Journal of Behavioural Economics, Finance, Entrepreneurship, Accounting and Transport, 2017, Vol. 5, No. 1, 30-38
Available online at http://pubs.sciepub.com/jbe/5/1/4

DOI:10.12691/jbe-5-1-4

Test of the Arbitrage Pricing Theory in the Egyptian Stock Exchange

Khairy Ali Mostafa Elgiziry[1], Mai Mostafa Awad[2,*]

[1]Faculty of Commerce, Cairo University, Cairo, Egypt
[2]Assistant Lecturer at the Institute of National Planning, Cairo, Egypt
*Corresponding author: mai.awad@inp.edu.eg

Abstract Following the introduction of the Arbitrage Pricing Theory (APT) to the literature by Steven Ross in December 1976, a huge number of empirical studies were carried out aiming to test the Arbitrage Pricing Theory and to explain the relationship between the market risk and the market return in different stock exchanges around the world during different time periods. The main objective of this paper is to test the Arbitrage Pricing Theory (APT), which allows multiple sources of systematic risks to be taken into account, in the Egyptian Stock Exchange by using the Principal Component Analysis. For this purpose, the monthly return of all the shares included in the EGX30 index from January 2007 to December 2013 of the Egyptian Stock Exchange is used as the dependent variable. The explanatory variables are growth rates of the value added of Industrial production, Consumer price index (inflation rate), Money supply (M1), Short-term interest rate, Discount rate, Exchange rate of the Egyptian pound with the US$, Price of Brent crude petroleum, and the market Index (EGX100). The results show that only the growth rates of Consumer price index (inflation rate), and Price of Brent crude petroleum have significant influence on the stock return and thus will be included in The Egyptian Arbitrage Pricing Model. Overall, the results suggest validity but weak applicability of APT in the Egyptian Stock Exchange over the study period.

Keywords: *arbitrage pricing theory, Egyptian Stock Exchange, principal component analysis*

Cite This Article: Khairy Ali Mostafa Elgiziry, and Mai Mostafa Awad, "Test of the Arbitrage Pricing Theory in the Egyptian Stock Exchange." *Journal of Behavioural Economics, Finance, Entrepreneurship, Accounting and Transport*, vol. 5, no. 1 (2017): 30-38. doi: 10.12691/jbe-5-1-4.

1. Introduction

Following the introduction of the Arbitrage Pricing Theory (APT) to the literature by Steven Ross in December 1976, a huge number of empirical studies were carried out aiming to test the Arbitrage Pricing Theory and to explain the relationship between the market risk and the market return in different stock exchanges around the world during different time periods. These researches tried to compare the results of their empirical models with a large stream of previous researches to reach a general conclusion whether the chosen factors in their models are the same like others or different from them and the financial justification behind that. So, in this research, we are concerned with measuring the size and statistical significance of each macroeconomic factor used in the Egyptian Arbitrage Pricing Model.

Arbitrage pricing models were tested mainly in developed economies, such as the US and other European nations; therefore, the application of these models in developing countries is scarce. As a result, the research problem can be stated as "Exploring and identifying the factors that should be included in the Egyptian Arbitrage Pricing Model and to what extent the Arbitrage Pricing Model can fit the environment of the Egyptian stock market.

This paper aims to investigate the factors that should be included in the Egyptian Arbitrage Pricing Model by seeking to: formulate the Arbitrage Pricing Model to depict the most relevant factors that affect the stock return, investigate the formulated model using data from Egypt, and compare results of the empirical model with previous stream of researches.

The research contributes to the extant literature and fills the existence gab in the literature by providing evidence of the factors that should be included in the Arbitrage Pricing Model in Egypt. The relationship between the market risk and the market return, which is explained by the Arbitrage Pricing Theory, is so important in taking proper investment and financing decisions. The results also reveal that the most relevant macroeconomic factors that affect stock returns in the Egyptian Stock Exchange are not the same compared to other countries. Therefore, the results are likely to benefit the firm's management, investors, policy makers, and other interested bodies in the Egyptian market.

The rest of the paper is organized as follows. Section two presents the literature review of the main studies of the Arbitrage Pricing Theory and discusses the frequently used factors in the Arbitrage Pricing Model. Section three describes the sample used and the research methodology, and also it will present the empirical model used in the study. Section four provides the results of the empirical model, compares the results of this research with previous researches and explain the financial justification of these

results. Section five concludes and summarize the main findings of this research.

2. Literature Review and Hypotheses Development

Most of the multifactor asset pricing models try to explore the risk contribution of systematic factors effective on expected returns by constructing linear multiple regression equations that are expected to best represent the relationship between risk factors and asset returns. One of the most important models of the multifactor prediction models is the Arbitrage Pricing Theory which was developed by Stephen A. Ross (1976).

