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Time Series Analysis of the Impact of Real Interest Rates on Stock Market Activity and Liquidity in Egypt: Co-integration and Error Correction Model Approach

Mohammed Omran[a,b]
[a] *Arab Academy for Science & Technology, College of Management & Technology, Alexandria, Egypt*
[b] *Arab Monetary Fund, Economic Policy Institute, Abu Dhabi, Unites Arab Emirates*
E-mail: momran@aast.edu

ABSTRACT

Since 1991 Egypt has witnessed major and radical changes in its economic climate as a result of the government's adoption of a program of economic reform aimed at increasing the growth rate of the economy. Arguably, this objective can be assisted through creating a strong stock market. This paper focuses on examining the impact of real interest rates as a key factor in the program on the performance of the Egyptian stock market, both in terms of market activity and liquidity. By applying Engle and Granger's two-stage procedure, results from co-integration analysis through error correction mechanisms (ECM) indicate significant long-run and short-run relationships between the variables, implying that real interest rates have an impact upon stock market performance.

JEL: *C12, C22, E44, G10, O23*

Keywords: *Real interest rates; Stock market; Egypt; Co-integration; Error correction mechanism*

I. INTRODUCTION

Numerous scholars have performed extensive empirical investigation of the impact of several macro-economic variables on the stock market performance, concentrating on investors' perspectives by looking at stock prices and returns. However, little attention has been paid to real interest rates, which might be considered an important factor. Yet, there are other important issues concerning the extent to which real interest rates may affect the smooth functioning of stock markets, in terms of the extent of trading, capital issues and the dominance of major companies. Such issues require investigation. It can be argued that for emerging markets these examples can be especially critical in terms of success in economic reform. An emerging stock market can indeed be seen as an important vehicle in a country's strategy to facilitate the flow of investment into the business sector in order to accelerate economic growth and reduce external debt (Ploeg, 1996).

As an example, Egypt has been particularly successful in its program of economic reform and is chosen here as the focus of this study as to the impact of real interest rates upon these functional aspects of stock market performance.

With regard to real interest rates as an important variable, it has been argued that it has a positive relationship with economic growth (Pill, 1997)[1]. In fact, this means that an economic reform program, in terms of financial liberalization, permits real interest rates to rise to modestly positive, equilibrium levels. Through a variety of mechanisms, higher real interest rates prompt financial activities, and in turn economic development and growth (see, Landi and Saracoglu, 1983; Gelb, 1989; and Pill, 1997).

As mentioned previously, many studies (Mukherjee and Naka, 1995; Masih and Masih, 1996; Kwon, Shin, and Bacon, 1997; Cheung and Ng, 1998; and Nasseh and Strauss, 2000) examine the impact of several macroeconomic variables (including nominal interest rates and inflation) on stock markets in both developed and emerging economies. Most studies find that these macroeconomic variables have significant influence on the stock market and/or the existence of a long-run relationship between these macroeconomic variables and stock prices/returns. Additionally, the work of Omran and Pointon (2001) investigates the impact of the inflation rate on the performance of the Egyptian stock market and concludes that there is a long-run relationship between inflation rate and stock market performance. On the other hand, real interest rates seem to be a neglected variable in the literature. Among the very few studies, Spiro (1990) examines the relationship between real interest rates and stock market performance in developed economies and documents a negative relationship between real interest rates and stock prices. The argument is that people may prefer to invest in banks rather than stock markets when real interest rates go up; hence, higher real interest rates may affect stock markets negatively.

It should also be mentioned that real interest rates depend on the changes in both nominal interest rates and the inflation rate. In fact, the real interest rate can be calculated from the Fisher equation (1930): One plus the nominal rate of interest is set equal to the product of (i) one plus the general inflation rate and (ii) one plus the real rate. It follows that the real rate equals the excess of the nominal rate and the rate of inflation, where both are divided by one plus the inflation rate (Davis and Pointon, 1994).

