INTERNATIONAL JOURNAL OF BUSINESS, 21(4), 2016 ISSN: 1083-4346

A Five-Factor Asset Pricing Model: Empirical Evidence from Egypt

Rehab Taha[a] and Khairy Elgiziry[b]

[a] *Corresponding author, CFA, Department of Business Administration, Faculty of Commerce, Cairo University, Egypt*
rtaha12@hotmail.com

[b] *Department of Business Administration, Faculty of Commerce Cairo University, Egypt*
elgiziry@gmail.com

ABSTRACT

In this paper, we propose an extended five-factor asset pricing model in Egypt. Beside market, size and book-to-market, we investigate whether earnings-to-price, sales-to-price, dividends-to-price, liquidity and momentum are priced risk factors. Factors are formed using Fama and French (1993) methodology. Ordinary least squares time series regression is run using HAC method-Newey and West (1987) using 55 companies during the period from July 2005 to June 2013.We document significant size and value effects. Book-to-market does not absorb the role of earnings-to-price. Liquidity plays an important role. Sales-to-price and dividends-to-price are redundant. There is no momentum effect in Egypt. We conclude that a model, which incorporates market factor, firm size, book-to-market, earnings-to-price and liquidity, yields better results than the competing models. We assess the performance of the proposed model based on different evaluation criteria. The robustness of the model is tested for the separation of up and down market periods.

JEL Classifications: *G11, G12*

Keywords: *CAPM; Fama and French three-factor model; Carhart four-factor model; Chan and Faff four-factor model; size effect; value effect; momentum effect*

* The authors would like to thank the anonymous referee for the very thoughtful insight.

I. INTRODUCTION

One of the most debatable topics in financial literature is identifying determinants of stock returns. The literature has progressed from a single-factor model to multi-factor models. Currently, there is practical evidence that stock returns can be determined by a combination of several risk factors rather than one sole factor. Both institutional and individual investors in Egypt use different variables in the stock selection process. These variables include, but are not limited to price-based ratios (e.g., book-to-market equity, earnings-to-price, sales-to-price and dividends-to-price ratios), investment factors (e.g., investment-to-assets and assets growth ratios), prior returns (momentum and reversal), profitability ratios, leverage ratios and liquidity factor.

With a large variety of variables, determining a well specified asset pricing model, to explain variations in stock returns, becomes very complicated and confusing. The choice of a model based on risk factors or firm characteristics becomes unclear to both academics and practitioners in Egypt.

The Capital Asset Pricing Model (CAPM), developed independently by Sharpe (1964) and Lintner (1965), is the first model built to determine the expected rate of returns on risky assets. An essential argument is on the sole role of the systematic risk in the model. Researchers notice that different patterns of stock returns are not explained by the CAPM; they are called anomalies. But none knows whether they are actual anomalies or a result of an incomplete model being tested for market inefficiencies. The most prominent anomalies are firm size (Banz, 1981; Reinganum, 1981; Fama and French, 1992, 1993, 1996), earnings-to-price (Basu, 1977; Ball, 1978; Reinganum, 1981; Fama and French, 1992), book-to-market equity (Rosenberg et al., 1985; Chan and Chen, 1991; Fama and French, 1992, 1993, 1996), leverage (Bhandari, 1988; Fama and French, 1992), momentum (Jegadeesh and Titman, 1993; Rouwenhorst, 1998, 1999), liquidity (Amihud and Mendelson, 1986; Datar et al., 1998; Amihud, 2002; Chan and Faff, 2005), dividend-to-price (Zhang, 2007; Al-Mwalla et al., 2010) and asset growth (Chen and Zhang, 2009; Fama and French, 2014). Despite the fact that the CAPM is widely used by market practitioners in Egypt, it has come under attack from several directions. First, recent research testing weak form efficiency in the Egyptian stock market shows that stock prices do not completely reveal all historical information, thus rejects the random walk hypothesis (Al-Jafari and Altaee, 2011). Therefore, the CAPM, which is based on an efficient market assumption, does not fit well in an inefficient stock market. Second, the Egyptian market index EGX30-which is weighted by market capitalization and adjusted by free float for the most active 30 companies-cannot be regarded as a good representative of the securities universe. EGX30 is concentrated around different securities, e.g. Commercial International Bank (CIB) represents 35.75% of EGX30 index market capitalization as of the end of July 2015 (Egyptian Stock Exchange website).Therefore, the Egyptian market index may not be a good representative of the mean-variance efficient portfolio. Third, during market downturn (when the market return is lower than the risk free rate), market risk premium reports a negative sign, providing unreasonable results. Consequently, it seems clear from the previous studies that beta does not tell the whole story of risk. There seems to be risk factors affecting stock returns beyond the one-dimensional measurement of market sensitivity. Therefore, market practitioners attempt to add an arbitrary value to the risk free rate to determine their required rate of return.

The motivating point is that, there is no supporting theory to rationalize the choice of the variables to be incorporated in the CAPM in addition to beta.

The latest study on the Egyptian stock market (Shaker and Elgiziry, 2014) evaluates different asset pricing models, namely the CAPM, Fama and French three-factor model (thereafter, FF3 model), momentum-augmented FF3 model, Liquidity-augmented FF3 model and momentum and liquidity-augmented FF3 model. Although they find that FF3 model performs the best based on the GRS test, the authors conclude that their results are not satisfactory compared to other studies. This motivates us to suggest a multi-factor asset pricing model that explains and forecasts stock returns in the Egyptian stock market, consequently assisting professionals and practitioners to understand the nature of the market.

The study main contribution is to propose an extended five-factor asset pricing model with an application to Egypt. In addition to market factor, we screen firm-specific characteristics that seem on grounds to proxy for exposure to systematic risk. These factors are chosen as variables based on past evidence seem to have higher average return than predicted by the CAPM; hence they carry their own risk premia. These variables include firm size, price-based ratios (book-to-market equity, earnings-to-price, sales-to-price and dividends-to-price), momentum and liquidity factors. Then, we examine their significant power in explaining stock returns and propose a five-factor asset pricing model. Finally, we compare the proposed model with several asset pricing models, based on different evaluation criteria, to determine which model performs the best in explaining stock returns in Egypt.

Our main findings indicate significant size and value effects. However, the size effect is stronger than the value effect. Book-to-market equity ratio does not absorb the role of earnings-to-price ratio. Moreover, liquidity plays an important role in explaining stock returns. On the other hand, sales-to-price and dividends-to-price ratios are considered redundant in describing stock returns. Finally, there is no momentum effect in the Egyptian stock market. We conclude that a model, which incorporates market factor, firm size, book-to-market ratio, earnings-to-price ratio and liquidity, provides a good description of the variation in stock returns compared to the competing models. The results of our model are robust to different market conditions.

The remainder of this study is organized as follows: Section II sheds light on the literature review. Section III describes the data and methodology. Section IV focuses on the empirical analysis and discussion of the results. Section V concludes the study.

II. LITERATURE REVIEW

The Capital Asset Pricing Model (CAPM), developed independently by Sharpe (1964) and Lintner (1965), is the first theoretical model built to determine the expected rate of returns on risky assets. The central prediction of the model built on mean-variance portfolio theory developed by Markowitz (1959). The CAPM has been built on the notion that stock returns are affected by one type of risk factor, namely systematic risk as measured by beta (β). The model states that the systematic risk as measured by beta is sufficient to describe cross-sectional of expected returns. The basic version of the CAPM has some restrictive assumptions. Intense criticisms on each of these assumptions introduced developments in the model by initiating new versions of the CAPM. Different research papers attempt to relax some of the unrealistic assumptions of the CAPM. However, most of these efforts have their drawbacks. Due to the severe criticism toward the CAPM, Ross (1976) suggests the Arbitrage Pricing Theory (APT), which is built on three main assumptions: capital markets are perfectly competitive, investors always prefer more wealth to less wealth with certainty and the stochastic process generating asset returns can be expressed as a linear function of more than one common factor. Ross (1976) assumes that stock returns can be explained by many factors but he gives no clue neither on the number of the factors nor their identifications.