This theory has been considered an alternative to the Capital Asset Pricing Model (CAPM) and does not presume the presence of a fully efficient market. But, there are a few assumptions mentioned below on which the theory is based:

a) The capital market fits the conditions of perfect competition,

b) Investors are rational under certainty conditions, which means that they prefer more wealth to the less,

c) The stochastic process explaining how asset returns exist can be explained by a linear K-factor model,

d) Market does not allow for arbitrage opportunities arising from the violation of the law of one price. If any arbitrage opportunity existed, investors would immediately react in order to benefit from that situation by buying the asset in the market where it has been undervalued and then selling where the asset has been relatively overvalued. All these attempts would make the existing arbitrage opportunity suddenly disappear.

Ross starts his model explanation with a single factor model resembling the CAPM and formulates the risk-return relationship using the following single equation:

$$r_i = \alpha_i + \beta_i F + e_i. \quad (1)$$

In the equation, the actual rate of return is abbreviated by r_i, α_i refers to the expected rate of return on the asset *i*, F denotes systematic risk factor, and β_i represents the sensitivity of the asset's returns to the risk factor. The prediction error arising from the effect of idiosyncratic factors is symbolized with e_i.

The theory assumes that all the firm-specific risk factors (e_i) can be fully eliminated if a portfolio has been sufficiently diversified and therefore systematic risk component becomes the only case for portfolios. The return estimation equation turns out to be in a new form presented below.

$$r_p = E\left(R_p\right) + \beta_p F. \quad (2)$$

It is a simplifying assumption to say that there is only one systematic risk factor affecting asset returns. To get closer to the reality, the theory suggests the use of multiple variables as determinants on systematic risk in order to cover all the effects of potential systematic risk factors. In most of the relevant studies performed, major macroeconomic indicators such as interest rate, inflation, gross domestic product (GDP), have been preferred as the representatives of potential systematic risk factors.

A typical multifactor APT Model is similar to linear multiple regression models. The theory assumes the validity of the suggestion that the APT points out also for individual assets if it is really valid for well diversified portfolios. Expected return on any financial asset is finally formulated as in the Equation 3:

$$E\left(R_i\right) = \lambda_0 + \lambda_1 b_{i1} + \lambda_2 b_{i2} + ...\lambda_n b_{in} \quad (3)$$

where

$E\left(R_i\right)$: Expected rate of return on the asset *i*

λ_0: Risk free rate of return

λj: Risk premium related to the factor *j*

b_{ij}: Coefficient showing the sensitivity of the asset *i* to the factor *j*.

There is no formal theoretical guidance in choosing the appropriate group of economic factors to be included in the APT model. Authors explain further that this is both its strength and its weakness. It is strength in empirical work since it permits the researcher to select whatever factors provide the best explanation for the particular sample at hand; it is weakness in practical applications because, in contrast to the CAPM, it cannot explain variation in asset returns in terms of limited and easily identifiable factors, such as equity's beta.

The approach to the choice of factors has usually been to some extent arbitrary and controversial. The economic interpretation of the common factors is probably the most important step for any research. Therefore, the choice of factors should include any systematic influences that impact future dividends, the way traders and investors form expectations and the rate at which investors discount future cash flows.

One of the good and simple instructions of what kind of variables qualify as legitimate risk factors in the APT framework are shown below. The legitimate risk factors must possess three important properties:

I. At the beginning of every period, the factor must be completely unpredictable to the market.

II. Each APT factor must have a pervasive influence on stock returns.

III. Relevant factors must influence expected return; i.e. they must have non-zero prices.

In the finance literature, there are three approaches used to identify the factors of the APT. The first consists of an algorithmic analysis of the estimated covariance matrix of asset returns. The second approach is one in which a researcher starts at the estimated covariance matrix of asset returns and uses his judgment to choose factors and subsequently estimate the matrix. The third approach is purely judgmental in that it is one in which the researcher primarily uses his intuition to pick factors and then estimates the factor loadings and checks if they explain the cross-sectional variations in estimated expected returns.

2.1. Industrial Production and Stock Return

Theory suggests, and many authors find, that corporate cash flows are related to a measure of aggregate output such as Gross Domestic Product (GDP) or industrial production. Reference [1] argues that industrial production is positively correlated with stock prices in the US.

According to them, the positive relation reflects the value of insuring against real systematic production risks. Changes in productive activity, through their impact on expected dividends, should in turn influence stock returns. Reference [2] found an evidence that stock returns are positively and significantly related to the level of real economic activity as proxied by the industrial production index in Singapore. Reference [3] concluded that stock prices are positively related to industrial production in the US and Japan. Another study done by [4] investigates the relationships between the Indian stock market index and the industrial production and it reveals that stock prices positively relate to the industrial production.

Reference [5] examined the relationship between the New Zealand Stock Index and the GDP and concluded a positive relationship. Reference [6] employed the linear regression model to test the effect of GDP on stock returns in Taiwan. According to them, GDP seem to affect negatively returns of the three portfolios each of big, medium and small companies listed in Taiwan 50 Index. The authors justified this result as imbalance between energy and environmental needs and economic growth had caused GDP to have a negative relationship with portfolio returns. Reference [7] attempted to determine the relationship between GDP and the Nigerian capital market index. They found that GDP is not significant in the short run but significant at 10% level in the long run. The explanation for this relationship, according to them, is that high and rising income growth rate are indicative of booming business condition, which in turn implies a conducive investment climate and this has beneficial implications for stock market activities.

