

Structural Break in the Egyptian Stock Market: A Logistic Regression Analysis

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ABSTRACT

This paper examines the structural behavior of the Egyptian stock market following the introduction of the economic reform program in 1991. The logistic regression results indicate significant changes in the data of market activity, market size, market liquidity, and market concentration. Overall, the Egyptian stock market experienced significant structural changes from 1991 to 1998. However, the Egyptian stock market needs further development to function properly.

JEL Classifications: C12, G10, N25

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I. INTRODUCTION

In the past few years stock markets have been set up in a number of developing countries in order to facilitate their financial development. The foundations of these stock markets were built to support the transition from planned-based to market-based economic systems. Egypt, like many other developing countries, embarked on an economic reform program in the early 1990s, which resulted in major and radical changes in its economic climate. Consequently, Egypt entered a new era in economic development bringing its capital market to the attention of foreign and domestic investors (Hegazy 1997 and El-Hilaly 1997).

Table 1
Selected economic indicators under the economic reform program era

| Variables | 1990/1991 | 1997/1998 |
|--|------------------|------------------|
| Total external debt (Billions of US\$) | 49.2 US\$ | 26.6 US\$ |
| Total external debt as a percentage of GDP | 151% | 37.7% |
| Real interest rates | (6%) | 5% |
| Inflation rate | 21.2% | 4.1% |
| Total foreign reserve (Billions of US\$) | 3.6 | 21.8 |
| Budget deficit as a percentage of GDP | 18.2% | 1.3% |
| Real GDP growth rate | 3.6% | 5.7% |

Source: Central Bank of Egypt, (Various issues: 1992-1998) *Annual Economic Review*, (Cairo: CBE).

However, the Egyptian economy has faced serious problems since the second half of the 1980s because of the combined effects of the collapse of oil prices and the sharp decline in Suez Canal dues and workers' remittances. At the same time, macroeconomic imbalances widened while the government found itself facing serious financial difficulties. As a result, the government was obliged to launch a reform program agreement with the International Monetary Fund (IMF) in 1987. This agreement, however, was cancelled three months later because of the government's failure to meet the IMF requirements. Perhaps not surprisingly, the country's economic situation continued to deteriorate, and at the onset of the Gulf War in 1990/91, the economy was on the brink of collapse. As Table (1) presents, by late 1990 Egypt's total external debt had reached US\$ 49.2 (151% of the GDP negative real interest rates as a result of a 21% hyper-inflation rate, accompanied by a budget deficit almost 20% of the GDP). To further add to the country's economic upheaval, the total foreign reserve was just US\$ 3.6 billion, and the GDP growth rate stood at 3.6%.

The end of the Gulf War proved to be a boon for Egypt and brought about positive changes to its economy. In particular, the Gulf States, the US, and the Paris Club agreed to increase their financial assistance to Egypt and to forgive and reschedule a significant portion of its debt¹. These developments eased the drain on foreign exchange, and improved Egypt's capacity to embark on another economic reform program supported by both the IMF and the World Bank in 1991. The program consisted of three phases: (1) stabilizing the current economy, reducing corruption, and restructuring the stock market; (2) reorganizing the financial sector and encouraging free trade, promoting privatization and private sector development; and then (3) consolidating the first and second phases. By 1998, these reform efforts were partly successful and led to some major achievements: (1) external debt and budget deficits were reduced to 38 and 1.3% of the GDP, respectively; (2) inflation was cut to 4.1%, which brought the real interest rate to the positive side; (3) international reserves reached more than US\$ 18 billion; and (4) the annual GDP growth rate reached 5.7%

In market-based economies the capital market is an important means of mobilizing savings and reallocating resources, an avenue for domestic and foreign investment promotion via the stock market, and a significant source of capital formation and business financing. Consequently, with the introduction of the economic reform program, the Egyptian government recognized the role of the capital market in economic development, and that role became instrumental in the success of this program. Therefore, as part of the comprehensive economic liberalization, a plan to revitalize the stock market and remove any constraints hindering its development was implemented (Butter 1997 and El-Ahmady 1997).

