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Abstract

This paper tests for structural changes in the price indices of four stock markets in the Middle East region, namely, Egypt, Turkey Jordan, Morocco and Israel. The Innovational Outlier (IO) model and Additive Outlier (AO) model indicate that all variables show evidence of non-stationarity, $I(1)$, even with structural change. Moreover the coefficients for all dummy variables such as intercept, slope and time of the break are found to be significant and all have the right signs. The endogenously determined times of the breaks for all variables coincides with observed real events for each country, like Asian crises, fluctuation in oil prices and the political conflict in the Middle East.

I. INTRODUCTION

A significant amount of economic and statistical literature has focused on the unit root hypothesis when using time series data. It becomes a preliminary procedure to test the null hypothesis of a unit root against the alternative hypothesis of stationarity. Stationarity in this context means that the fundamental form of the data generating process remains the same over time, in other words, the mean and the variance of the time series are independent of time. The unit root test is the most widely used test for stationarity; it is also considered as a preliminary step in testing for cointegration or causality tests, as all series need to be integrated of the same order. Different methods have been used to test for stationarity; the commonly used methods are the Augmented Dickey-Fuller (ADF), Phillips and Perron (PP) tests, and (KPSS) tests.

According to Perron (1989) most economic time series are characterized by a stochastic rather than deterministic nonstationarity. He argues that macroeconomic time series may be stationary if one allows for structural changes in the trend function of the regression. When there are structural breaks present, the Dickey–Fuller statistics are biased towards the non rejection of unit root (Ender, 2004, p. 200). These tests lack power in the presence of potential structural breaks in the series, and they may fail to show whether a series is first difference stationary (Wilson, et. al. 2003).

Perron (1989) proposes a unit root test in which he incorporates dummy variables into the Augmented Dickey-Fuller (ADF) test to allow for a single change in the intercept of the trend function and/or a single change in the slope of the trend function, this structural change is allowed at a known break date T_B ($1 < T_B < T$), where T_B is the time of a structural change. Determining the time of the break a priori means that the date chosen was uncorrelated with the data and it is related to an exogenous event. Usually economic theory suggests that this event has an effect on the series. Perron (1989) proposes two different models; the first one is the Innovationl Outlier model (IO), where changes are assumed to occur gradually. The second model is the Additive Outlier model (AO), where rapid and sudden changes are assumed to affect the trend function.

The Perron (1989) approach has been criticized by several subsequent studies for the assumption of a known break, which is assumed to be given exogenously. The problem with this assumption is that the choice of the break point is based on visual inspection of the data and that the problem of pre-testing or data mining can arise. The criticism was first pointed out by Christiano (1992), and followed later by several others, including Zivot and Andrews (1992), Banerjee, Lumsdaine and Stock (1992), Perron and Vogelsang (1992), and Perron (1997)). All of these studies follow new procedures, in which the choice of the break point is considered as

endogenous. So, these studies test for the unit root hypothesis that allow for a possible change in the level of the series occurring at an unknown time of the break point. By applying these tests, one could determine the most significant structural change detected over the time series period.

The aim of this study is to examine the presence of structural changes at an unknown time of break in four stock markets indices in the Middle East region. No study before has addressed this issue in these markets. However, only three main studies in particular have studied stock markets in the Middle East region, namely, Darrat et al. (2000), Neaime (2002) and Maghyereh (2003). These studies examined stock markets integration in MENA region, but they did not address the issue of structural change while testing for integration, and also, Israel has not been included in any of these studies. This study follows Perron's (1997) procedure as it is the most inclusive one among all previous studies.

The paper is divided into five sections. After the initial introduction to the study, section two analyses the main features of the stock markets in The Middle East region. The data for these stock markets and some important statistical characteristics of these markets are presented and interpreted in section three. The theoretical background and the results of testing unit root with structural change for these four countries are presented in section four. The last section closes with conclusions.

II. STOCK MARKETS IN THE MIDDLE EAST

The Middle East region covers many countries extending from the Arabian Sea in the east to the Atlantic Ocean in the west. The stock markets in the Middle East have achieved positive development during the last decade. This study focuses on the three Arabic stock markets, namely, Egypt, Jordan and Morocco, as well as that of Israel. The Arab countries are classified as low to middle-income by the World Bank. Israel is classified as high income country. Table 1 reports the main economic indicators for these countries. These countries have relatively active stock markets compared to other markets in the region.