Since real interest rates depend on changes in nominal interest rates and the inflation rate, the impact of real interest rates on stock markets depends, mainly, upon its sign from the movements in nominal interest rates and inflation rate. Since the decrease in both nominal interest rates and the inflation rate affects the stock market positively, the relationship between real interest rates and stock markets in this case is expected to be positive. As the latter case represents the same situation as in Egypt, it can be argued that the relationship between real interest rates and the stock market performance is expected to be positive. However, the intention here is to try to outline an empirical framework of the relationship between real interest rates and other stock market performance variables such as market activity and liquidity, where stock prices and returns cannot be examined given that a stock market index in Egypt was not developed until late 1993.

By applying Engle and Granger's two-stage procedure, this paper empirically investigates the relationship between real interest rates and stock market activity and liquidity in Egypt. I document significant long-run and short-run relationships between the variables, implying that real interest rates have an impact on stock market performance in Egypt. These findings seem to be consistent with Omran (1999) who documents significant long-run and short-run relationship between some macro-economic variables - such as nominal interest rates and GDP growth rates- and stock market performance in Egypt, and Omran and Pointon (2001) who document a significant impact of inflation rate on the Egyptian stock market. However, the positive relationship between real interest rates and stock market performance tends to oppose the findings of Spiro (1990), who documents a negative relationship between real interest rates and stock prices.

The next section presents an overview of the conceptual framework of real interest rates in Egypt. The data and hypotheses are discussed in the third and fourth sections, respectively. Methodological issues and the structure of the empirical model are presented in the fifth section with empirical results discussed in section six. The seventh and final section presents the conclusion and main findings.

II. CONCEPTUAL FRAMEWORK

Small countries with large external debt and a low rate of economic growth are often advised by economists to cut back the size of the public sector and reduce the government debt. Such policies are expected to give more chance for private initiative and investment and as a result, they can boost the rate of economic growth and reduce government debt. In light of the above, in late 1990 Egypt started its economic reform program in order to make major radical changes in its economic climate.

With real interest rates an important factor in any economy, it is essential that they have to be positive in order to encourage society to save. However, interest rates should not be too high so as to encourage firms to finance their businesses and other investors to establish new businesses since both help to accelerate the rate of economic growth. In many developing countries, including Egypt, the rate of inflation has been higher than nominal interest rates, so, real interest rates have been negative and this, in fact, has led to distortion and discouragement in financial savings and intermediation. To avoid this circumstance, Egypt, with the introduction of this program, linked the interest rates with the inflation rate.

By January 1991 official limits on interest rates were lifted, and Treasury bill auctions were introduced. These were followed by elimination of lending limits to the private and public sectors in 1992 and 1993, respectively (Handy and Subramanian, 1997). As a result of removing the ceilings on interest rates and making them freely dependent on market forces, the gap between the nominal interest rate and the inflation rate became narrow at first. Furthermore, with the sharp decrease in the inflation rate, the real interest rates became positive at 5 per cent in 1997/1998 compared with a negative rate of interest at 6 per cent in 1990/1991. Indeed, this dramatic change in the real interest rates assisted the financial institutions, in particular banks, in attracting more savings from society and investing these savings in many projects inside Egypt. In addition, although the increase in interest rates depressed the business environment at the beginning, this was followed by inverse movements in interest rates as the inflation rate decreased sharply.

III. DATA SET

The data set for this paper covers 18 years from 1980/81 to 1997/98, which incorporates time periods prior to and after the introduction of the economic reform program. The Central Bank of Egypt, the Egyptian Cabinet Information and Decision Support Center, and the International Monetary Fund have been consulted as the sources for the real interest rates data series; whereas, the Capital Market Authority and the Central Bank of Egypt were the source of stock market data.

Since emerging markets monthly and quarterly data are rare relative to those of developed economies, annual data are usually used. This is more so in a country like Egypt, where its stock market is considered relatively new even compared with other emerging markets in Asia or Latin America, where these data are nonexistent. Essentially, the intention of the paper is to gain useful insights into the likely extent to which real interest rates have had an impact upon market activity and liquidity both in the long- and short- run within the context of the data set. So, although the analysis will be reasonably sophisticated, it must be remembered that the data set is constrained. As a result, an important caveat to the findings of this paper is that a longer period of study, or more frequent observations, may perhaps have provided different implications.