To facilitate policy making with regard to future development of the Egyptian stock market, this paper focuses on testing and analyzing the structural changes in the stock market from 1980 to 1998, which is after the introduction of the economic reform program. Employing the logistic regression technique, we document significant changes in stock market indicators, in terms of market activity, market size, market liquidity, and market concentration. The overall conclusion indicates clearly that the Egyptian stock market has experienced significant structural changes but still needs further development to function properly

The rest of the paper is organized as follows: Section II briefly reviews the history and recent developments in Egypt's stock market. Section III deals with the data set, while Section IV focuses on the methodology and empirical model. Section V presents and discusses our empirical findings, whereas Section VI summarizes some of the reasons currently impeding the development of the Egyptian stock market.

II. A BRIEF OVERVIEW OF EGYPT'S STOCK MARKET

The stock market activity in Egypt goes as far back as 1888, and during its heydays it was ranked as the fifth most active exchange worldwide (Capital Market Authority 1996a). As can be seen from Table 2, the Egyptian stock market was negatively affected in the late 1950s by the massive and successive waves of nationalization that radically changed the structure of the economy. For example, the ninety-three most active companies in the stock market had their stocks transferred to government bonds

at 4% annual interest rate for 15 years. As figures in Table 2 suggest - in terms of market size - market capitalization as a percentage of the GDP, the number of listed companies, and the number of stockbrokers decreased significantly because of the restructured economy. Market capitalization as a percentage of the GDP, decreased from 13% in 1958 to just 1% in 1974, whereas the number of listed companies decreased from 275 in 1958 to only 55 in 1974. As well, the number of stock brokers declined sharply between 1958 and 1974, from 55 to only 15. On the other hand - in terms of market activity - the value of trade disintegrated from L.E. 66.7 million in 1958 to only L.E. 4 million in 1974, while the importance of the market as a source of new capital, essential to both the private and public sector, fell from 56.2% in 1958 to only 2% in 1974.

Table 2
Selected stock market indicators between 1958 and 1974

| Description | 1958 | 1974 | % Change |
|--|-------------|-------------|-----------------|
| Market capitalization as a percentage of GDP | 13% | 1% | -92% |
| Number of listed companies | 275 | 55 | -80% |
| Number of stock brokers | 55 | 15 | -73% |
| Total value traded (Millions of Egyptian Pounds) | 66.7 | 4 | -94% |
| % of new issue to the GDP | 56.2% | 2% | -96% |

Source: El-Safwa Brokerage Company, (1998), *Capital Market in Egypt; History of Egyptian Capital Market*, (Cairo: El-Safwa).

In conclusion, the nationalization process had a devastating effect, not only on the primary market but also on the secondary market, which weakened the Egyptian stock market. Despite the inevitable slowdown in the Egyptian stock market, it remained open but dormant until the open door policy went into effect in the mid 1970s.

The adoption of the open door policy in 1974 was meant to improve the economic environment by relaxing government controls over the economy and encouraging both foreign and domestic investments in the banking system and stock market. With this new economic policy came the Egyptian Capital Market Authority (CMA), which was established to organize and manage the stock market. Yet, due to a host of reasons - biases in the tax code against investments in securities, absence of securities laws, inadequate requirements for firm financial disclosure, and lack of protection for small investors - stock market activity remained stagnant during the 1970-90 time period. This sluggish stock market together with a weak economy further impeded development of the securities industry until 1992. (Capital Market Authority 1996b).

In 1991, Egypt introduced a new economic reform program with capital market restructuring as an essential element. Prior to 1992, the Egyptian securities industry was governed by two outdated and overlapping pieces of legislation² in addition to several other laws and rules that regulated the stock market, which all proved inadequate for the demands of a market-oriented economy. So, in order to end the duplication of responsibilities and simplify the regulatory environment, a new capital market law was enacted in 1992 to replace the outdated multiplicity of laws. The new law aimed at encouraging private investment, increasing investors' protection, and enhancing the banks' role in stimulating capital markets through the establishment of mutual funds³. These reforms, coupled with improvements in institutional procedures and macroeconomic indicators, succeeded in revitalizing the stock market⁴.