In 1992, a prominent paper was published that reflects much of the previous empirical work. Using Fama and Macbeth (1973) methodology, Fama and French (1992) argue that systematic risk alone cannot illustrate cross-sectional fluctuation of stock returns. They suggest that both book-to-market equity (B/M) ratio and firm size are proxies for exposure to systematic risk not captured by market beta, hence they carry their risk premia.

In 1993, Fama and French introduce a five-factor model (FF5). They employ FF3 model along with two additional risk factors, namely term and default spreads. They test whether the factors that explain bond returns help to explain stock returns and vice versa. They create mimicking portfolios for size, book-to-market and term structure risk factors and use Black et al. (1972) time series regression. They conclude that the five-factor model is able to explain average returns on bonds and stocks.

Fama and French (1996) show that the three-factor model, containing market factor and mimicking portfolios for size and B/M ratio, captures the returns on portfolios constructed on sales growth, Cash flow-to-Price (C/P) and Earnings-to-Price (E/P) ratios. They argue that firms with low earnings have higher average returns as indicated by positive coefficients on high minus low (HML) portfolios. These stocks have high B/M, high C/P, high E/P and low sales growth ratios. Consequently, FF3 model gains wide acceptance in both developed and emerging markets. Fama and French (1998) report a premium for value stocks in twelve out of thirteen international markets. Rouwenhorst (1999) concludes that small firms outperform big firms and value stocks outperform growth stocks in 20 emerging markets. Chen and Tu (2000) report a significant size and value premia in Taiwan stock market and support the validity of FF3 model in explaining cross-sectional variation in stock returns in Taiwan market. Drew and Veeraraghavan (2003) find a robust size and value effects in Hong Kong, Malaysia, Korea and Philippines. They conclude that FF3 model is able to explain cross-sectional fluctuation of stock returns in the above mentioned markets over the 1990s. Malin and Veeraraghavan (2004) challenge the findings of Fama and French (1993, 1996) and document a small size effect in both France and Germany and a big size effect in the United Kingdom. In addition, they report a growth effect in the three European markets. Shum and Tang (2005) investigate the applicability of FF3 model in Taiwan, Singapore and Hong Kong. The results are in line with US findings and those of Drew and Veeraraghavan (2003). Nartea et al. (2008) find significant size and value effects in Hong Kong stock market. They conclude that FF3 model performs better than the CAPM in explaining stock returns in Hong Kong stock market. Brailsford et al. (2012) validate the superiority of FF3 model over the CAPM in explaining stock returns in Australia. Al-Mwalla (2012) supports the validity of FF3 model in Amman stock market. Unlu (2013) concludes that FF3 model performs well in Istanbul. Shaker and Elgiziry (2014) conclude that FF3 model is the best model to explain volatility of stock returns in Egypt. Abbas et al. (2015) confirm the applicability of FF3 model in Pakistan stock market.

To overcome the inability of FF3 model to catch the momentum effect initiated by Jegadeesh and Titman (1993), Carhart (1997) constructs a 4-factor model using FF3 model plus momentum. The author uses the previous eleven-month returns lagged one month as a proxy for momentum factor. Carhart concludes that adding one year returns to FF3 model improves the explanatory power of the model. L'Her et al. (2004) conclude that adding a mimicking portfolio for momentum factor enhances the results of FF3 model in the Canadian stock market. Ammann and Steiner (2008) examine Carhart (1997) model in Swiss stock market. They conclude that the four factors are statistically significant and the intercepts are insignificantly different from zero in seven out of eight portfolios. Lam et al. (2010) support the power of Carhart four-factor model in explaining fluctuations of stock returns in Hong Kong stock market. Al-Mwalla (2012) documents strong size and value effects in Amman stock market and concludes that momentum effect is not a general trait in this market. In addition, the results reveal that FF3 model provides better explanation to the variation in stock returns compared to Carhart (1997) model. Cakici et al. (2013) show that Carhart (1997) four-factor model, based on size and momentum sorting, seems to perform the best in three regions (Asia, Latin America and Eastern Europe). They conclude that Carhart (1997) model performs better than both CAPM and FF3 model. Unlu (2013) confirms the validity of Carhart (1997) model in Istanbul stock market. Shaker and Elgiziry (2014) find that there is no momentum effect in Egypt and the model is not valid in explaining volatility in stock returns.

Although trading costs are an essential part of the investment practice, most of the asset pricing models are based on frictionless markets assumption. Despite this unrealistic assumption, the importance of liquidity in the performance of the capital markets has been highlighted by several studies. Amihud and Mendelson (1986) paved the way to various studies proposing liquidity as a significant priced risk factor. Chan and Faff (2005) examine the role of liquidity in Australia. They add mimicking portfolio for liquidity factor to FF3 model using Fama and French (1993) methodology. The results provide a strong support for a four-factor model that incorporates a share turnover factor, market factor, firm size and book-to-market ratio. Liu (2006) constructs a two-factor model, Liquidity-augmented CAPM (LCAPM), comprising market factor plus mimicking portfolio for liquidity factor (IML - Illiquid minus Liquid portfolios). Liu constructs the model utilizing a new measure of liquidity for individual stocks, namely the standardized turnover-adjusted number of zero trading volume over the past 12 months. The study supports the success of LCAPM to catch the cross-sectional variation in stock returns. In addition, the new model captures the liquidity risk that both CAPM and FF3 model fail to explain. Lam and Tam (2011) examine liquidity-returns relationship. They find that a four-factor model, which incorporates market, size, book-to-market ratio and liquidity factor, is the best model to explain stock returns in Hong Kong stock market. Lischewski and Voronkova (2012) find that the extension of FF3 model by liquidity factor fails to explain all the variation in Polish stock market. Minović and Živković (2012) evaluate different models, namely CAPM, FF3 model, LCAPM and Liquidity-augmented FF3 model in Serbia. They use zero rate return, introduced by Lesmond et al. (1999), as a measure of stock illiquidity. They find that

LCAPM and its versions perform better than CAPM and FF3 model in explaining stock returns.

Basu (1977) is the first to examine the relationship between price-earnings ratio and stock returns in the American stock market. The author finds that firms with high earnings-to-price (E/P) ratios exhibit higher future return than predicted by the CAPM. Reinganum (1981) documents empirical anomalies and proves that the CAPM is misspecified. The author figures out that firm size and E/P ratio portfolios earn average returns systematically different from those predicted by the CAPM. However, after controlling for the size effect, the effects of E/P ratio on stock returns disappear. This indicates that the size effect absorbs the E/P effect. Basu (1983) investigates the relationship between P/E ratio, firm size and stocks returns. The results prove that firms with high E/P ratio display higher risk-adjusted returns compared to firms with low E/P ratio. Additionally, earnings-to-price effect is significant even after controlling for differences in firm size, while the size effect vanishes after controlling for E/P ratios. Artmann et al. (2011) evaluate different asset pricing models in Frankfurt stock market. The results indicate that the coefficients on E/P, B/M and momentum factors are positively significant. In addition, adding E/P factor to the traditional models increases adjusted R^2 compared to other models. Moreover, the risk premia associated with market and size factors are not priced; they are mostly insignificant. Noda et al. (2014) investigate the role of earnings-to-price ratio in explaining stock returns in the Brazilian stock market. They propose asset pricing models with mimicking portfolio for E/P ratio; high earnings minus low earnings (HEMLE). The researchers conclude that HEMLE factor is significant in explaining stock returns even after controlling for size and book-to-market factors. They argue that models, which contains HEMLE factor, are more efficient than the CAPM and FF3 model in explaining stock returns in the Brazilian stock market.

III. DATA AND METHODOLOGY

A. Data and Variables

The study sample comprises 55 firms out of the most active 100 companies in the Egyptian stock exchange, which constitute the EGX100 index. We collect data from Bloomberg and Egypt for Information Dissemination (EGID) Company. We use monthly data of stock prices over the period from July 2005 to June 2013 (96 months). However, we exclude February 2011 as the Egyptian stock exchange was closed at that time with the consequences of the Egyptian revolution in January, 2011. Financial firms are excluded because the high leverage characteristics associated with these firms differ from those of non-financial firms, where high leverage more likely indicates financial distress. To ensure that stock returns data are available, only listed stocks before 2005 are included in our sample. Value weighted market index, namely EGX 30, is used as the market proxy and the 90 days Treasury bill rate is used as a proxy for risk free rate.

