4.63	49.95
		(0.79)		(0.00)			(0.052)			(0.77)	(0.98)	(0.99)		(0.00)
	h_t=	0.0000005	+	0.909202***	h_{t-1}	+	0.084900**	e^2_{t-1}	0.99					
		(0.68)		(0.00)			(0.03)							
Jordan	r_t=	0.000031	+	0.242822***	r_{t-1}	+	2.6195	h_t		34.83	29.28	1.87	4.85	658.26
		(0.80)		(0.00)			(0.17)			(0.004)	(0.022)	(0.018)		(0.00)
	h_t=	0.000003***	+	0.753377***	h_{t-1}	+	0.2294***	e^2_{t-1}	0.98					

		(0.00)		(0.00)			(0.00)							
Abu Dhabi	r_t=	0.000578*	+	0.285873***	r_{t-1}	-	0.430585	h_t		25.17	8.36	0.51	6.27	643.05
		(0.0693)		(0.00)			(0.85)			(0.067)	(0.937)	(0.94)		(0.00)
	h_t=	0.000006**	+	0.778292***	h_{t-1}	+	0.20233***	e^2_{t-1}	0.98					
		(0.0103)		(0.00)			(0.00)							
Tunisia	r_t=	0.000293*	+	0.2636***	r_{t-1}	+	8.4569	h_t		26.27	38.3	2.49	4.48	116.85
		(0.07)		(0.00)			(0.29)			(0.05)	(0.001)	(0.0009)		(0.00)
	h_t=	0.000001*	+	0.7627***	h_{t-1}	+	0.1823***	e^2_{t-1}	0.94					
		(0.06)		(0.00)			(0.00)							
Saudi Arabia	r_t=	0.000355***	+	0.178631***	r_{t-1}	+	0.167723	h_t		76.8	9.1	0.596	8.41	5315.8
		(0.00)		(0.00)			(0.89)			(0.00)	(0.909)	(0.88)		(0.00)
	h_t=	0.000002***	+	0.779111***	h_{t-1}	+	0.228102***	e^2_{t-1}	1					
		(0.00)		(0.00)			(0.00)							
Kuwait	r_t=	0.001313***	+	0.156036***	r_{t-1}	-	0.828157	h_t		49.03	9.64	0.58	5.19	480.5
		(0.00)		(0.00)			(0.77)			(0.00)	(0.88)	(0.89)		(0.00)
	h_t=	0.000002***	+	0.791312***	h_{t-1}	+	0.199397***	e^2_{t-1}	0.99					
		(0.00)		(0.00)			(0.00)							
Qatar	r_t=	0.000419	+	0.29338***	r_{t-1}	+	1.418995	h_t		45.663	26.51	1.62	4.65	156.28
		(0.16)		(0.00)			(0.30)			(0.00)	(0.047)	(0.056)		(0.00)
	h_t=	0.0000116***	+	0.6045***	h_{t-1}	+	0.430481***	e^2_{t-1}	1.03					
		(0.00)		(0.00)			(0.00)							
Dubai	r_t=	0.001296	+	0.10289	r_{t-1}	+	0.094352	h_t		78.64	18.58	1.109	4.52	146.2
		(0.0001)		(0.002)			(0.94)			(0.00)	(0.291)	(0.34)		(0.00)
	h_t=	0.000001***	+	0.69024***	h_{t-1}	+	0.33606**	e^2_{t-1}	1.02					
		(0.00)		(0.00)			(0.00)							
Oman	r_t=	0.000394***	+	0.3236***	r_{t-1}	+	0.2358	h_t		20.81	11.21	0.67	8.81	1672.84
		(0.104)		(0.00)			(0.92)			(0.18)	(0.79)	(0.82)		(0.00)
	h_t=	0.000002***	+	0.833***	h_{t-1}	+	0.1669***	e^2_{t-1}	0.99					
		(0.00)		(0.00)			(0.00)							
AMEX	r_t=	0.000646**	+	0.0649***	r_{t-1}	-	1.077997	h_t		10.53	9.97	0.63	6.03	906.2
		(0.03)		(0.00)			(0.75)			(0.83)	(0.87)	(0.86)		(0.00)
	h_t=	0.000002	+	0.909758***	h_{t-1}	+	0.067311***	e^2_{t-1}	0.98					
		(0.106)		(0.00)			(0.00)							