Despite numerous empirical studies which have focused on developed stock markets in different parts of the world, especially the US and Europe, and other emerging stock markets in Latin America, South Asia and Pacific-Basin, the stock markets in the Middle East region have not been discussed deeply despite the exceptional international role and importance of this region on the international economic and political events.

Table 1 Economic Overview for Middle Eastern Countries

		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Egypt	GDP, \$US Billions	51.90	60.16	67.65	75.61	82.71	89.21	98.73	98.48	89.85	82.43
	Exchange Rate	3.38	3.39	3.40	3.40	3.41	3.42	3.54	4.05	4.63	5.88
	Change in CPI (%)	8.2	15.7	7.2	4.6	4.2	3.1	2.7	2.3	2.7	4.5
	Population	60.46	61.64	62.82	64.02	65.24	66.49	67.78	69.12	70.51	71.93
Jordan	GDP, \$US Billions	6.08	6.51	6.72	6.98	7.39	8.07	8.34	8.83	9.38	9.86
	Exchange Rate	0.69	0.70	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
	Change in CPI (%)	3.5	2.4	6.5	3.0	4.4	0.6	0.7	1.8	1.8	2.3
	Population	4.05	4.25	4.43	4.59	4.74	4.89	5.04	5.18	5.33	5.47
Morocco	GDP, \$US Billions	30.35	32.99	36.64	33.42	35.55	35.28	33.35	33.90	36.09	43.73
	Exchange Rate	9.19	8.54	8.69	9.52	9.59	9.80	10.93	11.30	11.02	9.58
	Change in CPI (%)	5.1	6.1	3.0	0.9	2.9	0.7	1.9	0.6	2.8	1.2
	Population	26.39	26.84	27.28	27.73	28.18	28.64	29.11	29.59	30.07	30.57
Israel	GDP, \$US Billions	74.7	86.9	95.5	98.6	100.5	100.8	110.4	113.6	104.2	110.2
	Exchange Rate	3.01	3.01	3.19	3.45	3.80	4.14	4.08	4.21	4.74	4.55
	Change in CPI (%)	12.3	10.0	11.3	9.0	5.4	5.2	1.1	1.1	5.6	0.7
	Population	5.18	5.35	5.50	5.65	5.78	5.91	6.04	6.17	6.30	6.43

Sources:

1. Standard & Poor's, Emerging Stock Markets Factbook, 2002, New York.
2. Standard & Poor's, Global Stock Markets Factbook, 2005, New York.
3. International Monetary Fund, International Financial Statistics, Yearbook, 2004, Washington DC.

The emerging stock markets in the Middle East region have achieved considerable improvements in the last decade. Several factors have played vital roles in their growth, such as the achievement of higher economic growth, monetary stability; stock markets reforms, privatisation, financial liberalization and institutional framework for investors (Claessens, et al., 2004). Table 2 reports the main indicative statistics for the four markets in this study. To ensure comparability and consistency between all stock markets, this study relies on Emerging Markets Factbooks and Global stock Market Factbook, both published by Standard & Poor's for the main stock market indicators.

The stock market in Israel (Tel-Aviv Stock Exchange) is the largest among all stock markets in the Middle East. By the end of 1994, the market capitalization in the Tel- Aviv Stock Exchange (TSE) was \$US 32,730 million compare with \$US 4,263 for Egypt, \$US 4,594 for Jordan and \$US 4,376 for Morocco. During the last decade the market capitalization in all markets has increased significantly, with TSE still the largest among all stock market in the Middle East.