Following Fama and French (1992), in order to ensure that the accounting information is available before the stock returns for which the accounting information is used to explain, the stock returns for the period between July of year (t) to June of year (t + 1) are matched to the accounting data of the company at the fiscal year-end in December (t - 1). Thus, the accounting data are collected from December 2004 to

December 2012. The majority of the listed firms have the fiscal-year end month of December. Since the financial statements are released within 4-6 months after the fiscal year end month, we leave 6-month gap between fiscal year end and the calculation of stock returns. We choose July-June cycle for portfolio rebalancing. Stock returns are calculated as the differences of the natural logarithm stock price at the end of month (i) and the preceding month (i - 1). Monthly market returns are the differences of the natural logarithm price index at the end of month (i) and the preceding month (i - 1).

The portfolios are formed at the end of June of each year (t). Size is the market capitalization at the end of June in year (t). The firm market capitalization at the end of December (t - 1) is used to compute its book-to-market equity, earnings-to-price, sales-to-price and dividends-to-price at the end of year (t - 1). Momentum is measured as cumulative stock returns from i - 12 to i - 2; momentum is calculated based on the previous 11-month returns lagged one month. Liquidity is measured by stock turnover, which is calculated as the average daily trading volume of the stock scaled by the average number of its outstanding shares in year (t - 1).

B. Construction of the Portfolios

This section illustrates how we form portfolios for different factors. All portfolios are formed using Fama and French (1993) methodology. However, the portfolios are constructed from a two-by-two sort on size and book-to-market, size and earnings-to-price, size and sales-to-price, size and dividends-to-price, size and liquidity and size and momentum. Fama and French (2014) indicate that the choice of 2x3 sorting portfolios is arbitrary. Therefore, there are two reasons for constructing 2x2 instead of 2x3 sorting portfolios. First, as the number of stocks in our sample is obviously small, we use two-by-two sorting to guarantee that the number of stocks in each portfolio is satisfactorily large (not less than ten) in any certain year. Second, there is a practical concern about 2x3 approach. This sorting has the drawback that not all securities are included in the portfolios; the average monthly return on the middle group is excluded from the calculation. Therefore, our portfolios are constructed as follows:

1. Market Factor (MKT)

The market factor is the monthly return on the market index (EGX 30) in excess of the risk free rate.

2. Size and Book-to-Market Equity Factors

Small minus Big size (SMB) and High minus Low book-to-market (HML) portfolios are formed from a two-by-two sort on size and book-to-market equity (B/M) ratio. We construct the portfolios as follows: first, at the end of June of each year (t), all stocks are ranked based on size. Then, the median value of size is used as a break point to split all stocks into two groups. Stocks above the 50% size break point are designated B (for big) and the remaining 50% are designated S (for small). Second, all stocks are ranked on book-to-market equity (B/M) ratio; the median value of B/M is used to divide all stocks into two groups, stocks above the 50% book-to-market ratio break point are designated H (for high) and firms below the 50% book-to-market ratio break point are designated L (for low). Four portfolios are formed from the intersection of the two size and the two B/M groups and rebalanced annually. The equally weighted monthly returns on the portfolios are calculated from July of year (t) to June of year (t + 1).

SMB is a zero-cost portfolio produced by longing small size portfolios and shorting corresponding big size portfolios. SMB represents the size premium and is calculated as the difference between the average monthly returns on the two small size portfolios and the two big size portfolios.

HML is a zero-cost portfolio produced by longing high B/M portfolios and shorting corresponding low B/M portfolios. HML represents the value premium and is calculated as the difference between the average monthly returns on the two high B/M portfolios and the two low B/M portfolios.

3. Small Size/Low Book-to-Market portfolio (S/L)

S/L is the average monthly return on small size and low B/M portfolio in excess of the risk free rate.

4. Small Size/High Book-to-Market portfolio (S/H)

S/H is the average monthly return on small size and high B/M portfolio in excess of the risk free rate.

5. Big Size/Low Book-to-Market portfolio (B/L)

B/L is the average monthly return on big size and low B/M portfolio in excess of the risk free rate.

6. Big Size/High Book-to-Market portfolio (B/H)

B/H is the average monthly return on big size and high B/M portfolio in excess of the risk free rate.

7. Earnings-to-Price factor (E/P)

High Earnings-to-price minus Low Earnings-to-price (HEMLE) portfolio is formed from a two-by-two sort on size and E/P ratio. First, negative E/P values are excluded. Following the previous methodology, four portfolios are formed from the intersection of the two size and the two E/P groups. The equally weighted monthly returns on the portfolios are calculated from July of year (t) to June of year (t + 1).

HEMLE is a zero-cost portfolio produced by longing high E/P portfolios and shorting corresponding low E/P portfolios. HEMLE is calculated as the difference between the average monthly returns on the two high E/P portfolios and the two low E/P portfolios.

8. Sales-to-Price factor (S/P)

High Sales-to-price minus Low Sales-to-price (HSMLS) portfolio is constructed from a two-by-two sort on size and S/P ratio. Following the previous methodology, four portfolios are formed from the intersection of the two size and the two S/P groups. The equally weighted monthly returns on the portfolios are calculated from July of year (t) to June of year (t + 1).

HSMLS is a zero-cost portfolio produced by longing high S/P portfolios and shorting corresponding low S/P portfolios. HSMLS is calculated as the difference between the average monthly returns on the two high S/P portfolios and the two low S/P portfolios.

9. Dividends-to-Price factor (D/P)

High Dividends-to-price minus Low Dividends-to-price (HDMLD) portfolio is formed from a two-by-two sort on size and D/P ratio. Following the previous methodology, four portfolios are formed from the intersection of the two size and the two D/P groups. The equally weighted monthly returns on the portfolios are calculated from July of year (t) to June of year (t + 1).

HDMLD is a zero-cost portfolio produced by longing high D/P portfolios and shorting corresponding low D/P portfolios. HDMLD is calculated as the difference between the average monthly returns on the two high D/P portfolios and the two low D/P portfolios.

10. Liquidity Factor

Illiquid minus Liquid (IML) portfolio is constructed from a two-by-two sort on size and liquidity. Following the previous methodology, four portfolios are formed from the intersection of the two size and the two liquidity groups. The equally weighted monthly returns on the portfolios are calculated from July of year (t) to June of year (t + 1).

IML is a zero-cost portfolio produced by longing illiquid portfolios and shorting corresponding liquid portfolios. IML is calculated as the difference between the average monthly returns on the two illiquid portfolios and the two liquid portfolios.

11. Momentum

Winners minus Losers (WML) portfolio is constructed from a two-by-two sort on size and momentum factors. First, at the end of June of each year (t), all stocks are ranked on size. Then, the median value of size is used as a break point to split all stocks into two groups, Small (S) and Big (B). Second, at the end of each month, all stocks are ranked on the previous 11-month returns lagged one month, the median value is used to divide all stocks into two groups, Winners (W) and Losers (L). Four portfolios are formed from the intersection of the two size and the two momentum groups. The equally weighted monthly returns on the portfolios are calculated from July of year (t) to June of year (t + 1). Momentum portfolios are rebalanced monthly; we form 95 portfolios representing monthly momentum.

WML is a zero-cost portfolio produced by longing winners' portfolios and shorting losers' portfolios. WML is calculated as the difference between the average monthly returns on the two winners' portfolios and the two losers' portfolios.

C. Methodology

To determine the asset pricing model that best explains variation in stock returns, two test outcomes are anticipated:

First, a precise asset pricing model is estimated to have regression coefficients on the risk factors that are significantly different from zero. Therefore, Ordinary Least Squares (OLS) regression is employed. To test for heteroskedasticity and autocorrelation, we use the Breusch-Pagan-Godfrey test for the heteroskedasticity and Breusch-Godfrey Serial Correlation LM Test for autocorrelation. We discover evidence of heteroskedasticity in some models and autocorrelation in others. Therefore, t-test results from the standard OLS procedure may be unreliable. As a result, HAC method-Newey and West (1987) is suggested to adjust the standard errors to correct for the effects of heteroskedasticity and first-order autocorrelation.