IV. HYPOTHESES

Five main stock market activity variables have been identified, namely: the value of trade, the volume of trade, the number of transactions, the number of traded companies, and the value of new issues (including capital increases). Additionally, the total value traded to market capitalization and the volume of shares traded to volume of shares listed has been used to reflect market liquidity. This leads to the following two main hypotheses:

H1: Market activity increases as real interest rates increase.

The above hypothesis includes many sub-hypotheses as follows:

H1/1: The value of trade increases as real interest rates increase.

H1/2: The volume of trade increases as real interest rates increase.

H1/3: The number of transactions increases as real interest rates increase.

H1/4: The number of traded companies increases as real interest rates increase.

H1/5: The value of new issues (including capital increases) increases as real interest rates increase.

H2: Market liquidity increases as real interest rates increase.

The above sub-hypothesis can be, in turn, divided into sub sub-hypotheses as follows:

H2/1: The total value traded to market capitalization increases as real interest rates increase.

H2/2: The volume of shares traded to the volume of shares listed increases as real interest rates increase.

V. METHODOLOGY AND EMPIRICAL MODEL

A. Co-integration Analysis

The implications of co-integration for the theory and practice of econometrics are immense and have led to a revolution in the way applied work is carried out. In fact, few economic time series are stationary since most of the series tends to grow or decline over time (Holden and Thompson, 1992), which has always been regarded as a problem in econometric analysis. In the meantime, it is noticed that most economic variables tend to trend together. Unfortunately, most of the traditional statistical tests that are used in inference have been developed for the stationary, ergodic stochastic process. The absence of a formal statistical procedure to test whether the existence of similar trends implies a bounded linear relationship in the level of many time series led to induce two different approaches to modelling time series (Banerjee, Dolado, Hendry, and Smith, 1986). The first approach indicates that some econometricians have traditionally disregarded the stationarity issue and run static models in data levels. This approach has been criticized by time series analysts as being inconsistent with most data thus giving rise to spurious inferences. On the other hand, in light of the above discussion of spurious inference, another approach (the Box-Jenkins approach, 1970) advocates differencing and prewhitening the time series prior to estimating the models. With respect to this approach, it can be used to describe only relationships between changes in variables, but it disregards the potentially important long-run relationship between the levels of the time series to which the hypotheses of economic theory are usually taken to apply (Banerjee *et al*, 1986). In addition, regarding the error correction mechanism (ECM), it is stated that:

> *"ECM models provide a way of combining the advantage of these two approaches. In this type of model the dynamics both of short-run (changes) and long-run (levels) adjustment processes are modelled simultaneously".* (Banerjee *et al*, 1986, P. 255).

To capture both long-run adjustments and short-run dynamics between real interest rates and the stock market, co-integration analysis is used (Banerjee *et al*, 1986; and Engle and Granger, 1987).

First, both real interest rates and the stock market data series need to be stationary. Unit root tests are performed for each variable on the original data, the data being first differenced, second differenced and so on until the stationarity is achieved. Log transformations are used for market activity variables. The Dickey and Fuller approach (1979) can be considered as an appropriate and simple method of testing the order of integration. In this approach, the autoregressive coefficient α_0 is stated in:

$$y_t = \alpha_0 y_{t-1} + \varepsilon_t \tag{1}$$

which is consistent with:

$$\Delta y_t = (\alpha_0 - 1) y_{t-1} + \varepsilon_t \tag{2}$$

If $\alpha_0 < 1$, y_t is integrated of order zero, and if not, then:

$$\Delta\Delta y_t = (\alpha_1 - 1)\Delta y_{t-1} + \varepsilon_t, \tag{3}$$

is tested. If $\alpha_1 < 1$, then y_t is integrated of order one. This process can be continued until stationarity is achieved, although Charemza and Deadman (1992) argue that it is unusual in practice for economic series to be integrated of orders higher than two.