Accordingly, we have constructed this hypothesis as follow;

H1: There is a significant positive relationship between the percentage change in the value added of industrial production and the stock return.

2.2. Inflation Rate and Stock Return

Reference [1] found a significant negative relationship between inflation rate and stock return in the US as it impacts negatively both the level of the discount rate and the size of the future cash flows. Reference [2] examined the relationship between the Singapore stock index and inflation rate and it revealed the existence of a significant positive relationship between inflation and Singapore stock returns. According to the authors, a possible explanation for the positive relationship might be the government's active role in preventing prices escalation as the economy continued to improve after the 1997 crisis. Reference [8] posited that holding stocks might be an effective hedge against inflation and hence the "Fisher effect" would explain this positive correlation. Another study by [9] examined the relationships between the Karachi stock exchange index and inflation rate and concluded a negative relationship. According to the authors, the negative relationship between inflation and stock prices suggests that stocks are not a good hedge against inflation and hence negates the Fisher hypothesis.

Accordingly, we have constructed this hypothesis as follow;

H2: There is a significant negative relationship between the inflation rate and the stock return.

2.3. Money Supply (M_1) and Stock Return

Reference [10] studied the effect of money supply on the UK stock return and showed that the increased money supply has a positive liquidity effect on stock prices. Reference [2] supported the hypothesis of the positive correlation between money supply changes and stock returns in the Singapore's stock market. The authors attributed a rise in the discount rate to the expansionary effect of money supply increase. Reference [11] explained a spurious, rather than causal, positive relation between money supply and stock prices through a simple quantity theory model, where money demand is stimulated through increases in real activity, which in turn drive stock returns. Reference [3] found an insignificant (although positive) relationship between US stock prices and the money supply. According to the authors, this perhaps suggests that the various influences the money supply has on the stock price may cancel each other out. Another study by [9] revealed that stock prices were positively related with money supply in Pakistan. They concluded that this relation can be justified as the increase in money supply is associated with increased liquidity in stock market, higher volumes of trade and rising stock prices.

Accordingly, we have constructed this hypothesis as follow;

H3: There is a significant positive relationship between the percentage change in the money supply (M_1) and the stock return.

2.4. Short-term Interest Rate and Stock Return

The results of [10] on the UK economy showed that stock prices appear to react negatively to rising short-term interest rates. According to the author, the negative relationship of interest rates and stock prices would be expected as higher interest rates increase the attractiveness of alternative investments. Whenever interest rates rise, investors tend to switch out of stock, causing stock prices to fall. Reference [5] examined the relationship between the New Zealand Stock Index and the short term interest rate. They concluded a significant negative relationship. Another study by [9] studied the relationship between the Karachi stock exchange index and Short-term interest rate. A positive relationship between short term interest rates and stock prices is documented in Pakistan. According to the authors, short term interest rates are a measure of real rate of return in an economy. Therefore, rising short term rates suggest a higher real return on investment and economic growth which are both conducive for higher stock prices. Reference [12] examined the relationship between 91-day Treasury bill rate (as a proxy for short-term interest rate) and stock market returns in Ghana. He concluded a negative relationship and revealed that this indicates that interest rates represent alternative investment opportunities. As the interest rate rises, investors tend to invest less in stocks causing stock prices to fall.

Accordingly, we have constructed this hypothesis as follow;

H4: There is a significant negative relationship between the percentage change in the short-term interest rate and the stock return.

2.5. Discount Rate and Stock Return

Reference [2] examined the relationship between the Singapore stock index and the long-term interest rate, as proxied by the discount rate. According to the authors, long-term interest rates have significant negative relation with the Singapore's stock market as long-term interest rate serve as a better proxy for the nominal risk-free component used in the discount rate in the stock valuation models and may also serve as a surrogate for expected inflation in the discount rate. Reference [3] found that stock prices are negatively related to long-term interest rate in the US and Japan. Another study done by [13] suggested that the effect of nominal interest rate on stock price is negative in Iran because, increase in the interest rate cause to increase discount rate and with respect to the standard stock assessment models cause to reduce the stock price.

Accordingly, we have constructed this hypothesis as follow;

H5: There is a significant negative relationship between the percentage change in the discount rate and the stock return.

2.6. Exchange Rate and Stock Return

Reference [2] examined the relationship the Singapore stock index and the exchange rate and revealed a positive relationship. They explained that with the high import and export content in the Singapore's economy, a stronger domestic currency lowers the cost of imported goods and allows local producers to be more competitive internationally. Reference [14] also explained that a strong Singapore dollar limits imported inflation and hence is perceived as favorable news by the Singapore stock market, thereby generating positive returns. Another study by [12] concluded a negative relationship between the exchange rate and stock return in Ghana. He explained that the appreciation of a country's currency lowers the cost of imported goods, which in turn will decrease the demand for local products, and hence decrease the stock prices. A number of researchers, namely [15], investigated the relationship between Islamic stock market and exchange rate in Malaysia. They concluded that the Islamic share prices had a positive relationship with the foreign exchange rate. According to the authors, this positive relationship can also be seen from the investors' point of view as regards to the currency value of a particular country. If there is a decrease in currency value, the common presumption is that the country is in the throes of economic recession. This would probably lead investors to withdraw their capital out of the country and affect the firm's profits due to the loss of capital from foreign investors. This in turn would decrease the returns and share prices.