Second, the intercepts in the time series regression should be jointly equal to zero; this is done using the GRS-F statistics (Gibbons et al., 1989). This requirement enforces a rigid standard on evaluating any asset pricing model. If the intercepts are jointly not different from zero, there is nothing left that can be captured by the intercept (i.e, no other factor can be added to explain variation in stock returns). If the GRS test indicates that two models are valid in the stock market under investigation, then the one with the smallest GRS-value and the highest p-value is the best model to explain cross-sectional variation in stock returns.

Before running the regressions, some diagnostic tests are performed to detect problems in the models. We use the Augmented Dickey Fuller (ADF) test, to test for stationarity. The computed values of the ADF test are compared to the critical values at 1%, 5%, and 10% significance levels. The results show that there is no evidence of non-stationarity. The computed test statistic for each portfolio is lower than the critical Dickey Fuller values at all the three significance levels. The Variance Inflation Factor (VIF) is used to detect multi-collinearity problem. Since all VIF is lower than 10, we do not reject the null hypothesis that there is no multi-collinearity among the variables.

IV. EMPIRICAL ANALYSIS

This section introduces the empirical analysis of the study. It is divided into six subsections: the first one presents characteristics of the portfolios. The second sheds light on descriptive statistics of the study variables. The third subsection tests different portfolios to determine factors with a significant impact on our dependent variables and propose an asset pricing model in Egypt. In the fourth one, we introduce the empirical results of the time series regression and the GRS-F statistics for different models. In the fifth subsection, we analyze and evaluate different models based on different criteria to determine the asset pricing model that best explains variation in stock returns. The evaluation criteria are adjusted R^2, Standard Error of Regression, Akaike Information Criterion (AIC), Schwarz Criterion (SC), the GRS-F statistics, Root Mean Squared Error (RMSE), Mean Absolute Error (MAE) and Theil Inequality Coefficient (TIC).

Last but not least, we test the robustness of the proposed model under different market conditions.

A. Characteristics of the Portfolios

Table 1: Panel (A) describes the number of stocks in each of the four equally weighted size-B/M portfolios by year. The average number of stocks in small and big size portfolios and in high and low B/M portfolios is almost the same. The average number of stocks in our sample is small compared to the previous studies on developed markets. Therefore, we use 2x2 sorting portfolios on size and B/M ratio instead of the standard 2x3 implemented in the research papers on developed markets.

Panel (B) summarizes the average market capitalization of the study sample. The average market capitalization of the 55 companies over the period from July 2005 to the end of June 2013 is approximately LE123.9 billion. It is noteworthy that big size portfolios (B/L and B/H) and small size portfolios (S/L and S/H) represent approximately 95.7% and 4.27% of our sample market capitalization, respectively. Sorting on B/M ratio, companies with high B/M ratio (S/H and B/H) and companies with low B/M ratio (S/L and B/L) represent 39.24% and 60.76%, respectively of our sample market capitalization.

Table 1

Characteristics of the portfolios

	S/L	S/H	B/L	B/H	Total
Panel A: Number of stocks in each of the four size-B/M sorted portfolios by year					
2005	10	18	18	9	55
2006	13	17	14	11	55
2007	16	12	14	13	55
2008	13	14	15	13	55
2009	14	13	15	13	55
2010	13	14	15	13	55
2011	11	16	16	12	55
2012	13	15	15	12	55
2013	12	16	15	12	55
Average	12.8	15.0	15.2	12.0	
Panel B: Average Size (Market Capitalization, EGP million) of the study sample					
2005	918.7	2,160.5	80,710.5	41,798.3	125,588.0
2006	2,821.1	2,616.1	92,848.5	40,686.1	138,971.8
2007	4,287.3	2,546.4	126,226	53,383.2	186,443
2008	2,147.7	2,630.8	55,731.7	44,370	104,880.3
2009	3,039.3	3,137.1	50,327.4	51,470.3	107,974.1
2010	3,018.5	3,570.5	61,137.2	54,775.8	122,502.1
2011	1,546.5	2,082.7	50,072.2	44,710.4	98,411.8
2012	2,341.6	2,808.3	62,740.3	39,171	107,061.2
2013	2,432.6	3,510	75,167.4	42,056.7	123,166.6
Average	2,505.9	2,784.7	72,773.5	45,824.6	

Notes: This Table describes the number of stocks in each of the four equally weighted size- B/M portfolios using 55 companies over the period from July 2005 to June 2013.The four portfolios are Small size-Low B/M portfolio (S/L), Small size-High B/M portfolio (S/H), Big size-Low B/M portfolio (B/L) and Big size-High B/M portfolio (B/H).

B. Descriptive Statistics

Table 2 shows the descriptive statistics of 22 portfolios. It is noteworthy that variables based on different sorting portfolios are used in the descriptive statistics to illustrate the relationship between stock returns and size, book-to-market ratio, earnings-to-price ratio, sales-to-price ratio, dividends-to-price ratio, liquidity factor and momentum.

Table 2
Descriptive statistics of the study variables

Portfolios	Means (%)	Medians (%)	Standard Deviations (%)
Small size	-1.40	-0.37	13.56
Big size	-2.34	-0.60	10.77
High B/M	-1.85	-1.51	11.53
Low B/M	-1.89	0.51	12.81
High E/P	-1.00	0.49	11.19
Low E/P	-1.10	-0.16	12.7
High S/P	1.03	1.41	6.85
Low S/P	-1.43	-1.01	13.36
High D/P	0.34	2.31	11.89
Low D/P	-1.01	-2.99	35.50
Illiquid	-0.78	0.02	10.90
Liquid	-1.25	-0.43	13.65
Winners	-0.47	-0.61	12.96
Losers	-0.28	-0.41	7.51
MKT	-1.49	-0.25	10.13
SMB	-0.03	-0.26	5.92
HML	-0.94	-0.73	3.67
HEMLE	0.10	-0.49	4.59
HSMLS	0.13	0.56	3.81
HDMLD	-0.35	1.29	7.20
IML	0.46	-0.24	5.95
WML	-0.77	-0.70	5.07

Notes: This Table shows the means, medians and standard deviations of the average monthly returns of the following portfolios: small and big size, high and low book-to-market (B/M), high and low earnings-to-price (E/P), high and low sales-to-price (S/P), high and low dividends-to-price (D/P), illiquid, liquid, winners, losers, market (MKT), Small minus Big size (SMB), High minus Low B/M (HML), High Earnings-to-price minus Low Earnings-to-price (HEMLE), High Sales-to-price minus Low Sales-to-price (HSMLS), High Dividends-to-price minus Low Dividends-to-price (HDMLD), Illiquid minus liquid (IML) and Winners minus Losers (WML) portfolios using 55 companies over the period from July 2005 to June 2013.

As can be seen from Table 2, the average monthly returns on small size and big size portfolios are -1.40% and -2.34%, respectively. Consistent with the literature, small stocks outperform big stocks.

In addition, the results reveal that value stocks (stocks with high B/M, high E/P, high S/P and high D/P ratios) outperform growth stocks (stocks with low B/M, low E/P, low S/P and low D/P ratios). The average monthly return on high B/M portfolios is -1.85% compared to -1.89% on low B/M portfolios. Additionally, the average monthly returns on high E/P portfolios and low E/P portfolios are -1% and -1.10%, respectively. In addition, the average monthly return on high S/P portfolios is 1.03%, while the average monthly return on low S/P portfolios is -1.43%. Moreover, the average monthly returns on high D/P portfolios and low D/P portfolios are approximately 0.34% and -1.01%, respectively.

Furthermore, the average monthly return on illiquid portfolios is -0.78% compared to -1.25% on liquid portfolios, reflecting the negative relation between stock returns and liquidity.

Additionally, the relationship between stock return and momentum factor is negative; the average monthly return on winners' portfolios is approximately -0.47%, while the average monthly return on losers' portfolios is -0.28%. This indicates that stock returns exhibit reversal effect rather than momentum effect.