As can be seen in Table 3, all stock market indicators - market activity, size, liquidity, and concentration - experienced significant improvements in the post reform period. These improvements were due to several steps taken following the adoption of the economic reform program. For example, by mid 1996, two important factors contributed greatly to the rapid growth of the stock market: (1) the abolition of the two per cent capital gains tax that was levied on security investments in 1992 and (2) the acceleration of the privatization program⁵. At the same time, the year 1996 witnessed the first issue of Egyptian securities overseas—the Global Depositary Receipts (GDRs)—followed by seven more issues by 2005⁶. Furthermore, significant progress was made in the direction of global integration. In particular, the International Finance Corporation (IFC) included Egypt in its global and investable indices in 1995 and 1997, respectively (see Capital Market Authority 1998; International Finance Corporation 1997). Essentially, the Egyptian stock market started experiencing major changes with the introduction of the economic reform program in 1991.

III. DATA SET

The data set of this study was obtained from the Capital Market Authority and the Central Bank of Egypt⁷. The data cover the period from 1980/81 to 1997/98, which incorporates time periods prior to and after the introduction of the economic reform program. Although many academic papers consider the stock market index an important measure for stock markets performance, it is not a valid variable for this paper given the Egyptian market index was not established until late 1993. However, other aspects of stock market performance have been selected to reflect the development in Egypt's stock market. It is particularly important for policy-makers to look at market activity, size, liquidity, and concentration because these variables reflect the ability of the market to mobilize resources through non-bank intermediaries, broaden the ownership structure of corporate capital, and deepen and diversify the financial sector (Husnan, Hanafi, and Theobald 1993). Each of these variables mentioned can be decomposed into constituent elements.

Table 3
Stock market performance in Egypt between (91/92 and 97/98)

| Description | 91/92 | 97/98 | % change |
|--|-------|---------|----------|
| Market Activity | | | |
| Value of trade (Millions of L.E.) | 427.8 | 24219.8 | 5561% |
| Volume of trade (Millions of shares) | 22.7 | 372.5 | 1541% |
| Number of transactions | 10305 | 1225351 | 11791% |
| Number of traded companies | 218 | 416 | 91% |
| Value of new issues, including capital increases* | 1335 | 18289.6 | 1270% |
| Value of new issues, including capital increases, as a percentage of GDP | 1.2% | 7.1% | 492% |
| Market Size | | | |
| Market capitalization* | 8845 | 70873 | 701% |
| Market capitalization as a percentage of GDP | 7.8% | 27.7% | 255% |
| Number of listed companies | 627 | 650 | 3.5% |
| Volume of shares listed** | 394.1 | 1854.2 | 370.5% |
| Number of financial intermediaries | 12 | 213 | 1675% |
| Market Liquidity | | | |
| Total value traded to market capitalization | 4.8% | 34% | 608% |
| Total value traded to GDP | 0.38% | 9.4% | 2374% |
| Volume of shares traded to volume of shares listed | 5.8% | 20% | 245% |
| Market Concentration | | | |
| Percentage of the 10 biggest companies' share in market capitalization | 80% | 52% | -35% |
| Percentage of the 10 biggest companies' share in value traded | 48% | 31% | -35% |

*Millions of Egyptian L.E. ** Millions of shares

Source: The Egyptian Capital Market Authority, *Unpublished reports*, (Cairo: CMA, 1998).

Concerning market activity, the explanatory variables are the value of trade, the volume of trade, the number of transactions, the number of traded companies, the value of new issues (including capital increases), and the value of new issues (including capital increases) as a percentage of GDP. For market size, a different set of explanatory variables has been identified, namely, market capitalization, market capitalization as a percentage of GDP, the number of listed companies, the volume of shares listed, and the number of financial intermediaries. To represent market liquidity, the chosen explanatory variables are the total value traded to market capitalization, the total value traded to GDP, and the volume of shares traded to the volume of shares listed. Finally, for market concentration, the selected explanatory variables are the percentage of the 10 biggest companies' shares in market capitalization and the percentage of the 10 biggest companies' shares in value traded.