Table 2. Stock Markets Development Statistics

Market	Market variables	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Egypt	Market Capitalization (US\$)	4,263	8,088	14,173	20,830	24,381	32,838	28,741	24,335	26,338	27,847
	Trading Value	757	677	2,463	5,859	5,028	9,038	11,120	3,897	6,443	4,349
	Turnover Ratio (%)	18.7	10.9	22.2	33.5	22.3	31.6	34.7	14.2	24.46	15.62
	Listed Companies	700	746	649	654	861	1,033	1,076	1,110	1150	976
Jordan	Market Capitalization (US\$)	4,594	4,670	4,551	5,446	5,838	5,827	4,943	6,316	7,087	10,962
	Trading Value	626	517	297	501	653	548	416	933	1,335	2,607
	Turnover Ratio (%)	13.0	11.1	6.4	10.0	11.6	9.4	7.7	16.6	18.83	23.78
	Listed Companies	95	97	98	139	150	152	163	161	158	161
Morocco	Market Capitalization (US\$)	4,376	5,951	8,705	12,177	15,676	13,695	10,899	9,087	8,564	13,050
	Trading Value	788	2,426	432	1,048	1,390	2,530	1,094	974	1,441	2,444
	Turnover Ratio (%)	22.1	45.9	5.9	10.2	10.1	17.6	9.2	10.0	16.8	18.7
	Listed Companies	51	44	47	49	53	55	53	55	55	52
Israel	Market Capitalization (US\$)	32,730	36,399	35,935	45,268	39,628	63,820	64,081	70,271	45,371	75,719
	Trading Value	25,110	9,155	8,045	10,710	11,264	15,463	23,394	29,791	55,250	41,558
	Turnover Ratio (%)	60.4	25.9	22.2	26.7	26.4	29.8	36.3	44.7	99.3	67.9
	Listed Companies	638	654	655	640	650	644	654	646	615	576

Source:

1. Standard & Poor's, Emerging Stock Markets Factbook, 2002, New York.
2. Standard & Poor's, Global Stock Markets Factbook, 2005, New York.

In regard to the turnover ratio, which is an index of market liquidity, the TSE is the most active among all other stock markets. It increases from 60.4% in 1994 to %67.9 in 2003. Despite some volatility in some years, the turnover ratio in TSE is larger than the same ratio in other markets.

III. DATA

This study employs monthly stock market indices for four major stock markets in the Middle East region, namely Egypt, Jordan, Morocco and Israel. The data are obtained from Morgan Stanley Capital International (MSCI). It covers the period from December 1994 to June 2004, for a total of 115 monthly observations. The stock price indices are expressed in local currencies. Some previous studies have argued that denominating stock prices in the local currency incorporates hedging activities of investors against movements in the foreign exchange rate (See Darrat, 2003, p. 1092), others denominated in US dollar. This study uses stock prices indices on a monthly basis to avoid distortions common in weekly and daily data arising from non-trading and non-synchronous trading (see Hung and Cheung, 1995).

IV. TESTING FOR STRUCTURAL CHANGE

The current study uses Perron's (1997) procedure as it is the most inclusive one amongst all previous studies. Perron's (1997) statistical procedure includes both Innovational Outlier models, namely IO1 and IO2 and the Additive Outlier model (AO). These models test for a unit root allowing for the presence of structural change in the trend function occurred at most once.

In the case of applying the IO models this change is assumed to occur gradually by including dummy variables for the structural change into the Augmented Dickey-Fuller test. In the case of applying the AO model, the change is assumed to occur instantaneously.

IO2 model is the most inclusive model, which allows for the occurrence of both changes in the intercept and in the slope of the trend function. It is performed using the t -statistic for the null hypothesis that $\alpha = 1$. It takes the following formula:

$$y_t = \mu + \beta t + \theta DU_t + \gamma DT_t + \delta DT_B + \alpha y_{t-1} + \sum_{i=1}^k c_i \Delta y_{t-1} + e_t \quad (1)$$

where $DT_t = 1(t)$ if $t > T_B$, 0 otherwise. IO1 model allows for the occurrence of gradual change in the intercept of the trend function. It takes the following formula:

$$y_t = \mu + \beta t + \theta DU_t + \delta DT_B + \alpha y_{t-1} + \sum_{i=1}^k c_i \Delta y_{t-1} + e_t \quad (2)$$

where $DU_t = 1$ if $t > T_B$, 0 otherwise.

$$DT_B = 1 \text{ if } t = T_B + 1, 0 \text{ otherwise.}$$

The AO model allows for a sudden and rapid change in the trend function. When considering the additive outlier model, a two-step procedure is used. First the series is detrended using the following regression:

$$y_t = \mu + \beta t + \gamma DT_t^* + \tilde{y}_t \quad (3)$$

where $DT_t^* = 1(t - T_b)$ if $t > T_b$, 0 otherwise.

The test is then performed using the t -statistic for $\alpha = 1$ in the regression:

$$\tilde{y}_t = \alpha \tilde{y}_{t-1} + \sum_{i=1}^k c_i \Delta \tilde{y}_{t-i} + e_t \quad (4)$$

The selection of the order of lag employs the “general-to-specific” procedure based on the significant t -statistic of the coefficient associated with the last included lag in the estimated regression. In other words, we test the significance of the maximum order lag and start reducing the order until the last lag becomes significant. The selected lag is denoted k and according to some studies, the maximum order of the lag is set at 8 (Ben-David and Papell, 1997). A two-sided 10% test based on the asymptotic normal distribution, which is equal to (1.6), is used to assess the significance of the last lags (Perron, 1997).