On the other hand, the standard deviation of the monthly return decreases from 13.56% to 10.77% as we move from small to big size portfolios; reflecting the negative relation between size and total risk. Similarly, there is a negative relation between B/M ratio and standard deviation; the standard deviation decreases from 12.81% to 11.53% as we go from low to high B/M portfolios. The relationship between the standard deviations of the monthly returns and E/P, S/P, D/P and liquidity is negative. The standard deviations of high E/P, high S/P, high D/P and illiquid portfolios are lower than the standard deviations of low E/P, low S/P, low D/P and liquid portfolios. The standard deviations of the first group record 11.19%, 6.85%, 11.89% and 10.90%, respectively compared to 12.7%, 13.36%, 35.5%, and 13.65% in the same order for the second group.

The average monthly return on MKT is approximately -1.49%. It is noteworthy that the average monthly return on MKT is lower than the average monthly return on small size portfolios but higher than that on big size portfolios. Thus, small size portfolios outperform both the market and big size portfolios. On the other hand, the standard deviation of EGX30 is 10.13%, which is lower than the standard deviations of both small and big size portfolios.

Additionally, the average monthly returns on zero-cost portfolios; SMB, HML, HEMLE, HSMLS, HDMLD, IML and WML are -0.03%, -0.94%, 0.10%, 0.13%, -0.35%, 0.46 and -0.77%, respectively.

C. The Proposed Model

To reach to the asset pricing model that best fits the data in the Egyptian market, we run 4 regressions for four dependent variables (S/L, S/H, B/L and B/H) on eight independent variables (MKT, SMB, HML, HEMLE, HSMLS, HDMLD, IML and WML). We estimate Ordinary Least Squares (OLS) regression using HAC method-Newey and West (1987). Then a backward stepwise procedure is applied to identify the variables that have a statistical significant relationship with the four dependent variables. Table 3 shows the estimated slope coefficients and t-statistics of the four portfolios formed on size and B/M ratio. The results show that MKT, SMB, HML significantly affect the four dependent variables. In addition, there is a statistical significant relation between two dependent variables (S/H and B/L) and HEMLE. Similarly, there is a statistical significant effect of IML factor on two dependent variables (S/L and B/H). It can be observed that HSMLS, HDMLD and WML portfolios have no significant impact on our dependent variables. Therefore, HSMLS and HDMLD are regarded as redundent. Excluding the variables with insigficant effect on all our dependet variables, we conclude that market factor, firm size, book-to-market equity ratio, earnings-to-price ratio and liqudity factor are priced in by market participants in the Egyptian stock market, wherases sales-to-price ratio, dividends-to-price ratio and momentum are not priced in.

Therefore, the proposed asset pricing model is the one which includes the five mentioned independent variables. Therfore, our porposed asset pricing model can be stated as follows:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + e_i HEMLE_t + l_i IML_t + \varepsilon_{i,t} \quad t = 1,2,3,......,T$$

where $R_{i,t} - R_{f,t}$ is the return on portfolio (i) in excess of the risk free rate at time (t). $R_{i,t} - R_{f,t}$ is calculated for each one of our dependent variables (S/L, S/H, B/L and B/H). MKT_t, SMB_t, HML_t, $HEMLE_t$ and IML_t are the independent variables described in construction of the portfolios section. In addition, β_i, s_i, h_i, e_i, l_i are factor loading or factor sensitivities. Finally, $\varepsilon_{i,t}$ is a disturbance term assumed to have zero mean and to be uncorrelated with all other variables.

Table 3

Time series regression of four size-B/M portfolios excess returns on MKT, SMB, HML, HEMLE, HSMLS, HDMLS, IML and WML Portfolios: July 2005- June 2013, 95 months

	MKT	SMB	HML	HEMLE	HSMLS	HDMLD	IML	WML
S/L	0.559	1.334	-0.659	-0.259	-0.186	-0.147	-0.308	0.124
	(5.84)***	(7.50)***	(-3.91)***	(-1.56)	(-1.56)	(-1.21)	(-2.99)***	(1.00)
S/H	0.604	1.320	0.574	-0.459	-0.113	-0.001	-0.140	0.156
	(5.02)***	(7.49)***	(3.92)***	(-2.55)**	(-0.93)	(-0.01)	(-1.37)	(1.18)
B/L	0.726	0.423	-0.326	-0.570	-0.026	-0.090	-0.120	0.210
	(5.86)***	(2.47)**	(-2.08)**	(-3.09)***	(-0.18)	(-0.61)	(-1.16)	(1.43)
B/H	0.560	0.356	0.346	-0.260	-0.186	-0.147	-0.308	0.125
	(5.84)***	(1.97)**	(2.07)**	(-1.56)	(-1.56)	(-1.21)	(-2.99)***	(1.00)

Notes: This Table reports the estimated slope coefficients and t-statistics from regressing the four dependent variables (S/L, S/H, B/L and B/H) on eight independent variables: MKT, SMB, HML, HEMLE, HSMLS, HDMLD, IML and WML. S/L is the average monthly return on small size/low B/M portfolio in excess of the risk free rate. S/H is the average monthly return on small size/high B/M portfolio in excess of the risk free rate. B/L is the average monthly return on big size/low B/M portfolio in excess of the risk free rate. B/H is the average monthly return on big size/high B/M portfolio in excess of the risk free rate. MKT is the average monthly return on EGX 30 in excess of the risk free rate. SMB is the difference between the average monthly returns on the two small and the two big size portfolios. HML is the difference between the average monthly returns on the two high B/M and the low B/M portfolios. HEMLE is the difference between the average monthly returns on the two high E/P and the two low E/P portfolios. HSMLS is the difference between the average monthly returns on the two high S/P and the two low S/P portfolios. HDMLD is the difference between the average monthly returns on the two high D/P and the two low D/P portfolios. IML is the difference between the average monthly returns on the two illiquid and the two liquid portfolios. WML is the difference between the average monthly returns on the two winners' and the two losers' portfolios. t-statistics are in parentheses. *, ** and *** denote statistical significance of the coefficients at the 10%, 5% and 1% significance level, respectively.

D. Empirical Results

We estimate five asset pricing models to select the best model in explaining stock returns in Egypt. We begin with the CAPM, then employ forward stepwise procedure by adding additional explanatory variable one at a time and check the significance of the estimated coefficients as well as the change in adjusted R^2. The validity of an asset pricing model is assessed based on the results of the time series regression and the GRS-F statistics. The five models under investigations are as follows:

Model (1): The Capital Asset Pricing Model (CAPM)

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + \varepsilon_{i,t}$$

Model (2): Fama and French Three-Factor Model

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + \varepsilon_{i,t}$$

Model (3): Earnings-to-Price-augmented Fama and French Three-Factor Model

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + e_i HEMLE_t + \varepsilon_{i,t}$$

Model (4): Chan and Faff (2005) Four-Factor Model

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + l_i IML_t + \varepsilon_{i,t}$$

Model (5): Our proposed Five-Factor Model

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + e_i HEMLE_t + l_i IML_t + \varepsilon_{i,t}$$

1. Time Series Regressions

A precise asset pricing model is estimated to have regression coefficients for the risk factors that are significantly different from zero. In this section, we assess each asset pricing model based on individual t-statistic of the regression coefficients and adjusted R^2. Therefore, OLS regression is run using the HAC method-Newey and West (1987) using 55 companies during the period from July 2005 to June 2013.

a. Model (1): The Capital Asset Pricing Model (CAPM)

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + \varepsilon_{i,t} \qquad t = 1,2,3,\ldots\ldots, T$$

We estimate model (1) for four size-B/M portfolios excess returns on the MKT portfolio. Table 4 reports the estimated results of model (1). From the regression results, two out of four intercepts are statistically significant. In each B/M portfolio, the intercept is higher for small size portfolio than for big size portfolio. The intercept increases from -1.156 to -0.126 as we move from B/L to S/L portfolios. Similarly, the intercept rises from -1.164 to -0.156 as we shift from B/H to S/H portfolios. These results parallel the evidence of Fama and French (1993) that the intercepts show the size effect of Banz (1981). This conclusion confirms the negative relation between average returns and firm size. In each size portfolio, the intercept is higher for low B/M portfolio than for high B/M portfolio. The intercept decreases from -0.126 to -0.156 as we shift from S/L to S/H portfolios. Similarly, the intercept declines from -1.156 to -1.164 as we go from B/L to B/H portfolios. This result contradicts the evidence of Fama and French (1993) that the intercepts show the value effects.