Accordingly, we have constructed this hypothesis as follow;

H6: There is a significant positive relationship between the percentage change in the exchange rate of the Egyptian pound with the US$ and the stock return.

2.7. Price of Brent Crude Petroleum and Stock Return

Reference [17] explore the effects of crude oil price on the Japanese stock market. They observe that this factor is associated with significant risk premium in Japanese equities. Reference [12] examines the relationship between crude oil price and stock market returns in Ghana. The empirical results in Ghana reveal that crude oil prices do not appear to have any significant effect on stock returns. This finding is surprising, since Ghana is a net importer of oil. For oil importing countries, crude oil price is hypothesized to impact stock returns negatively. For such countries, increases in oil prices would cause a rise in production costs and a subsequent fall in aggregate economic activity. This would cause lower stock market returns. Reference [1,18] also does not specify oil price as an important pricing factor for British and American firms. Since UK and USA are other net importers of oil, this finding is also confusing. These findings imply that in Ghana, USA and the UK some other factors rather than oil are more important in determining the production costs of the firms.

Accordingly, we have constructed this hypothesis as follow;

H7: There is a significant negative relationship between the percentage change in the Price of Brent crude petroleum and the stock return.

2.8. Market Index and Stock Return

Reference [16] examines the relationship between market index and stock returns in Italy. The empirical results in Italy reveal that market index has a positive significant effect on stock returns. Reference [1] analyze the effects of the market return on the US stock market. They discovered that the market index are not priced by the financial market.

Accordingly, we have constructed this hypothesis as follow;

H8: There is a significant positive relationship between the percentage change in the market index and the stock return.

3. The Data and Methodologies

3.1. Sample and Data Sources

The Study used a sample that contains all the shares of the EGX30 market index (used as a proxy for the Egyptian stock market) with no missing data in the period under consideration and a systematic selection of companies of different size and industry sectors for seven years during the period from January 2007 to December 2013. Then, the monthly return for each stock is calculated and used as the dependent variable in order to render the series stationary. The monthly stock prices are collected from the Egyptian Exchange database. For the macroeconomic factors (independent variables), the variables in our

analysis are chosen taking into account the empirical literature in order to cover a wide spread of economic processes and sectors in the economy. We consider the percentage change of each macroeconomic variable, in order to render the series stationary and to facilitate comparison with stock returns. Data for macroeconomic factors is collected during the same period from the databases of Central Bank of Egypt, Ministry of Planning and the Central Authority for Public Mobilization and Statistics. The software used is SPSS 20.0 for windows.

3.2. The Model

In order to derive the Egyptian Arbitrage pricing model, we first undertook the Bera-Jarque Normality test on the return distribution of each stock to conclude if or not the variable distributions are normal as dictated by most of the linear modeling methods. Then, we applied the factor analysis with the principal component analysis on the return data to compute factor scores before carrying out a regression analysis in order to get the final equation that could be used to predict returns. Next, the obtained factor scores uncorrelated with each other then have been used as the predictors to regress returns for each stock and we have consequently constructed separate equations in which factor loads take place as regression coefficients and the factor scores are the values for independent variables. After regressing the geometric mean returns of the stocks on the factor loads, the study has resulted in a final regression equation. After that, we perform a similar analysis on a representative set of Egyptian macroeconomic variables to estimate the number and the loadings of factors that may represent the Egyptian economy. Finally, we try to find the relationships between the artificial factors and the macroeconomic variables through linear regression model as follows:

Stock return=β0+ β1 Value Added of Industrial production + β2 Inflation rate+β3 Money supply+β4 Short term interest rate+β5 Discount rate+β6 Exchange rate of the Egyptian pound with the US$+ β7 Price of Brent crude petroleum+β8 Market index +e

Where:

β0 = Intercept coefficient

β1, β2, β3, β4, β5, β6, β7 and β8

= Coefficient for each of the independent variables.

All independent variables are used as percentage change of the variable itself.

e = The residual term.

4. Data Analysis and Results

4.1. Normality Tests

Table 1 reports the summary statistics for the stocks in the sample. The table records mean, standard deviation, skewness and kurtosis of 30 time series (30 shares). The test for normality is the Bera-Jarque test, which has a $\chi^2(2)$ distribution under the null hypothesis of normality. The 1% critical value for $\chi^2(2)$ is 9.21.