However, the DF test may not be perfect because it does not take into account the possibility of autocorrelation in the error process ε_t. So, to reduce autocorrelation of the residuals in the original Dickey-Fuller tests, the Augmented Dickey- Fuller (ADF) test (Dickey and Fuller, 1981) simply solves this problem by using lagged left-hand side variables as additional explanatory variables to approximate the autocorrelation as follows:

$$\Delta y_t = \delta \cdot y_{t-1} + \sum_{i=1}^{k} \delta_i \cdot \Delta y_{t-i} + \varepsilon_t \tag{4}$$

where k represents the number of lags for Δy_{t-i}, which should be relatively small in order to save the degrees of freedom but large enough to allow for the existence of autocorrelation in ε_t.

The ADF unit root tests are performed using Personal Computer Generalized Instrumental Variables Estimators (PCGIVE) Version 8.0 (1994). Table 1 shows the results of the ADF unit root tests for the order of integration of all the variables.

Table 1
ADF unit root test results for order of integration of real interest rates and stock market variables

	ADF statistics			
Variables	**Levels form**		**First differenced**	
	rd	**ln**	**rd**	**ln**
y_1		2.2087 lag2 2.4791 lag1 3.3555 lag0		-0.7836 lag2 -1.2288 lag1 -2.3056* lag0
y_2		2.3426 lag2 2.9115 lag1 3.5246 lag0		-0.3158 lag2 -0.6780 lag1 -2.8940** lag0
y_3		1.2860 lag2 1.3256 lag1 2.4619 lag0		-2.2391* lag2 -1.5861 lag1 -2.1199* lag0
y_4		1.8014 lag2 3.2430 lag1 4.9655 lag0		-2.8043** lag2 -3.1763** lag1 -1.7542 lag0
y_5		-0.6458 lag2 0.6325 lag1 2.5218 lag0		-3.0977** lag2 -2.9671** lag1 -1.4236 lag0
y_6		1.3355 lag2 2.8931 lag1 4.3821 lag0		-2.0393* lag2 -2.5816* lag1 -3.8798** lag0
y_7		-1.7168 lag2 -1.8785 lag1 -1.2561 lag0		-0.99398 lag2 -1.4308 lag1 -2.8038** lag0
X_1	-1.3459 lag2 -1.2146 lag1 -1.3226 lag0		-1.8033 lag2 -2.6948* lag1 -3.2849** lag0	

Notes: rd= raw data, ln= natural logarithm,
y_1 = value of trade, y_2 = volume of trade, y_3 = number of transactions, y_4 = number of traded companies, y_5 = value of new issues (including capital increases), y_6 = total value traded to market capitalization, y_7 = volume of shares traded to volume of shares listed, X_1 = real interest rates.
Critical values: 5%=-1.966 1%=-2.741, * denote 5%, ** denote 1%

As seen from Table 1, integration of order zero is not found for the data levels without differencing for all the variables. In turn, this means that the null hypothesis for these variables cannot be rejected; that is, the alternative hypothesis is rejected, indicating that these variables had to be integrated of order higher than zero. Thus, they need to be first differenced to test for order of integration. Concerning the variables first differenced, the null hypothesis that $\alpha_1 = 1$ is rejected for all of them without exception, which means that these variables are integrated of order one. Since all variables are integrated of the same order, the second step is to test for co-integration between real interest rates and market activity and liquidity variables.

B. The Co-integration through Error Correction Models

To be co-integrated, the variables must drift together through time (Dickey, Jansen and Thornton, 1991). To test for co-integration, since all variables are integrated of the same order as mentioned above, I follow the Engle and Granger (1987) two-stage procedure. First, the ordinary least squares (OLS) regressions for the static long-run relationship between each stock market variable and real interest rates are performed as follows:

$$y_t = \alpha + \beta_1 x_t + \nu_t \tag{5}$$

where: y_t : the dependent variable, in this case any of the stock market performance variables, which is integrated of order one; x_t : the independent variable, in this case real interest rates, which are integrated of order one; and ν_t : the estimated residual from the equation, which refers to the deviation of any dependent variable (stock market performance) from its long-run path.