P-values of the coefficients are reported in parentheses. $\alpha_1 + \alpha_2$ is the sum of ARCH and GARCH coefficients and it is a measure of the volatility persistence. .Q(16) and $Q^2(16)$ are Ljung-Box statistics for standardized residuals and squared standardized residuals of order 16. ARCH LM(16) is the heteroskedasticity test F-statistic of order 16. J-B refers to Jarque-Bera normality test statistic. ***, ** and * indicate significance levels at 1, 5 and 10 percent respectively.

3.2. Kalman Filter estimations

Using the GARCH-M (1,1) specification, the state-space model is formulated in order to take not only changing variance structure in stock returns into consideration but also the time-varying dependency of the daily returns on their lagged values as follows:

$$r_t = \beta_0 + \beta_{1t} r_{t-1} + \delta h_t + e_t \qquad e_t \sim N(0, h_t) \qquad (3)$$

$$h_t = \alpha_0 + \alpha_1 h_{t-1} + \alpha_2 e_{t-1}^2 \qquad (4)$$

$$\beta_{1t} = \beta_{1t-1} + v_{it} \qquad \mathrm{v}_{it} \sim N(0, \sigma_i^2) \qquad (5)$$

The β_{1t}, in equation (3), is not to be estimated as constant over time like in equation (1), but as a time-varying parameter. Equation (3) being the space or signal equation and equation (4) and (5) the two state equations. Equation (4) describes the behavior of the variance of the residuals as before, and equation (5) describing the behavior of β_{1t} following a random walk.

Graphs 1 to 12 in Appendix C show the time paths of β_{1t} and the 95% confidence interval obtained through Kalman Filter state-space estimations. In AMEX case, β_{1t} coefficient is very close to zero and goes towards zero, without being sensitive to any of the contemporaneous crises. This is consistent with the weak-form efficiency properties of a developed mature market. In contrast, Arab markets behave differently indicating a clear departure from weak-form efficiency since β_{1t} are significantly different from zero, in spite of temporary improvements in Jordan, and Saudi and Egypt exchanges before 2001 and 2006, and in Kuwait, Adu Dhabi, Qatar and Dubai before the end of 2008. Indeed, β_{1t}s move in the wrong direction away from zero during the current crises or since 2006 local crises in Saudi Arabia, Kuwait, Jordan and Egypt cases. Regarding Tunisia, Oman and Morocco cases β_{1t} time paths are highly instable, which might be explained by their lack of liquidity as stressed in section2.

Overall, all Arab stock exchanges are found weak-form inefficient and inefficiency does not improve towards the first quarter of 2009. This reveals the ineffectiveness of the reforms undertaken during the last years and calls for a serious reflection on the way forward to redress the situation.

The possible explanations of the weak-form inefficiency of Arab stock exchanges lie in the lack of liquidity given the thinness of those markets, in the nature of the traders and in other microstructural aspects. In fact, the 11 markets are pure order driven markets which could hamper the liquidity provision function, make them more volatile and then can be seen as constraint towards more efficiency. It is well documented that order driven markets organization runs better with very liquid stocks (Seppi (1997), Handa and Schwartz (1996), Demarch and Foucault (1998) and Revest (1999)). Huang and Stoll (1996) also found that order book fits more with small or medium orders. Market makers improve liquidity either for less liquid stocks or for big orders. Introducing market makers in Euronext Paris and Stockholm helped these markets in reducing the bid-ask spread and increasing the trade volume (Bessembinder, Hao, and Lemmon (2007), Anand, Tanggaard and Weaver (2006) and Venkataraman and Weisbard (2006)), which should also be done in Arab stock markets given their thinness.