All estimated coefficients on the market factor are statistically significant at 1% significance level. However, no constant pattern is found between beta (β) and both size and B/M ratio. When we move from low to high B/M portfolios, beta increases for small size portfolio, while it decreases for big size portfolio. The same pattern is noticed for low and high B/M portfolios when we shift from small to big size portfolios. These results coincide with Fama and French (1993). Consequently, using β as the sole risk factor to explain stock returns does not capture the cross-sectional variation in average returns that is related to size and B/M ratio.

Adjusted R^2 ranges from 34.73% to 55.71% with an average of 47.71% for the four portfolios, indicating that the MKT factor alone explains on average 47.71% of the variation in stock returns in Egypt.

Table 4

Time series regression of four size-B/M portfolios excess returns on MKT portfolio: July 2005- June 2013, 95 months

	Book-to-Market ratio			
Size	Low (L)	High (H)	Low (L)	High (H)
Regression: $R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + \varepsilon_{i,t}$				
	α_i		$t(\alpha_i)$	
Small (S)	-0.126	-0.156	-0.111	-0.171
Big (B)	-1.156	-1.164	-1.642^{*}	-1.987^{**}
	β_i		$t(\beta_i)$	
Small (S)	0.825	0.874	5.922^{***}	6.083^{***}
Big (B)	0.857	0.734	6.791^{***}	6.871^{***}
	Adjusted R^2		S.E regression	
Small (S)	34.73%	45.15%	11.341	9.701
Big (B)	55.71%	55.25%	7.710	6.663

Notes: This Table reports the estimated coefficients from the CAPM model: $R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + \varepsilon_{i,t}$ using 55 companies from July 2005 to June 2013, 95 months. S/L is the average monthly return on small size/low B/M ratio in excess of the risk free rate. S/H is the average monthly return on small size/high B/M ratio in excess of the risk free rate. B/L is the average monthly return on big size/low B/M ratio in excess of the risk free rate. B/H is the average monthly return on big size/high B/M ratio in excess of the risk free rate. α_i is the intercept estimate of the CAPM. The factor loading or sensitivity β_i is the estimated coefficient on MKT. MKT is the average monthly return on EGX 30 in excess of the risk free rate. t( ) indicates t-statistics. *, ** and *** denote statistical significance of the coefficients at the 10%, 5% and 1% significance level, respectively.

b. Model (2): Fama and French Three-Factor Model

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + \varepsilon_{i,t} \qquad t = 1,2,3,\ldots\ldots, T$$

Table 5 shows the results of regressing four size-B/M portfolios excess returns on the MKT, SMB and HML portfolios. Three out of four intercepts are statistically significant. In each B/M portfolio, the intercepts increase as we move from big size to small size portfolios from -1.737 to -0.987 for low B/M portfolios and from -0.987 to -0.042 for high B/M portfolios. In each size portfolio, the intercepts shift up as we move from low B/M to high B/M portfolios from -0.987 to -0.042 for small size portfolios and from -1.737 to -0.987 for big size portfolios. These results are in conjunction with the documentation of Fama and French (1993) that the intercepts in the time series regression display both size and value effects. These outcomes affirm the negative relation between average returns and size and the positive relation between average returns and B/M ratio.

All estimated coefficients on the market factor are statistically significant at 1% significance level and range from 0.646 (for S/L and B/H portfolios) to 0.804 (for B/L portfolio). No obvious relation between market (β) and both size and B/M ratio can be noticed. For low B/M portfolios, small size portfolio, which has higher average returns, does not have higher beta. For big size portfolios, high B/M portfolio, which has higher average returns, does not have higher beta. This confirms the premise that β is not the only risk factor to explain stock returns. It fails to reflect both size and value effects.

The coefficients on SMB portfolio (s_i) are related to firm size. All estimated coefficients on size are statistically significant at 1% level. The coefficients (s_i) decrease with the increase in size for both low and high B/M portfolios. The coefficients dwindle from 1.577 to 0.575 with the increase in size (for low B/M portfolios) and from 1.386 to 0.577 (for high B/M portfolios). Therefore, small size portfolios, which have higher average returns, have higher coefficients on SMB, representing the size effect.

The estimated coefficients on HML portfolio (h_i) are related to B/M ratio. Three out of four coefficients on B/M are statistically significant at 1% significance level, whereas the estimated coefficient on B/H portfolio is significant at 5% level. After controlling for size, the coefficients (h_i) increase with the rise in B/M ratio for both small and big size portfolios. The coefficients escalate from -0.695 to 0.381 (for small size portfolios) and from -0.557 to 0.305 (for big size portfolios). Consequently, portfolios with high B/M ratio, which have higher average returns, have higher coefficients on HML, representing the value effect. Therefore, SMB and HML are able to capture variations in stock returns that are not captured by β.

Accordingly, Fama and French three-factor model (model 2) yields better results compared to the CAPM (model 1). The improvement in adjusted R^2 confirms our results. Compared to the CAPM, adjusted R^2 for FF3 model increases on average from 47.71% to 74.68%.

Table 5
Time series regression of four size-B/M portfolios excess returns on MKT, SMB and HML Portfolios: July 2005- June 2013, 95 months

	Book-to-Market ratio			
Size	Low (L)	High (H)	Low (L)	High (H)
Regression: $R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + \varepsilon_{i,t}$				
	α_i		$t(\alpha_i)$	
Small (S)	-0.987	-0.042	-2.112**	-0.092
Big (B)	-1.737	-0.987	-3.098***	-2.112**
	β_i		$t(\beta_i)$	
Small (S)	0.646	0.678	6.447***	5.752***
Big (B)	0.804	0.646	6.339***	6.447***
	s_i		$t(s_i)$	
Small (S)	1.577	1.387	15.193***	11.947***
Big (B)	0.575	0.577	4.185***	5.557***
	h_i		$t(h_i)$	
Small (S)	-0.695	0.381	-5.240***	2.966***
Big (B)	-0.557	0.305	-3.685***	2.303**
	Adjusted R^2		S.E Regression	
Small (S)	82.95%	81.97%	5.796	5.563
Big (B)	67.66%	66.14%	6.589	5.796

Notes: This Table reports the estimated coefficients from FF3 model: $R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + \varepsilon_{i,t}$ using 55 companies from July 2005 to June 2013, 95 months. S/L is the average monthly return on small size/low B/M portfolio in excess of the risk free rate. S/H is the average monthly return on small size/high B/M portfolio in excess of the risk free rate. B/L is the average monthly return on big size/low B/M portfolio in excess of the risk free rate. B/H is the average monthly return on big size/high B/M portfolio in excess of the risk free rate. α_i is the intercept estimate of FF3 model. The factor loading or sensitivities β_i, s_i and h_i are the estimated coefficients on MKT, SMB and HML portfolios, respectively. MKT is the average monthly return on EGX 30 in excess of the risk free rate. SMB is the difference between the average monthly returns on the two small and the two big size portfolios. HML is the difference between the average monthly returns on the two high B/M and the two low B/M portfolios. t( ) indicates t-statistics. *, ** and *** denote statistical significance of the coefficients at the 10%, 5% and 1% significance level, respectively.

c. Model (3): Earnings-to-Price-augmented Fama and French Three-Factor Model

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + e_i HEMLE_t + \varepsilon_{i,t} \qquad t = 1,2,3,\ldots\ldots, T$$

In estimating model (3), we regress the four size-B/M portfolios excess returns on the MKT, SMB, HML and HEMLE portfolios. The estiamtes of model (3) are presented in Table 6. All the intercepts, except that for S/H portfolio, are statistically significant. In both B/M portfolios, the intercepts increase as we shift from big to small size portfolios. Similarly, the intercepts increase across the size as we move from low to high B/M portolios.These results concide with the literature; confirming the negative relation between average returns and size and the positive relation between average returns and B/M ratio.