In fact, ν_t in this case reflects the error correction aspects of the equation or the error correction mechanism (ECM). If the residual from the long-run equation is found to be stationary in the ADF test that is, integrated of order zero then there is a co-integrating relationship (Charemza and Deadman, 1992). But because this test has low power, and therefore might incorrectly infer that the variables are co-integrated, the ECM should be tested for significance. However, the ECM states that changes in the dependent variable depend not only on changes in the independent variables but also on the extent of disequilibrium between the levels of both dependent and independent variables (Dolado, Jenkison and Sosvilla-Rivero, 1990). So, the second stage is that the residual from the co-integrating regression is lagged and also appropriate lags are applied to the differenced variables. The lagged residual, in fact, can be described as the equilibrium errors in the long-run regression. The general model for the ECM, then, is based on the lagged residual and a first differenced Autoregressive Distributed Lag (ADL) model.

However, Thomas (1997) states that differenced variables may be lagged further depending on the data series. Since the stock market variables may react slowly to changes in interest rates as they stabilize, further lags are investigated for significance. Hence, the EC model takes the following form:

$$\begin{aligned}\Delta y_t &= \pi_0 + \pi_1 \Delta y_{t-1} + \pi_2 \Delta y_{t-2} + \pi_3 \Delta y_{t-3} + \pi_4 \Delta x_t + \pi_5 \Delta x_{t-1} + \pi_6 \Delta x_{t-2} \\ &\quad + \pi_7 \Delta y_{t-3} + \pi_8 \mathrm{ECM}_{t-1} + \varepsilon_t\end{aligned} \tag{6}$$

where $\Delta y_t, \Delta y_{t-1}, \Delta y_{t-2}, \Delta y_{t-3}$ = the first differenced dependent variable, lagged zero, one, two and three year respectively; $\Delta x_t, \Delta x_{t-1}, \Delta x_{t-2}, \Delta x_{t-3}$ = the first differenced independent variable, lagged zero, one, two and three year respectively; ECM_{t-1}= the disequilibrium error from the static long-run equation, that is, the error correction mechanism; and ε_t = the disturbance.

As seen from equation (6), the right-hand side contains the first differenced dependent variable lagged one, two, and three years plus the first differenced independent variable, lagged zero, one, two and three years, that is, this bivariate model is estimated in its full general form. In fact, the above equation (6) is the initial equation to be used in a general-to-specific modeling approach, which starts with a very general model with many parameters and may be a complicated model that contains a series of simpler models, which should represent alternative economic hypotheses that need to be considered.

However, a simplification search is carried out in a systematic matter involving the gradual elimination of apparently unimportant lagged variables. To reduce the general model, a two-tailed t-test with a ten per cent level of significance is used to eliminate non-significant variables until no further reductions are feasible. Strictly, general-to-specific models are reduced using the above criteria, up to the point where the “right-hand side” of the EC model contains at least one differenced independent variable and the lagged ECM, which represents the basic form of the EC model. For each bivariate relationship, once the final version of the EC models have been specified, various diagnostic tests are run in order to test for the power of the models. More precisely, the diagnostic tests used are: Autocorrelation of the Residual (AR), Autoregressive Conditional Heteroscedasticity (ARCH), Normality and Model mis-specification (RESET).

VI. EMPIRICAL RESULTS

As shown in the previous section, the ADF unit root tests indicate that real interest rates and all market activity and liquidity variables have the same order of integration, that is, these variables are integrated of order one. As a result, I perform the first stage of Engle and Granger (1987) two-stage procedure mentioned in the previous section that is the static long-run regressions, to test for co-integration relationships between the variables (Equation 5). The outcome of this analysis is given in Table 2, which summarizes the results of this test.

Most importantly here is that the results from the ADF unit root tests upon the residuals from each bivariate static long-run equation given in Table 2 indicate that the residuals from the five static long-run equations are integrated of order zero, suggesting that the variables in each bivariate relationship are co-integrated, that is, there is a long-run relationship between these variables. Additionally, the long-run relationships between these market activity and liquidity variables and real interest rates are positive. The second stage of Engle and Granger two-stage procedure is to confirm this co-integration relationship by employing the EC models (Equation 6) to explain both long-run and short-run relationships simultaneously.