Further subjacent factors lie in the nature of traders in these markets, essentially individuals (88% in Saudi Arabia and more than 60% for others, which is very high internationally), with poor equity investment culture given the short life of these markets. In addition, such traders could not have easy access for high quality and reliable information as institutional traders can do. In sum, their ability to correctly analyze news my be seriously detrimental, by introducing lots of noise and increasing volatility especially in crises periods. Thus, the traders learning process is clearly in its infancy and needs to be improved by better investment culture and channeled by institutional trading.

4. Conclusion

Arab countries have shown a growing interest for stock markets since the early 1990s, which explains their number and the many reforms undertaken in order to improve their liquidity and efficiency. These markets have shown a fair development regarding their size and liquidity. Nonetheless, the progress in terms of efficiency remains mixed if one refers to the literature. However, traditional tests often applied to these emerging markets are considered inadequate given their thinness, their organization and the nature of traders. Also these tests measure the efficiency in a given point of time and do not account for its evolution over time, expected to move towards weak-form efficiency thanks to reforms and agents learning process.

The approach considered in this paper allows us to overcome these two problems. The results reveal a clear departure from weak-form efficiency. Overall, efficiency paths of the 11 stock markets do not show a clear trend towards more efficiency and are quite instable being affected by the contemporaneous crises. In addition these markets are highly sensitive to past shocks indicating that undesirable shocks exert their influence for a long period.

In sum, the results stands in contrast with developed mature markets, represented here by AMEX, and reveals the ineffectiveness of the reforms undertaken during the last decade and calls for serious reflection in order to boost the markets, improve their liquidity and counteract the shortcomings of the large individual trading.

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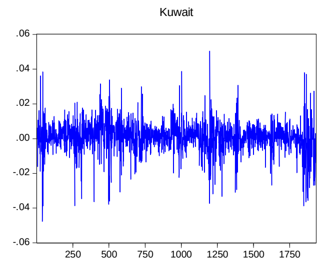
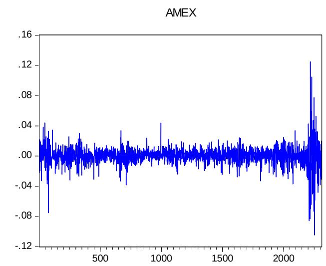
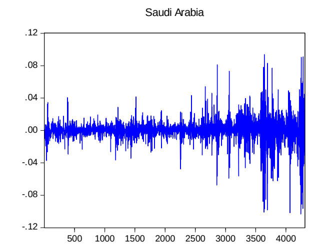
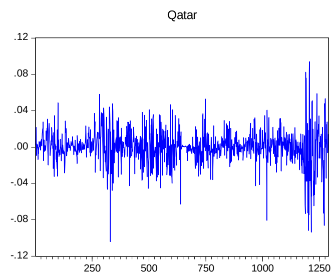
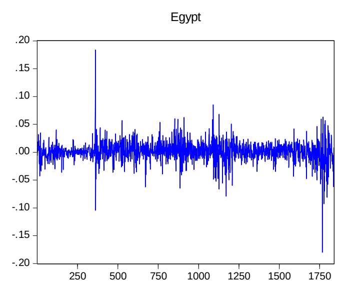
Appendix A: Daily returns