To determine the time of the break point endogenously at an unknown break point, the time of the break T_b is selected as the value that minimizes the t -statistic for testing $\alpha = 1$. The reason for this is to make it more likely to reject the null hypothesis of $\alpha = 1$ (Wilson, 2004, p.16). In this context, Zivot and Andrews (1992) argue to select the break point that gives the least favorable result for the null hypothesis.

The IO2 model (equation 1) is estimated first as it is the most inclusive one. The results are reported in Table 3. The results indicate that all variables show evidence of non stationarity, as the

values of $t_{\hat{\alpha}}$ for all variables are less than the critical values. However, the coefficients of all dummy variables for Egypt, Morocco and Israel are not significant. Only Jordan has significant dummy variables with the same expected sign. The time of the break is on December 2001, and it is found to be coincided with observed real events.

However, as $t_{\hat{\gamma}}$ is not significant for three markets, the IO1 model (equation 2) is estimated. The results are reported in Table 4. The results show that all variables show evidence of unit root and all dummy variables are significant. The time of the break for Egypt is April 2001, for Morocco is November 1996 and for Israel is December 2001, and all of them are found to be coincided with observed real events.

In order to allow for a sudden and rapid change to the trend function, the AO model (equation 3) is applied and the results that are reported in Table 5. The statistics indicate that all variables show evidence of unit root and the coefficients for all dummy variables are significant.

The possible causes for structural changes in these markets are analysed as follow: In the case of the Egyptian stock market, it witnessed a sharp drop in all market indicators in the year 2000. Many factors caused this abysmal performance. The Egyptian economy was under enormous pressure during 2000 and 2001 because of a sharp drop in oil prices, a sharp decrease in tourism revenue after Luxor events, and the continuing violence and political crisis in the Middle East. All of these factors played a vital role in weakening the performance of the Egyptian economy. By January 2001, the Egyptian Pound was devalued by 9.6%. After that the central bank adopted more flexible exchange rate policy; it again devaluated the Pound by 6.4% in August 2001. All of these events had a negative impact on the Egyptian Stock Market indicators.

The stock market in Jordan has been affected by the limits to investor confidence and political developments in the region especially the Palestinian “Intifada”, which casts its shadow on the Jordanian market, and the aftermath of the 11th September 2001 attacks.

In the case of Morocco, despite a huge reduction in the trading value during 1996, it is believed that the signing of the trade agreement with the European Union in 1996 had pushed for more improvement in the private sector, which was reflected in the stunning performance of the Casablanca stock Exchange at the end of 1996 and during 1997. The stock market in Morocco has witnessed a sharp drop in trading value during 1996, which has a negative impact on the performance of Casablanca Price index.

In the case of Israel, the stock market in Israel (Tel-Aviv Stock Exchange) was affected by the slowdown in the economy during the 2001. The main reasons for this slowdown were the escalation of political and military tension with the Palestinians and with Lebanon. Moreover, the high-technology sector dropped dramatically during the 2001 by 10.5%. These events had negative

impacts on the economy as whole. All of these events, in addition to the aftermath of the 11th September 2001 attacks, had negative impacts on the stock market.

To summarize these findings, first, the power of these tests has been questioned by Perron and others, who raise the issue of the trade-off between the power of the test and the amount of information incorporated with respect to the choice of break point (Perron, 1997, p. 378). That is, assuming an unknown break point will provide the test with less power than if the break point is already known. Second, although it is essential to consider the covariate-Perron's test with unknown break point, it is still considerable - in some circumstances - implementing the test assuming a known break point. Finally, these tests have been extended to allow the possibility of multiple endogenous break points. Some Studies, such as Lumsdine and Papell (1997), Bai and Perron (1998), Ben-David and Papell (1997), Wilson et al. (2003) and Bai and Perron (2003), have argued that allowing for the possibility of two or more endogenous breaks points provides more evidence against the unit root hypothesis (Maddala and Kim, 2003). However, the debate is still continuing.