Table 1. Summary Statistics

No.	Share Name	Mean	Standard Deviation	Skewness	Kurtosis	Normality
1	COML.INTL.BANK (EGYPT)	.000754850096	.0000242201572	-.812	.764	26.40798168
2	GLOBAL TELECOM	.004624849205	.0733419128219	.606	3.875	**7.726287774***
3	TELECOM EGYPT	.020747819578	.1109345201134	-.052	1.388	**9.020262871***
4	QATAR NATIONAL BANK ALAHLY	.012134396253	.0947073977230	.467	2.591	**3.594995197***
5	TALAAT MOUSTAFA GROUP	.007632210108	.1134552415227	.296	1.254	11.76121557
6	VODAFONE EGYPT TELECOM	.007405801217	.1624240850527	.368	.834	18.09899703
7	ABOU KIR FERTILIZERS	.005013159663	.0849810781967	.147	3.616	**1.61185269***
8	BANK OF ALEXANDRIA	.010211906735	.1279131442116	.104	1.626	**6.675479119***
9	EGYP.CO.FOR MOBL.SVS. (MOBINIL)	.021475628157	.1568306164589	2.506	17.871	851.7010827
10	JUHAYNA FOOD INDS.	.002223242398	.1406219070613	2.305	12.251	369.4353768
11	ALEXANDRIA MRL.OILS	.007311033048	.0924364019643	.981	2.965	13.32855291
12	CITADEL CAPITAL	-.003170504747	.1198493673020	.446	1.133	14.80544373
13	EASTERN TOBACCO	.003905145386	.1231399980308	.983	2.505	14.22218682
14	EFG HERMES HDG.	.020974797940	.1245610168364	1.765	11.206	275.9759473
15	EGYPTIAN KUWAITI HOLDING	.000530195458	.0928107714971	.022	3.238	**0.203488783***
16	EL EZZ ALDK.STEEL ALEXA.	.013717703663	.1595035442081	2.504	12.653	408.9660086
17	EZZ STEEL	.014680674012	.0755194774119	.168	.974	14.58084996
18	ORASCOM TELC.& MDA.COS.	.011932778976	.1289269718855	-.475	4.288	**8.850175542***
19	PIONEERS HOLDING	.005940107024	.1263005917168	.458	2.206	**5.090527919***
20	SIDI KERIR PETROCHEM.	.009891409000	.1101889019993	1.600	5.504	57.11238907
21	ADVANCED PHARM.PCKG.	.022160124482	.1665752394466	.248	4.402	**7.648285537***
22	AMER GROUP	.021519902410	.1639201550870	2.125	8.836	180.2764161
23	ARAB COTTON GINNING	.000965623084	.1338439509982	.843	2.701	10.1463825
24	CREDIT AGRICOLE EGYPT	.052910082892	.3765742314518	5.050	32.651	3393.352251
25	EGYP.FOR TOURISM RSTS.	.002462205446	.1603473000051	1.557	5.964	63.92783898
26	HELIOPOLIS HOUSING	.137540124795	1.3395772074843	8.986	81.537	22448.00284
27	NTRL.GAS & MNG.PROJECT (EGYPT GAS)	.011332746048	.1256582751263	.457	1.915	**6.958595154***
28	ORIENTAL WEAVERS	.011617980072	.1747634969683	2.682	23.654	1574.811897
29	PALM HILLS DEVS.SAE	.00	.002	-9.110	83.000	23281.5
30	SIX OF OCT.DEV.& INV.	.000031545807	.0994895019844	-.419	3.169	**2.524458328***

* indicates non rejection of the null hypothesis of normality at 1%.

The null hypothesis of normality cannot be rejected at the 1% level of confidence in 11 out of the 31 series. This indicates that the returns distribution of the Egyptian stock exchange as a whole may be normal. For our purposes, the high number of non rejection cases of the null hypothesis of normality, which includes the market index, gives further confidence in the reliability of the usual statistical tools applied in this study.

4.2. Results of Factor Analysis and Cross-Sectional Regression of Average Returns against Factor Scores Coefficients

The matrix X in our test is the (83, 30) matrix formed by the 30 share vectors (each vector has 83 components, corresponding to the 83 monthly observations). Table 2 shows the eigenvalues, which represent the proportion of total variance in all the variables that is accounted for by that factor. To decide the number of factors to retain, both the scree test and the Kaiser criterion were used. The Kaiser criterion consists in dropping the eigenvalues less than one. In our case, the "Total variance explained table" shows that there are 10 dominant factors whose eigenvalues are more than one. In particular, the first three factors account respectively for the 29.7%, 7.8% and 6.3% of the total variance.

Looking at the scree plot (that plots the eigenvalues for each component); we see that after the 10th factor the eigenvalues are decreasing slowly. Following standard practice, we retain the first 10 factors, corresponding to the 10 first eigenvectors, and accounting for nearly 73% of the total variance.

The eigenvalue analysis suggests that there are 10 dominant factors affecting the behavior of share prices in the Egyptian Stock Exchange and that one of these factors has prominent importance, explaining nearly 30% of the total variance.