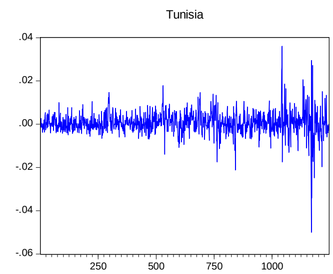


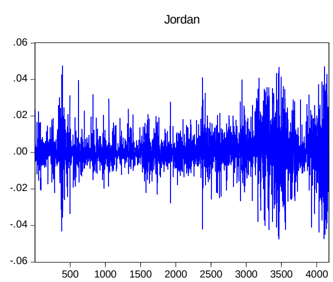


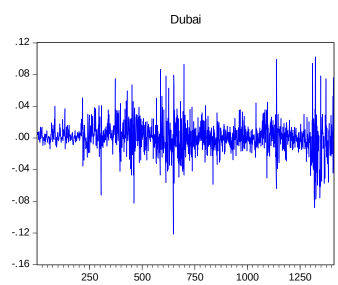


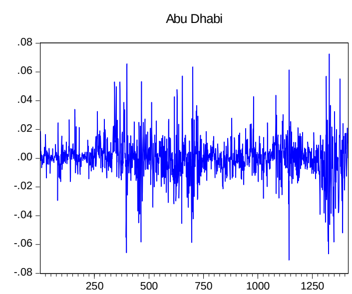


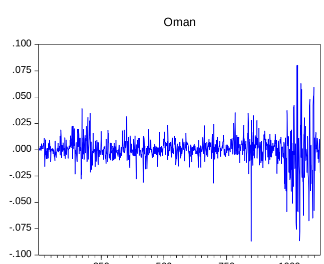


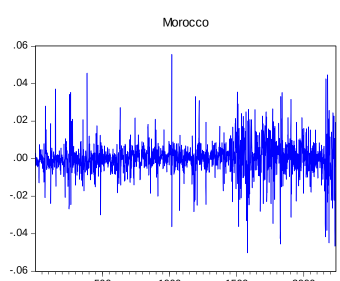


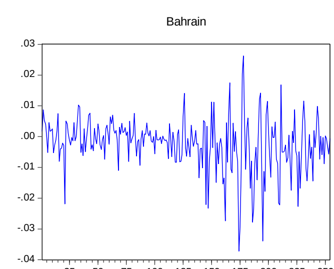












Appendix B: : Mean equation estimations

Mean Equation Regression		T-statistic	DW	Q(16)	$Q^2(16)$	B-G LM(16)	ARCH LM F-stat(16)
Saudi Arabia							
C	0.00025	1.236737	1.82	136.34	4395.0	8.62	89.44
				(0.00)	(0.00)	(0.00)	(0.00)
Kuwait							
C	0.000756***	3.699065	1.53	229.81	1018.3	11.07	25.5
				(0.00)	(0.00)	(0.00)	(0.00)
Tunisia							
C	0.000674***	4.49	1.57	134.95	622.07	8.53	36.09
				(0.00)	(0.00)	(0.00)	(0.00)
Dubai							
C	0.00031	0.584761	1.88	80.147	813.85	3.90	24.41
				(0.00)	(0.00)	(0.00)	(0.00)
Egypt							
C	0.000999**	2.35453	1.66	82.6	350.04	5.05	17.48
				(0.00)	(0.00)	(0.00)	(0.00)
Qatar							
C	0.000227	0.451673	1.458	151.1	1189.2	9.58	29.61
				(0.00)	(0.00)	(0.0027)	(0.00)
Jordan							
C	0.00043***	2.77984	1.52	266.00	5178.6	18.92	105.43
				(0.00)	0.00	(0.00)	(0.00)
Abu Dhabi							
C	0.000203	0.532	1.401	179.75	760.61	11.89	22.05
				(0.00)	(0.00)	(0.00)	(0.00)
Bahrain							
C	-0.00228***	-4.31434	1.43	72.71	133.67	3.85	4.69
				(0.00)	(0.00)	(0.00)	(0.00)
Morocco							
C	0.000301	1.629573	1.34	269.27	807.34	18.55	29.22
				(0.00)	(0.00)	(0.00)	(0.00)
Oman							
C	0.000299	0.714454	1.47	171.4	1453.1	12.42	38.88
				(0.00)	(0.00)	(0.00)	(0.00)
Amex							
C	0.000185	0.74558	1.92	44.677	2707.8	3.11	69.73
				(0.00)	(0.00)	(0.00)	(0.00)

P-values of the coefficients are reported in parentheses. DW is Durbin-Watson statistic. Q(16) and $Q^2(16)$ are Ljung-Box statistics for standardized residuals and squared standardized residuals of order 16. B-G LM(16) is Breusch-Godfrey serial correlation LM test of order 16. ARCH LM(16) is the Heteroskedasticity test F-statistic of order 16. ***, ** and * indicate significance levels at 1, 5 and 10 percent respectively.

Appendix C: Evolving efficiency graphs