Table 2
Static long-run models for the impact of real interest rates upon market activity and liquidity variables

	Variables	Coefficient	Std. Error	t-Prob.	F- Prob.	R^2
$y_{1,t}$	Constant	7.0113	0.3381	0.0000	0.0000	
	Expl. Variable	27.581	3.0.46	0.0000	0.0000	0.7666
$y_{2,t}$	Constant	3.5906	0.2037	0.0000		
	Expl. Variable	20.439	2.2925	0.0000	0.0000	0.8324
$y_{3,t}$	Constant	10.860	0.3620	0.0000		
	Expl. Variable	27.992	4.0734	0.0000	0.0000	0.7469
$y_{4,t}$	Constant	5.4692	0.1437	0.0000		
	Expl. Variable	9.0726	1.6166	0.0000	0.0000	0.6630
$y_{5,t}$	Constant	7.9374	0.1967	0.0000		
	Expl. Variable	23.275	2.2133	0.0000	0.0000	0.8736
$y_{6,t}$	Constant	-2.4103	0.1796	0.0000		
	Expl. Variable)	8.8153	2.0207	0.0005	0.0005	0.5430
$y_{7,t}$	Constant	-2.7184	0.1018	0.0000		
	Expl. Variable)	9.9684	1.1460	0.0000	0.0000	0.8250

Notes: Expl = Explanatory or independent variable. y_1 = value of trade, y_2 = volume of trade, y_3 = number of transactions, y_4 = number of traded companies, y_5 = value of new issues (including capital increases), y_6 = total value traded to market capitalization, and y_7 = volume of shares traded to volume of shares listed.

C. Real Interest Rates and Market Activity

As seen in Table 3, real interest rates models, which take market activity as a dependent variable, contain significant ECMs without exceptions and are consistent with the previous results from the static long-run regressions and the ADF unit root tests for the residuals. The ECMs are significant at the one per cent level for the value of trade, the number of transactions, the number of traded companies and the value of new issues (including capital increases), while the ECM is significant at the five per cent level for volume of trade. In addition, the diagnostic tests for the EC models show that the assumptions behind these models are supported by examinations of the Autocorrelation of the Residual (AR), Autoregressive Conditional Heteroscedasticity (ARCH), the Normality and Model mis-specification (RESET) tests.

The real interest rate models mentioned above contain a number of significant coefficients for both differenced independent and dependent variables at different lags. Such significant coefficients of the variables capture the short-run relationship between real interest rates and market activities and show whether market activity variables are affected by their previous performance. The results indicate that the coefficients of differenced real interest rates with different number of lags are significant for all models except for the number of traded companies. Moreover, coefficients of the lagged differenced dependent variables (stock market variables) are significant for all models at different lags apart from the number of transactions.

Table 3
The specific EC models for the impact of real interest rates upon market activity variables

D.V	**Length of Lags**							
	Lag0		**Lag1**		**Lag2**		**Lag3**	
	RHSV	R^2 **(F.P)**	**RHSV**	R^2 **(F.P)**	**RHSV**	R^2 **(F.P)**	**RHSV**	R^2 **(F.P)**
$\Delta y_{1,t}$	N. S.	0.28 (0.25)	N. S.	0.28 (0.25)	N. S.	0.28 (0.25)	Cons*** $\Delta y_{1,t-1}$** $\Delta x_{2,t-3}$** ECM-1***	0.65 (0.01)
Diagnostic tests for the chosen EC model			AR = 0.39462 [0.5455] ARCH = 9.67e-005 [0.9924] Normality = 0.31656 [0.8536] RESET = 0.0039357 [0.9513]					
$\Delta y_{2,t}$	N. S.	0.02 (0.63)	N. S.	0.16 (0.45)	N. S.	0.26 (0.23)	Cons*** $\Delta y_{2,t-1}$** $\Delta x_{2,t-3}$** ECM-1**	0.60 (0.00)
Diagnostic tests for the chosen EC model			AR = 2.3387 [0.1605] ARCH = 0.34581 [0.5727] Normality = 3.0966 [0.2126] RESET = 0.25477 [0.6259]					
$\Delta y_{3,t}$	Cons* $\Delta x_{2,t}$ ECM-1**	0.36 (0.054)	Cons* $\Delta x_{2,t}$ ECM-1**	0.36 (0.054)	Cons $\Delta y_{3,t-2}$ $\Delta x_{2,t-2}$ ECM-1**	0.44 (0.087)	Cons*** $\Delta x_{2,t-3}$* ECM-1***	0.54 (0.01)
Diagnostic tests for the chosen EC model			AR = 0.3252 [0.5811] ARCH = 0.74871 [0.4094] Normality = 1.149 [0.5630] RESET = 0.92909 [0.3578]					
$\Delta y_{4,t}$	Cons*** $\Delta x_{2,t}$ ECM-1**	0.42 (0.03)	Cons*** $\Delta y_{4,t-1}$** $\Delta x_{2,t}$ ECM-1***	0.66 (0.004)	Cons* $\Delta y_{4,t-2}$*** $\Delta x_{2,t-2}$ ECM-1*	0.76 (0.001)	Cons* $\Delta y_{4,t-2}$*** $\Delta x_{2,t-2}$ ECM-1*	0.76 (0.001)
Diagnostic tests for the chosen EC model			AR = 1.9474 [0.1931] ARCH = 0.00251 [0.9611] Normality = 3.6278 [0.2656] RESET = 0.98355 [0.3447]					