Table 2. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.925	29.748	29.748	8.925	29.748	29.748
2	2.350	7.833	37.582	2.350	7.833	37.582
3	1.881	6.270	43.851	1.881	6.270	43.851
4	1.482	4.939	48.790	1.482	4.939	48.790
5	1.418	4.728	53.518	1.418	4.728	53.518
6	1.336	4.454	57.972	1.336	4.454	57.972
7	1.231	4.104	62.076	1.231	4.104	62.076
8	1.107	3.691	65.767	1.107	3.691	65.767
9	1.048	3.495	69.262	1.048	3.495	69.262
10	1.030	3.433	72.695	1.030	3.433	72.695
11	.910	3.035	75.730			
12	.844	2.815	78.544			
13	.803	2.675	81.219			
14	.706	2.353	83.572			
15	.676	2.252	85.824			
16	.638	2.126	87.950			
17	.503	1.677	89.627			
18	.473	1.576	91.203			
19	.422	1.406	92.609			
20	.390	1.300	93.908			
21	.321	1.068	94.977			
22	.269	.897	95.873			
23	.242	.806	96.680			
24	.213	.711	97.390			
25	.168	.561	97.952			
26	.162	.541	98.493			
27	.146	.487	98.980			
28	.127	.425	99.405			
29	.102	.340	99.745			
30	.076	.255	100.000			
Extraction Method: Principal Component Analysis.						

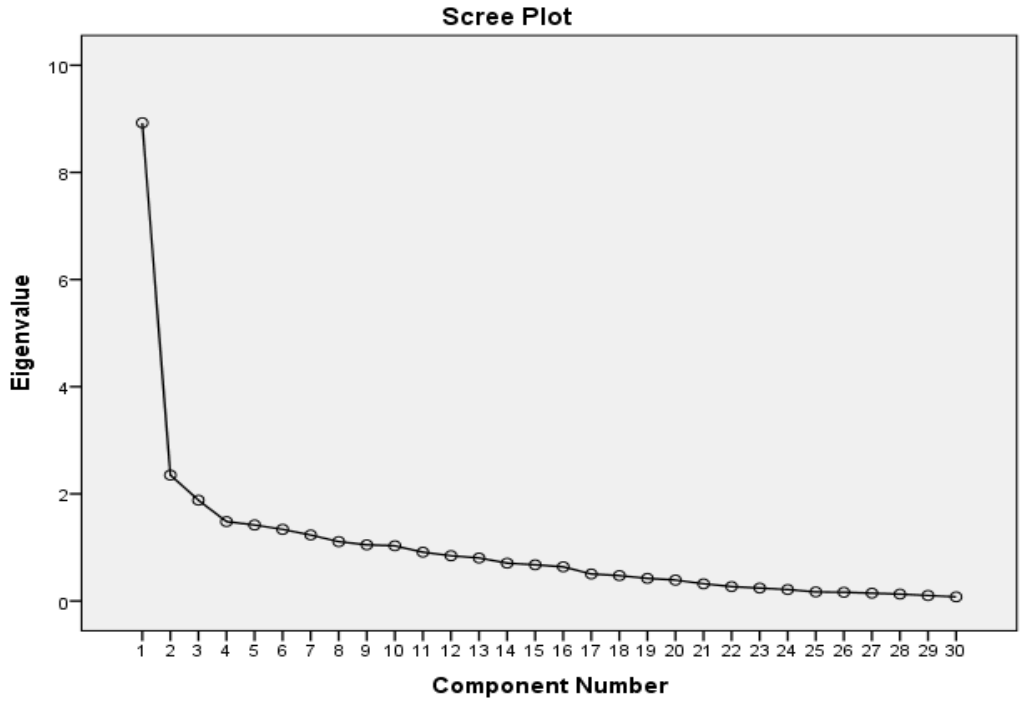

Figure 1. Scree Plot

To test the model, we examine in the second step the results of the cross sectional regression of the mean stock returns on the estimated factor loadings as independent variables (Chen (1983)). The results of the regression are shown in Table 3. The APT is overall significant (F statistic) at 10% significance level. The adjusted R^2 coefficient for the APT is 32%.

The resulting equations (using monthly intervals) for the Egyptian Stock Exchange in the period January 2007 – December 2013, for the APT is:

$$E(Ri) = 0.052 - 0.383bi1 - 0.340bi2 - 0.061bi3 - 0.140bi4 - 0.058bi5 - 0.062bi6 + 0.212bi7 + 0.056bi8 + 0.370bi9 + 0.596bi10.$$

4.3. Results of the Factor Structure of the Egyptian Economy

The objective of this section is to identify the set of macroeconomic variables that represent the Egyptian economy. Eight macroeconomic variables that covered a wide spread of economic processes were analyzed. In this section, we perform a factor analysis using the principal component analysis on this representative set of Egyptian macroeconomic variables Table 4 shows the eigenvalues, which represent the proportion of total variance in all the variables that is accounted for by that factor. To decide the number of factors to retain, the Kaiser criterion were used. The Kaiser criterion consists in dropping the eigenvalues less than one.