IV. METHODOLOGY AND EMPIRICAL MODEL

This paper examines the structural behavior of the Egyptian stock market following the introduction of the economic reform program in 1991. We analyze the stock market indicators/variables to determine whether they experience significant changes after 1991 compared with the previous period (1980-1990). To test for this proposition we employ several logistic regressions. This allows us to estimate multiple regression models when the response being modeled is dichotomous and can be scored 0,1; that is, the outcome must be one of two choices. This methodology is widely used when we want to model a relationship whose underlying variables should be expressed as an event/nonevent that has two possible outcomes. Logistic regression analysis is often used to investigate the relationship between discrete responses and a set of explanatory variables. Logistic regression uses logit as a link function, i.e., it takes the log of the odds of the success ratio. The fitted regression shows the log of the odds ratio as a linear function of the independent variables. Each regression takes the following form.

$$\ln\left[\frac{P}{(1-P)}\right] = \alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n \quad (1)$$

with

$$P = \frac{e^{\alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n}}{1 + e^{\alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n}} \quad (2)$$

where \ln is the natural logarithm, $\frac{P}{(1-P)}$ is the odds ratio, α is constant, $\beta_1, \beta_2, \dots, \beta_n$ are other regression coefficients, and X_1, X_2, \dots, X_n are explanatory variables. These explanatory variables refer to any of the stock market indicators mentioned previously: market activity, size, liquidity, and concentration.

The logistic methodology fits linear logistic regression models for binary or ordinal response data by the method of maximum likelihood in which the maximum likelihood estimation is carried out with either the Fisher-scoring algorithm or the Newton-Raphson algorithm. Logistic regression has been used in Lasfer and Levis (1998), Raad and Ryan (1995), and Morton and Shane (1998).

This methodology is normally used to predict the success or failure of events. Success here refers to a significant positive change in stock market performance variables, while failure is defined as a non-significant change in these variables. But, the intention here is to examine whether the data prior to 1991 can be separated from the data relating to the period from 1991⁸. The odds ratio is calculated by taking the probability that the data relate to the economic reform program period and dividing it by one minus the probability that the data relate to the previous period. The deviance in the logistic regression is approximately Chi-square distributed (Open University, 1998). Hence, if the significance probability in the deviance of the logistic regression for the given degrees of freedom is small, then the null hypothesis of no significant changes in

the data prior to and after the introduction of the economic reform program is rejected. Strong evidence implies structural changes in the data, thus making a distinction between the two periods.

Before performing the logistic regressions, it is necessary to consider the raw data. It can be deduced from the data set that there were economic changes following 1991. However, it could be argued that performing a logistic regression on the raw data might reveal that the post 1991 period improved significantly, solely because of sustained economic growth. Hence, there is a need for a method to eliminate this growth from the data. For comparative purposes the logistic regressions are run on (1) the differenced data, (2) the relative annual changes in the data, and then on (3) the deflated data—i.e., after adjusting for sustained growth.

In order to deflate the data, the growth trend through 1990 was computed, using the following formula:

$$A(1+g)^L=B \quad (3)$$

where A is the data value at the beginning of the series, g is the compound annual growth factor, L is the length in years for the pre-economic reform program period, and B is the value of the last data point before the introduction of the economic reform program. Hence,

$$\begin{aligned} (1+g)^L &= B/A \\ L \log(1+g) &= \log(B/A) \\ \log(1+g) &= (1/L) \log(B/A) \\ 1+g &= \exp[(1/L) \log(B/A)] \\ \therefore g &= \exp[(1/L) \log(B/A)] - 1 \end{aligned} \quad (4)$$

can be used as a device to deflate the data.

After we compute the growth factor, each data value is then deflated⁹. If the data values after 1991 are significantly different from the values prior to 1991, then, after deflating the data, it could not be argued that the difference is purely due to the time factor¹⁰.