Table 6
Time series regression of four size-B/M portfolios excess returns on MKT, SMB, HML and HEMLE Portfolios: July 2005- June 2013, 95 months

	Book-to-Market ratio			
Size	Low (L)	High (H)	Low (L)	High (H)
Regression: $R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + e_i HEMLE_t + \varepsilon_{i,t}$				
	α_i		$t(\alpha_i)$	
Small (S)	-0.892	0.094	-2.029**	0.231
Big (B)	-1.577	-0.892	-3.071***	-2.029**
	β_i		$t(\beta_i)$	
Small (S)	0.608	0.623	6.115***	5.175***
Big (B)	0.740	0.608	6.098***	6.115***
	s_i		$t(s_i)$	
Small (S)	1.551	1.350	14.774***	13.566***
Big (B)	0.533	0.551	4.827***	5.252***
	h_i		$t(h_i)$	
Small (S)	-0.567	0.563	-3.838***	4.428***
Big (B)	-0.343	0.432	-2.409**	2.925***
	e_i		$t(e_i)$	
Small (S)	-0.340	-0.487	-2.074**	-2.827***
Big (B)	-0.571	-0.340	-3.308***	-2.074**
	Adjusted R^2		S.E Regression	
Small (S)	83.85%	84.33%	5.641	5.186
Big (B)	71.80%	67.92%	6.152	5.641

Notes: This Table reports the estimated coefficients from E/P-augmented FF3 model: $R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + e_i HEMLE_t + \varepsilon_{i,t}$ using 55 companies from July 2005 to June 2013, 95 months. S/L is the average monthly return on small size/low B/M ratio in excess of the risk free rate. S/H is the average monthly return on small size/high B/M ratio in excess of the risk free rate. B/L is the average monthly return on big size/low B/M ratio in excess of the risk free rate. B/H is the average monthly return on big size/high B/M ratio in excess of the risk free rate. α_i is the intercept estimate of E/P-augmented FF3 model. The factor loading or sensitivities β_i, s_i, h_i and e_i are the estimated coefficients on MKT, SMB, HML and HEMLE portfolios, respectively. MKT is the average monthly return on EGX 30 in excess of the risk free rate. SMB is the difference between the average monthly returns on the two small and the two big size portfolios. HML is the difference between the average monthly returns on the two high B/M and the two low B/M portfolios. HEMLE is the difference between the average monthly returns on the two high E/P and the two low E/P portfolios. t( ) indicates t-statistics. *, ** and *** denote statistical significance of the coefficients at the 10%, 5% and 1% significance level, respectively.

All coefficients on the market factor are statistically significant at 1% level and range from 0.61 (for S/L and B/H portfolios) to 0.740 (for B/L portfolio). As previously mentioned, the cross-sectional variation in stock returns that is linked to size and B/M ratio cannot be observed when using one risk factor as represented by β. Again, when moving from low to high B/M portfolios, beta increases for small size portfolio, while it decreases for big size portfolio. The same pattern is noticed for low and high B/M portfolios when we move from small to big size portfolios.

All estimated coefficients on SMB are highly significant at 1% level. The SMB coefficents decrease with the increase in size for both low and high B/M portfolios, reflecting the negative relation between firm size and stock returns. The coefficents decrease with the increase in size from 1.551 to 0.533 (for low B/M portfolios) and from 1.350 to 0.551 (for high B/M portfolios). It is obvious that the t-statistics of the estiamted coefficents on SMB for the two small size portfolios (S/L and S/H) are very high compared to those on MKT, HML and HEMLE portfolios; registering 14.77 and 13.57, respectively. This evidence also confirms the importance of the size effect in the Egyptian stock market.

Three out of four estimated coefficients on HML are significant at 1% level, while the estiamted coeffcient (h_i) on B/L portolio is signifcant at 5% level. After controlling for size, the coefficents (h_i) increase with the increase in B/M for both small and big size portfolios. The coeffients shift up from -0.567 to 0.563 (for small size portfolios) and from -0.343 to 0.432 (for big size portfolios).

The estimated coefficients on HEMLE portfolio are related to E/P factor. All coefficients on E/P are statistically significant. The estimated coefficients on both S/H and B/L are significant at 1%, whereas the estimated coefficients on both S/L and B/H are significant at 5%. Therefore, it can be concluded that B/M factor does not absorb the role of E/P factor and both of them are highly significant in explaining variation in stock returns. It can be observed from the regression that the returns on both S/H and B/L portfolios are more sensitive to swing in earnings-to-price factor than the returns on S/L and B/H portfolios.

Compared to FF3 model (model 2), the inclusion of E/P factor improves adjusted R^2 on average by approximately 3% from 74.68% to 76.97%. In addition, S.E regression declines on average to 5.66 from 5.94. Therefore, a model containing MKT, SMB, HML and HEMLE yields higher adjusted R^2 and lower S.E regression than both FF3 model (model 2) and the CAPM (model 1).

d. Model (4): Chan and Faff (2005) Four-Factor Model

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + l_i IML_t + \varepsilon_{i,t} \quad t = 1,2,3,......,T$$

Table 7 shows the results of regressing four size-B/M portfolios excess returns on the MKT, SMB, HML and IML portfolios. All the intercepts, except that for S/H portfolio, are significant. As mentioned before, the intercepts for small size and high B/M portfolios are greater than those for big size and low B/M portfolios.

The results in Table 7 show that, all estimated coefficients on the market factor are statistically significant at 1% level. As previously mentioned, no obvious relationship between market beta and both size and B/M ratio can be observed.

All estimated coefficients on SMB are statistically significant at 1% level. After controlling for B/M ratio, the coefficients on SMB decrease with the increase in size for both low and high B/M portfolios. The coefficients decrease with the increase in size from 1.529 to 0.556 (for low B/M portfolios) and from 1.364 to 0.529 (for high B/M portfolios). It is obvious that the inclusion of IML factor does not weaken the significance of the size effect. The t-statistics of the estimated coefficients on SMB for the two small size portfolios S/L and S/H are very high compared to those on MKT, HML and IML portfolios, registering 15.06 and 11.53, respectively.

Three out of four coefficients on HML are statistically significant at 1% level, whereas the coefficient on B/H portfolio is significant at 10% level. After controlling for size, the coefficients on HML boost with the increase in B/M ratio for both small and big size portfolios. The coefficients on HML increase from -0.741 to 0.360 (for small size portfolios) and from -0.576 to 0.259 (for big size portfolios).

Table 7

Time series regression of four size-B/M portfolios excess returns on MKT, SMB, HML and IML Portfolios: July 2005- June 2013, 95 months

	Book-to-Market ratio			
Size	Low (L)	High (H)	Low (L)	High (H)
Regression: $R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + l_i IML_t + \varepsilon_{i,t}$				
	α_i		$t(\alpha_i)$	
Small (S)	-0.969	-0.033	-2.116**	-0.073
Big (B)	-1.729	-0.969	-3.029***	-2.116**
	β_i		$t(\beta_i)$	
Small (S)	0.592	0.652	5.837***	5.336***
Big (B)	0.781	0.592	5.807***	5.837***
	s_i		$t(s_i)$	
Small (S)	1.529	1.364	15.06***	11.528***
Big (B)	0.556	0.529	4.106***	5.217***
	h_i		$t(h_i)$	
Small (S)	-0.741	0.360	-5.08***	2.629***
Big (B)	-0.576	0.259	-3.661***	1.778*
	I_i		$t(I_i)$	
Small (S)	-0.309	-0.144	-2.868***	-1.540
Big (B)	-0.130	-0.309	-1.225	-2.868***
	Adjusted R^2		S.E Regression	
Small (S)	84.30%	82.15%	5.563	5.534
Big (B)	67.70%	68.81%	6.585	5.563

Notes: This Table reports the estimated coefficients from Chan and Faff (2005) four-factor model: $R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + l_i IML_t + \varepsilon_{i,t}$ using 55 companies from July 2005 to June 2013, 95 months. S/L is the average monthly return on small size/low B/M portfolio in excess of the risk free rate. S/H is the average monthly return on small size/high B/M portfolio in excess of the risk free rate. B/L is the average monthly return on big size/low B/M portfolio in excess of the risk free rate. B/H is the average monthly return on big size/high B/M portfolio in excess of the risk free rate. α_i is the intercept estimate of Chan and Faff model. The factor loading or sensitivities β_i, s_i, h_i and l_i are the estimated coefficients on MKT, SMB, HML and IML portfolios, respectively. MKT is the average monthly return on EGX 30 in excess of the risk free rate. SMB is the difference between the average monthly returns on the two small and the two big size portfolios. HML is the difference between the average monthly returns on the two high B/M and the two low B/M portfolios. IML is the difference between the average monthly returns on the two illiquid and the two liquid portfolios. t( ) indicates t-statistics. *, ** and *** denote statistical significance of the coefficients at the 10%, 5% and 1% significance level, respectively.