Table 3 (Continued)

$\Delta y_{5,t}$	N. S.	0.18 (0.28)	N. S.	0.32 (0.18)	Cons $\Delta y_{5,t-2}$*** $\Delta x_{2,t}$** ECM-1***	0.63 (0.01)	Cons* $\Delta y_{5,t-2}$** $\Delta x_{2,t}$** $\Delta x_{2,t-3}$** ECM-1***	0.82 (0.002)
Diagnostic tests for the chosen EC model				AR = 0.30866 [0.5937] ARCH = 6.1e-005 [0.9940] Normality = 3.7724 [0.1516] RESET = 0.0031465 [0.9566]				

Notes: * denotes 10% level of significance, ** denotes 5% level of significance, and *** denotes 1% level of significance. D. V. = Dependent Variable, RHSV = Right hand-side variable, (F.P) = F test probability, N. S. = None of the essential variables in the right hand-side equation (main independent variable and the ECM) is significant at any level. Bold print indicates the best model. AR: Autocorrelation of the Residual, ARCH: Autoregressive Conditional Heteroscedasticity, and RESET: model mis-specification.

y_1 = value of trade, y_2 = volume of trade, y_3 = number of transactions, y_4 = number of traded companies, y_5 = value of new issues (including capital increases), and x_1 = real interest rates.

The implication of these results is that real interest rates have a significant impact on market activity as all five variables indicate a significant positive long-run relationship. Moreover, real interest rates seem to have a significant short-run relationship with all market activity variables except for the number of traded companies. In all cases, the overall fit of the real interest rate models, including market activity variables, are good with R^2 ranging from 0.54 to 0.82. Hence, the hypothesis, which states that the market activity increases as the real interest rates increase, cannot be rejected, implies a positive relationship between the variables. Such conclusion is valid for the sub-hypothesis.

D. Real Interest Rates and Market Liquidity

As seen in Table 4, the models of the relationship between real interest rates and total value traded to market capitalization and volume of shares traded to the volume of shares listed confirm the co-integration relationship between the variables, and the diagnostic tests for the EC models show that the assumptions behind them support the power of these models.

However, the coefficients of the differenced dependent variables lagged one year are significant at the one per cent level, implying that the total value traded to market capitalization and the volume of shares traded to the volume of shares listed can be affected by their previous value in the short-run. In addition, the coefficient of the differenced real interest rates lagged three years with the total value traded to market capitalization is significant at the one per cent level. On the other hand, the coefficients of the differenced real interest rates lagged one and three years with the volume of shares traded to the volume of the shares listed are significant at the five per cent level.