Using an index plot of the cook statistics, a diagnostic chart (not provided here) was made for each logistic regression. These measures for each data point prove the extent to which estimates for the model parameters vary when the data point is omitted. In such a case, outliers, models, or other points with large absolute residuals are normally possible candidates for significant cook statistics. For each test, the index plot was reviewed, and it was confirmed that the data points were not unusual in this regard.

V. EMPIRICAL FINDINGS AND ANALYSIS

This section presents the empirical findings of the performance changes in stock market variables (market activity, size, liquidity and concentration) described in Section III.

The analysis is based on the results of several logistic regressions and considers market activity (Table 4, Panel A), market size (Panel B), market liquidity (Panel C), and market concentration (Panel D).

A. Market Activity

As the first entry in Table 4, Panel A indicates, the results of the logistic regression reveal very small, standardized residuals for the market activity area as a whole, hence demonstrating an excellent fit. As mentioned previously, to test whether the changes in market activity variables are significant, the significance probability of the deviance in logistic regression should be near to zero. With regard to this point, using a linear combination of all market activity variables, the market activity as a whole indicates that the Chi-square probability is highly significant. Evidence suggests structural changes in the data, thus making a distinction between the environmental conditions of the two periods: (1) prior to the economic reform program and (2) after the introduction of the economic reform program. On the other hand, for each individual variable, the results indicate the same conclusion for all market activity variables. Generally speaking, market activity witnesses a dramatic change after the introduction of the economic reform program in 1991 compared to the situation prior to 1990/91.

B. Market Size

The results of the logistic regression given in Panel B show very small, standardized residuals for the market size as a whole, and the probability of the Chi-square is highly significant. Moreover, the results indicate similar findings for each individual variable, but not for the number of listed companies. Accordingly, this indicates structural changes in the data, thus distinguishing between the environmental conditions of the two periods. Strictly speaking, it can be argued that market size changes dramatically after 1991. Results document that four out of five variables—representing market size—experience significant change after 1991 compared to the prior period.

C. Market Liquidity

In Panel C, we report the logistic regression results for market liquidity. The first entry in the panel reports that the probability of the Chi-square is highly significant, implying structural changes in the data, thus distinguishing between the environmental conditions of the two periods—prior to and after economic reform. Moreover, for each individual variable, we obtain qualitatively similar results. The standardized residuals are not excessively large, hence demonstrating a good fit. We can then conclude that market liquidity changes dramatically after 1991 since all three variables experience significant changes after the introduction of the economic reform program.

Table 4
Testing for structural change in environmental conditions in stock market variables using logistic regression

| Panel A: Market Activity | | | |
|---|------------------------------|----------------|----------------------------|
| Variables | Standardized residual | | Regression deviance |
| | Maximum | Minimum | |
| Market activity | 0.00 | 0.00 | 24.06* |
| Value of trade | 1.78 | -1.42 | 3.74** |
| Volume of trade | 2.52 | -1.26 | 7.23* |
| Number of transactions | 1.92 | -0.96 | 9.51* |
| Number of traded companies | 1.72 | -1.74 | 20.54* |
| Value of new issues (including capital increases) | 1.95 | -1.17 | 3.13*** |
| Value of new issues (including capital increases) as a % of GDP | 1.93 | -1.10 | 3.99** |
| Panel B: Market Size | | | |
| Market size | 0.00 | 0.00 | 24.06* |
| Market capitalization | 1.85 | -1.18 | 3.28*** |
| Market capitalization as a % of GDP | 1.74 | -1.50 | 4.42** |
| Number of listed companies | 2.81 | -1.42 | 1.51 |
| Volume of shares listed | 2.02 | -1.29 | 5.45** |
| Number of financial intermediaries | 2.33 | -0.44 | 17.17* |
| Panel C: Market Liquidity | | | |
| Market liquidity | 2.27 | -1.43 | 17.43* |
| Total value traded to market capitalization | 1.81 | -1.29 | 3.34*** |
| Total value traded to GDP | 0.01 | -0.01 | 24.06** |
| Volume of shares traded to volume of shares listed | 2.18 | -1.34 | 14.93* |
| Panel D: Market Concentration | | | |
| Market concentration | 0.01 | -0.01 | 13.67* |
| % of the 10 biggest companies' share in market capitalization | 2.10 | -1.41 | 5.91** |
| % of the 10 biggest companies' share in value traded | 2.45 | -0.84 | 12.79* |

*, ** and *** refer to 1%, 5%, and 10% significance level, respectively, of the probability of Chi-square of regression deviance.