Table 3. Cross-Sectional Regression of average returns against factor scores coefficients

Model	β0	β1	β2	β3	β4	β5	β6	β7	β8	β9	β10	F	Adjusted R Square
Beta	.052	-0.383	-0.340	-0.061	-0.140	-0.058	-0.062	0.212	0.056	0.370	0.596	2.319	.320
Significance	0.001	0.0506	0.0793	0.7716	0.4006	0.7218	0.8097	0.437	0.8062	0.138	0.017	0.058	

Table 4. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.467	30.836	30.836	2.467	30.836	30.836
2	1.649	20.614	51.450	1.649	20.614	51.450
3	1.019	12.732	64.182	1.019	12.732	64.182
4	.943	11.784	75.966			
5	.773	9.668	85.634			
6	.686	8.580	94.214			
7	.369	4.607	98.821			
8	.094	1.179	100.000			

Extraction Method: Principal Component Analysis.

In our case, the "Total variance explained table" shows that there are three dominant factors, which their eigenvalues are more than one. In particular, the first three factors account respectively for the 30.8%, 20.6% and 12.7% of the total variance. Following standard practice, the first three factors are accounting for nearly 64% of the total variance.

Table 5. Component Score Coefficient Matrix

	Component		
	1	2	3
Value_added_Industrial_production	-.268	.221	.062
Inflation_rate	-.260	.325	.027
Money_supply_M1	.020	-.331	.611
Short_term_Interest_rate	.347	.201	-.139
Discount_rate	.354	.145	-.124
US$_Exchange_rate_vs._EGP	.141	.185	.731
Price_crude_oil	.000	-.400	-.173
Market_Index	-.010	-.296	-.072

The overall results from the principal component analysis shows that the eight macroeconomic variables were grouped into three factors. (See Table 5)

- **First factor**: consists mainly of short-term interest rate and Egyptian official discount rate. We will call the first factor the **fixed income securities factor.**
- **Second factor**: consists mainly of inflation rate and price of crude oil. We call it the **inflation factor**.
- **Third factor:** consists mainly of money supply and exchange rate. We call it the **monetary and foreign factor**.

4.4. Results of the APT Model

The APT model showed the relationship between stock returns and macroeconomic variables to reach the economic determinants of stock returns in the Egyptian market. We know from the factor analysis performed on the share sample that there are 10 factors affecting share returns in the Egyptian Stock Exchange (section 4.2) and 3 macroeconomics factors representing the drivers of economic activity (section 4.3).

For the APT model, an economic variable is considered significant if and only if it is significantly related to at least one of the ten common stock factors, and the null hypothesis of non-validity of the test is that the three regression coefficients are jointly zero.

The results of the regression and the level of significance of the economic variables are reported in Table 6.

Table 6. Significance of Economic Variables

Factor	β0	β1	β2	β3	F	Adjusted R Square
		Fixed Income Securities Factor	Inflation Factor	Monetary and Foreign Factor		
Factor Share 1	-0.0010966	0.132	**-0.47769**	-0.089814	9.093	0.228
Significance	0.99095435	0.175	**4.05E-06**	0.35557081	**0.000031**	
Factor Share 2	0.000461	0.031408	0.079602	-0.063073	0.304226	-0.02612
Significance	0.99670086	0.7783463	0.47721	0.5722978	0.822	
Factor Share 3	0.0007	-0.132543	0.140144	-0.04219	1.080711	0.002944
Significance	0.99491761	0.2302093	0.205843	0.7014343	0.362	
Factor Share 4	-0.00045	-0.19267	0.003399	-0.0462423	1.089604	0.003267
Significance	0.99673148	0.0826277	0.975397	0.67431159	0.358491	
Factor Share 5	-0.000649	0.023055	-0.05124	-0.0973786	0.340309	-0.02473
Significance	0.99535451	0.836183	0.646733	0.38366673	0.796227	
Factor Share 6	-6.697E-05	0.066635	0.049903	-0.1808721	1.100891	0.003678
Significance	0.99951381	0.5448529	0.650802	0.10287376	0.353841	
Factor Share 7	-0.001225	0.017699	-0.15314	-0.031521	0.673376	-0.01209
Significance	0.99117549	0.873084	0.170411	0.77613765	0.5709	
Factor Share 8	-0.003184	-0.116667	**-0.32974**	-0.157905	4.581805	0.115859
Significance	0.97546672	0.261792	**0.002059**	0.13018	**0.005207**	
Factor Share 9	0.000185	0.0129337	0.067401	-0.1120533	0.468327	-0.01984
Significance	0.99866919	0.9074211	0.545862	0.31535597	0.705209	
Factor Share 10	-0.000842	-0.057705	-0.10405	0.01453599	0.386967	-0.02294
Significance	0.99396973	0.6047077	0.352651	0.89620077	0.762685	

Findings summarized in Table 6 demonstrate that, the results show that only the inflation factor, which consists of the inflation rate and the price of crude oil, is the factor that has significant influence on the stock return and thus will be included in The Egyptian Arbitrage Pricing Model.