Table 4
The specific EC models for the impact of real interest rates upon market liquidity variables

D.V	Length of Lags							
	Lag0		Lag1		Lag2		Lag3	
	RHSV	R^2 (F.P)	RHSV	R^2 (F.P)	RHSV	R^2 (F.P)	RHSV	R^2 (F.P)
$\Delta y_{6,t}$	N. S.	0.14 (0.37)	Cons* $\Delta y_{6,t-1}$* $\Delta x_{1,t-1}$ ECM-1*	0.40 (0.097)	Cons* $\Delta y_{6,t-1}$* $\Delta x_{1,t-1}$ ECM-1*	0.40	Cons*** $\Delta y_{6,t-1}$*** $\Delta x_{1,t-3}$*** ECM-1***	0.72 (0.004)
Diagnostic tests for the chosen EC model				AR = 2.3332 [0.1610] ARCH = 0.3971 [0.5462] Normality = 1.2919 [0.5242] RESET = 0.2868 [0.6053]				
$\Delta y_{7,t}$	N. S.	0.10 (0.51)	Cons $\Delta y_{7,t-1}$*** $\Delta x_{1,t}$ ECM-1*	0.59 (0.01)	Cons $\Delta y_{7,t-1}$*** $\Delta x_{1,t}$ ECM-1*	0.59 (0.01)	Cons** $\Delta y_{7,t-1}$*** $\Delta x_{1,t-1}$** $\Delta x_{1,t-3}$** ECM-1***	0.84 (0.001)
Diagnostic tests for the chosen EC model				AR =0.031171 [0.8642] ARCH =1.1753 [0.3142] Normality =0.86057 [0.6503] RESET =0.38239 [0.5535]				

Notes: y_6= total value traded to market capitalization, y_7= volume of shares traded to volume of shares listed, and x_1= real interest rates.

As the coefficient of the independent variable from the static long-run equation has a positive sign, then there is a positive relationship between the variables. Likewise, the hypothesis, which states that the total value traded to market capitalization and the volume of shares traded to the volume of shares listed increase as the real interest rates increase, cannot be rejected, indicating a long-run and short-run relationship between the real interest rates and these variables.

From the results mentioned above, it could be concluded that real interest rates have a significant impact on market liquidity variables both in the short and long-run. The value of R^2 was 0.72 and 0.84 per cent for the real interest rate models of the relationship with the total value traded to market capitalization and the volume of shares traded to the volume of shares listed, respectively, reflecting a good fit for both.

Since the two variables, which represent market liquidity, are co-integrated with real interest rates, the hypothesis, which states that the market liquidity increases as real interest rates increase, tends to be accepted, indicates a positive long-run relationship between the variables.

VII. CONCLUSION AND IMPLICATION

Using co-integration analysis, the results indicate that there are significant long-run and short-run relationships between real interest rates and the stock market performance variables, in terms of market activity and liquidity, which reveal an expected behavior for the stock market response to the increase in real interest rates. As mentioned previously, the sign of the impact of real interest rates upon stock markets depends mainly on the changes in both interest rates and the inflation rate. In the case of Egypt, the decrease in the inflation rate was higher than the decrease in interest rates, resulting in an increase in real interest rates. A valid reason behind the positive relationship between real interest rates and both market activity and liquidity variables is that higher and positive real interest rates encouraged people to save in banks and other financial institutions. Hence, this increased the money available to these financial institutions, which, in turn, gave them the opportunity to invest in the stock markets. My finding seems to contradict Spiro (1990) who documents a negative relationship between real interest rates and the stock market. However, one should bear in mind that one feature of emerging markets is that they provide higher returns compared with mature markets. As a result, foreign portfolio managers are expected to invest in these markets even if real interest rates are high as these investors are expecting to achieve higher returns via capital gains. In contrast, when real interest rates increase in developed economies, investors would prefer to invest in risk-free assets, as stock markets might not provide them with the required rates of return. Hence, the relationship between high real interest rates and stock markets in developed economies might be expected to be negative.

The results of this paper might have several implications to both policy makers and different types of investors. As far as policy makers are concerned, it is clear that making real interest rates positive may offer substantial economic gains. Of course, as in the case of Egypt, such polices of increasing real interest rates have affected the stock market positively, which would potentially have a positive impact upon its economic growth as well. On the other hand, different types of investors, such as money managers, portfolio managers, and individual and institutional investors will understand that when government's policies permit real interest rates to rise to modestly positive, equilibrium levels, this is a sign that policy makers would like to promote economic activities. Hence, a positive impact upon the stock market is expected, and investors should bear in mind the possibility of achieving good returns under these polices.

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NOTES

1. For more details see Pill (1997), p.85.

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