D. Market Concentration

The final dimension of the stock market development is market concentration. In Panel D, we can clearly see that logistic regression results disclose very small standardized residuals, hence demonstrating an excellent fit. In the meantime, the results of market concentration as a whole indicate that the probability of the Chi-square is highly significant, giving evidence that there are structural changes in the data. The results indicate the same findings for both market concentration variables (the percentage of the 10 biggest companies' shares in market capitalization and the percentage of the 10 biggest companies' shares in value traded).

The overall conclusion from the above analysis clearly proves that all stock market indicators improve dramatically after 1991.

VI. SUMMARY AND CONCLUSION

This paper sheds lights on the stock market development in Egypt and compares its performance prior to and during the economic reform program era. The overall results clearly reveal that all stock market indicators: market activity, market size, market liquidity, and market concentration, experience significant improvements after the introduction of the economic reform program in 1991. In the meantime, the results support the same findings for each individual constituent element except for the number of listed companies.

Although we can not deny the notable progress of the capital market in Egypt during the economic reform period of the 1990s and early 2000s, it does not, as of yet, represent a solid vehicle for real investment opportunities. For example, in terms of disclosure, the stock market is in need of more transparency, through the promotion of timely disclosure and dissemination of information to the public. Besides, an increasing number of studies substantiate that the Egyptian stock market is inefficient (see, among others, Mecagni and Shawky 1999; Omran 2002; Omran and Farrar 2006). Of course, correctly pricing risk is necessary for the stock market to realize its role in securing investments and consequently, enhancing economic growth. Being of the same mind, Singh (1997) indicates that stock markets in many developing countries are not able to price risk accurately and suffer from excessive volatility, lack of transparency, and insider trading. As the Egyptian securities industry makes progress in dealing with the capital market institutional and legal framework—contract compliance, bankruptcy laws, and tax reforms—the stock market should develop into a healthy investment opportunity.

ENDNOTES

1. Egypt was offered the write-off of long-term debt valued at US\$ 7 billion from Arab countries, US\$ 6.7 billion in military debts from the US and US\$ 10 billion from Paris Club (50% of Egypt's outstanding commercial debt).
2. Companies' Law No.159 of 1981 and the Stock Exchange Law of 1959.

3. Specifically, its core provisions included the establishment of a new legal framework to govern specialized capital market companies, elimination of taxes on income from most stocks and bonds, strengthening of financial disclosure, giving foreign investors full access to the market, and increasing investor's rights through provisions prohibiting unfair market practices.
4. The Cairo and Alexandria stock exchanges merged. New institutional and technological procedures improved market operations by implementing innovative clearing and settlement systems and introducing a central depository. These procedures, among other, allowed registration, confirmation, and transfer of ownership to occur smoothly and quickly.
5. The privatization of Nasr City Housing in 1996 represented the first majority-stake privatization, after which increasing numbers of majority-stake initial public offerings were issued, thereby prompting stock market activity.
6. The eight GDRs are: Commercial International Bank, Misr International Bank, Suez Cement, Al-Ahram Beverages, Paints and Chemical (Pachin), Egyptian Financial Group-Hermes (EFG-Hermes), Al-Ezz Steel, and Lakah Group.
7. Annual figures are used in the analysis.
8. Clearly, the terms, success and failure are used purely in the sense of a Bernoulli trial, which implies binary responses that are categorized as one for a Bernoulli success and zero for a Bernoulli failure. In this case, zero represents the period prior to 1991, and one represents the period from 1991.
9. For example, given an 8% growth factor, a raw data value of 100 in 1997 would be deflated to $100/(1.08)^{17}=27.03$.
10. We believe that deflating the data using this method is appropriate. Alternative methodologies would have included first data differencing or determining the annual relative changes. However, the final conclusions were identical.

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