V. CONCLUSION

This study follows Perron's (1997) Innovatioanl Outlier (IO) and the Additive Outlier (AO) models, which are the most inclusive among all other procedures in testing for a unit root in the presence of structural change at an unknown time of the break. The study empirically examines the existence of structural changes in the price indices of four stock markets in the Middle East region, namely, Egypt, Jordan, Morocco and Israel. The results indicate that all variables show evidence of non-stationarity. Also the coefficients for all dummy variables such as the intercept, slope and time of the break and trend are significant and have the expected sign. The time of the break for all variables coincides with observed important shocks to these economies, like exchange rate devaluation, a sharp drop in oil prices, the Asian crises during 1997 and the continuing of the political crisis in the Middle East. Also the aftermath of the September 11 attacks on the US had negative impacts on the performance of stock markets in the Middle East region, especially Jordan and Israel.

The finding of these structural changes has important implications. It becomes essential to determine these structural changes when performing any cointegration relationship. Moreover, the determining of these structural changes is crucial for economic policy makers and for financial analysts, brokers and all participants.

For future studies, although this study has used an advanced technique to test for a unit root in the presence of unknown structural changes, other techniques have been used recently to allow for multiple structural breaks. These techniques could be implemented in Middle East stock markets. Moreover, the sample of the study could be extended to include more stock markets, including those in the Gulf region.

Table 3. The Empirical Results for Using Perron (1997), Model (2): the Innovatioanl Outlier model (IO2) with a Change in the Intercept and the Slope, minimizing $t_{\hat{\alpha}}$ for testing $\alpha = 1$

Series: monthly stock price index	Time of the break (T_b)	k	β	t_{β}	θ	t_{θ}	γ	$t_{\hat{\gamma}}$	α	$t_{\hat{\alpha}}$	Inference*
Egypt	1996: 7	11	0.015	1.184	0.319	1.458	-0.016	-1.202	0.872	-3.074	Unit root
Jordan	2001: 12	12	-0.003	-4.156	-1.058	-4.672	0.012	4.731	0.473	-4.581	Unit root
Morocco	1996: 11	9	-0.000	0.313	0.091	1.376	-0.002	-0.521	0.903	-3.487	Unit root
Israel	1999:8	10	0.002	1.497	0.818	3.706	-0.231	-1.419	0.733	-4.49	Unit root

* The results are significant at 5%. The Critical value = -5.57

Table 4. The Empirical Results for using Perron (1997), Model (1): the Innovatioanl Outlier model (IO1) with a Change in the Intercept, minimizing $t_{\hat{\alpha}}$ or testing $\hat{\alpha} = 1$

Series: monthly stock price index	Time of the break (T_b)	k	β	t_{β}	θ	t_{θ}	$\hat{\alpha}$	$t_{\hat{\alpha}}$	Result*
Egypt	2001: 4	11	0.001	1.684	-0.083	-1.789	0.838	-3.205	Unit root
Jordan	2003: 2	12	-0.000	-1.787	0.081	3.347	0.845	-2.850	Unit root
Morocco	1996: 11	9	-0.000	-2.630	0.059	2.355	0.907	-3.525	Unit root
Israel	2001:12	10	0.004	3.42	-0.389	-3.845	0.720	-4.853	Unit root

* The results are significant at 5%. The critical values are -5.57 and -5.08 at 1% and 5% levels, respectively.

Table 5. The Empirical Results for using Perron (1997), Additive Outlier model (AO): Minimizing $\alpha = 1$

$$y_t = \mu + \beta_t + \gamma DT_t + \hat{y}_t$$

and perform this test using t-statistics for $\alpha = 1$ in the regression:

$$\hat{y}_t = \alpha \hat{y}_{t-1} + \sum_{i=1}^k c_i \Delta \hat{y}_{t-i} + e_t$$

Series: monthly stock price index	Time of the break (T_b)	k	β	t_β	$\hat{\gamma}$	$t_{\hat{\gamma}}$	$\hat{\alpha}$	$t_{\hat{\alpha}}$	Inference
Egypt	1995: 7	11	0.063	2.108	-0.062	-2.050	0.893	-3.055	Unit root
Morocco	1996: 4	9	0.061	8.535	-0.062	-8.289	0.941	-2.921	Unit root
Jordan	2001: 9	12	-0.006	-19.473	0.028	23.638	0.513	-5.112	Unit root
Israel	2000:1	10	0.020	10.409	-0.045	-12.005	0.808	-3.206	Unit root

* The results are significant at 5%. The critical values are -5.41 and -4.80 at 1% and 5% levels, respectively.

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