Overall, the results suggest validity but weak applicability of APT in the Egyptian Stock Exchange over the study period. This can be seen in the results of the regression analysis, which generally find one to three factors being priced over the test period. From the Adjusted R square, the results suggest that maximum 23% of variance was explained by the factors. The 77% of variance remains without any explanation.

5. The Conclusion of the Research

This paper empirically tested the Arbitrage Pricing Theory (APT) on the Egyptian Stock Exchange. For this purpose, monthly return of all the shares of the EGX30 market index from January 2007 to December 2013 of the Egyptian Stock Exchange is used as the dependent variable. The explanatory variables are growth rates of the value added of Industrial production, Consumer price index (inflation rate), Money supply (M1), Short-term interest rate, Discount rate, Exchange rate of the US$ vs. the Egyptian Pound, and Price of Brent crude petroleum, and the Market index (EGX100).

The results show that only the inflation factor, which consists of the inflation rate and the price of Brent crude petroleum have significant influence on the stock return and thus will be included in The Egyptian Arbitrage Pricing Model. Overall, the results suggest validity but weak applicability of APT in the Egyptian Stock Exchange over the study period.

The results suggest that maximum 23% of variance was explained by the factors (according to the adjusted R square) of the APT model. The 77% of variance remains without any explanation. Therefore, there is arbitrage opportunity in the Egyptian Stock Exchange. This research found out that the eight macroeconomic variables identified did poorly in explaining the excess returns of the samples and all of these factors weakly affected stock market returns in the test period.

The overall conclusion of the research is that the behavior of securities returns in the Egyptian Stock Exchange is complex and cannot be fully explained by the APT model. Shares and portfolios in Egypt may be significantly influenced by other factors rather than the macroeconomic factors such as the anomalies explained by the behavioral finance theories.

References

[1] Chen, N.F., Roll, R., Ross, S.A., "Economic Forces and the Stock Market", *Journal of Business*, 59 (2), 1986

[2] Maysami, R.C., Koh, T.S., "A Vector Error Correction Model of the Singapore Stock Market", *International Review of Economics and Finance*, 9(1), 2000.

[3] Humpe, A., and Macmillan, P., "Can macroeconomic variables explain long term stock market movements? A comparison of the US and Japan" *Center for Dynamic Macroeconomic Analysis, University of St. Andrews*, 7(20), 2007.

[4] Naik, P., and Padhi, P., "The Impact of Macroeconomic Fundamentals on Stock Prices Revisited: Evidence from Indian Data", *Eurasian Journal of Business and Economics*, 5(10), 2012.

[5] Gan, C., Lee, M., Yong, H., and Zhang, J., "Macroeconomic Variables and Stock Market Interactions: New Zealand Evidence", *Investment Management and Financial Innovations*, 3(4), 2006.

[6] Mehta, S., Singh, T., and Varsha, M., "Macroeconomic factors and stock returns: Evidence from Taiwan", *Journal of Economics and International Finance*, 2(3), 2011.

[7] Osamwonyi, I., and Osagie, E., "The Relationship between Macroeconomic Variables and Stock Market Index in Nigeria", *Journal of Economics*, 3(1), 2012.

[8] Firth, M., "The Relationship between Stock Market Returns and Rates of Inflation", *Journal of Finance*, 34(3), 1979.

[9] Akbar, M., Ali, S., and Khan, M., "The relationship of stock prices and macroeconomic variables revisited: Evidence from Karachi stock exchange", *African Journal of Business Management*, 6(4), 2012.

[10] Cheng, A.C.S., "The UK Stock Market and Economic Factors: a New Approach", *Journal of Business Finance and Accounting*, 22(3), 1995.

[11] Fama, E.,F., "Stock returns, Real Activity, Inflation, and Money", *The American Economic Review*, 71(4), 1981.

[12] Kuwornu, J., "Macroeconomic Variables and Stock Market Returns: Full Information Maximum Likelihood Estimation", *Research Journal of Finance and Accounting*, 2 (4), 2011.

[13] Yahyazadehfar, M., "Macroeconomic variables and stock Prices", *Middle-East Journal of Scientific Research*, 11(4), 2012.

[14] Lovelock, C., and Yip, G., S., "Developing Global Strategies for Service Businesses", *California Management Review*, 38(2), 1996.

[15] Abu, M., Awang, S., Hussin, M., and Muhammad, F., "Macroeconomic Variables and Malaysian Islamic Stock Market: A Time Series Analysis", *Journal of Business Studies Quarterly*, 3(4), 2012.

[16] Cagnetti, A., "Capital Asset Pricing Model and Arbitrage Pricing Theory in the Italian Stock Market: an Empirical Study". 2002.

[17] Brown, S., J., and Otsuki, T., "Macroeconomic Factors and the Japanese Equity Markets: the CAPMD Project", *Japanese Capital Markets*, New York, 1990.

[18] Clare, D., A., and Thomas, H., S., "Macroeconomic Factors, The APT and the UK Stock Market", *Journal of Business Finance and Accounting*, 1994.