The coefficients on IML portfolio (l_i) are related to liquidity factor. Two out of four estimated coefficients on IML portfolios are significant at 1% (S/L and B/H), while the coefficients on S/H and B/L portfolios are statistically insignificant. Therefore, it can be concluded that the returns on S/L and B/H portfolios are sensitive to the variation in liquidity factor, while the returns on both S/H and B/L portfolios do not move with the swing in liquidity factor.

Compared to FF3 model, the inclusion of IML factor improves adjusted R^2 on average by 1.4% from 74.68% to 75.74%. Additionally, S.E regression dwindles on average to 5.81 from 5.94. Therefore, adding liquidity to FF3 model yields higher adjusted R^2 and lower S.E regression, providing better results than both FF3 model and the CAPM.

e. Model (5): Our Proposed Five-Factor Model

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + e_i HEMLE_t + l_i IML_t + \varepsilon_{i,t}$$
$$t = 1,2,3,......,T$$

In estimating model (5), we regress the four size-B/M portfolios excess returns on the MKT, SMB, HML, HEMLE and IML portfolios. The estiamtes of model (5) are presented in Table 8. All the intercepts, except that for S/H portfolio are statistically significant. As mentioned above, the intercepts for small size portfolios are greater than those for big size portfolios. Similarly, the intercepts for high B/M portfolios are higher than those for low B/M portfolios.

As can be seen from Table 8, all the estimated coefficients on the market factor are statistically significant at 1%. As previously mentioned, the cross-sectional variation in stock returns that is linked to size and B/M ratio cannot be observed when using one risk factor as represented by β.

All the estimated coefficients on SMB are statistically significant at 1%. After controlling for B/M ratio, the coefficients on SMB decrease with the increase in size for both low and high B/M portfolios. The coefficients on SMB decrease with the increase in size from 1.507 to 0.517 (for low B/M portfolios) and from 1.332 to 0.507 (for high B/M portfolios). We observe that adding additional independent variables does not weaken the significance of size. This evidence also confirms the robustness of the size effect in the Egyptian stock market.

The estimated coefficients on HML are statistically significant at 1% level for both S/L and S/H portfolios and at 5% for both B/L and B/H portfolios. After controlling for size, the coefficients (h_i) increase with the increase in B/M for both small and big size portfolios. The coefficients on HML increase from -0.618 to 0.541 (for small size portfolios) and from -0.362 to 0.381 (for big size portfolios).

The estimated coefficients on HEMLE are significant at 1% level for both S/H and B/L portfolios and at 5% for both S/L and B/H portfolios. Therefore, B/M factor does not absorb the role of E/P factor and both of them are significant in explaining fluctuations in stock returns. Again, the returns on S/H and B/L portfolios are more sensitive to the variation in earnings-to-price factor than the returns on both S/L and B/H portfolios.

The coefficients on IML (l_i) are related to liquidity factor. Two out of four coefficients on IML portfolio are statistically significant at 1% (S/L and B/H), while the coefficients on S/H and B/L portfolios are statistically insignificant. Therefore, we argue that the returns on S/L and B/H portfolios are sensitive to the volatility in liquidity factor, while the returns on both S/H and B/L do not act in response to the variation in liquidity factor.

Compared to Chan and Faff four-factor model (model 4), the inclusion of HEMLE in model (5) improves adjusted R^2 on average by 2.91% from 75.74% to 77.94%. S.E regression dwindles on average from 5.81 to 5.54 for models 4 and 5, respectively. Therefore, adding liquidity factor to a model, comprising MKT, SMB, HML and HEMLE, provides better results than other models.

Table 8
Time series regression of four size-B/M portfolios excess returns on MKT, SMB, HML, HEMLE and IML portfolios: July 2005- June 2013, 95 months

	Book-to-Market ratio			
Size	Low (L)	High (H)	Low (L)	High (H)
Regression: $R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + e_i HEMLE_t + l_i IML_t + \varepsilon_{i,t}$				
	α_i		$t(\alpha_i)$	
Small (S)	-0.879	0.099	-2.063^{**}	0.241
Big (B)	-1.573	-0.879	-3.005^{***}	-2.063^{**}
	β_i		$t(\beta_i)$	
Small (S)	0.558	0.602	5.673^{***}	4.888^{***}
Big (B)	0.721	0.558	5.562^{***}	5.673^{***}
	s_i		$t(s_i)$	
Small (S)	1.507	1.332	14.676^{***}	12.744^{***}
Big (B)	0.517	0.507	4.737^{***}	4.940^{***}
	h_i		$t(h_i)$	
Small (S)	-0.618	0.541	-3.908^{***}	4.091^{***}
Big (B)	-0.362	0.381	-2.547^{**}	2.411^{**}
	e_i		$t(e_i)$	
Small (S)	-0.323	-0.479	-2.079^{**}	-2.835^{***}
Big (B)	-0.565	-0.323	-3.326^{***}	-2.079^{**}
	l_i		$t(l_i)$	
Small (S)	-0.298	-0.128	-2.817^{***}	-1.241
Big (B)	-0.111	-0.298	-1.040	-2.817^{***}
	Adjusted R^2		S.E Regression	
Small (S)	85.11%	84.45%	5.417	5.165
Big (B)	71.77%	70.42%	6.155	5.417

Notes: This Table reports the estimated coefficients from our proposed model: $R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + e_i HEMLE_t + l_i IML_t + \varepsilon_{i,t}$ using 55 companies from July 2005 to June 2013, 95 months. S/L is the average monthly return on small size/low B/M portfolio in excess of the risk free rate. S/H is the average monthly return on small size/high B/M portfolio in excess of the risk free rate. B/L is the average monthly return on big size/low B/M portfolio in excess of the risk free rate. B/H is the average monthly return on big size/high B/M portfolio in excess of the risk free rate. α_i is the intercept estimate of the proposed model. The factor loading or sensitivities β_i, s_i, h_i, e_i and l_i are the estimated coefficients on MKT, SMB, HML, HEMLE and IML portfolios, respectively. MKT is the average monthly return on EGX 30 in excess of the risk free rate. SMB is the difference between the average monthly returns on the two small and the two big size portfolios. HML is the difference between the average monthly returns on the two high B/M and the low B/M portfolios. HEMLE is the difference between the average monthly returns on the two high E/P and the two low E/P portfolios. IML is the difference between the average monthly returns on the two illiquid and the two liquid portfolios. t( ) indicates t-statistics. *, ** and *** denote statistical significance of the coefficients at the 10%, 5% and 1% significance level, respectively.

2. The GRS-F Statistics

To determine whether the intercepts values are jointly insignificantly differing from zero, the GRS-F statistics (Gibbons et al., 1989) is recommended. The GRS test is performed to examine the following hypotheses for each model under investigation:

H_0: all the intercepts (α_i) coefficients obtained from an asset pricing model are insignificantly differing from zero (they are jointly equal to zero).
H_1: all the intercepts (α_i) coefficients obtained from an asset pricing model are significantly differing from zero.

The larger the GRS value as well as the lower the p-value, the stronger the evidence that H_0 does not hold. Hence, this provides evidence that the intercepts do not equal zero.

The GRS test is calculated as follows:

$$GRS = \left(\frac{T}{N}\right)\left(\frac{T-N-L}{T-L-1}\right)\left[\frac{\hat{\alpha}\hat{\Sigma}^{-1}\hat{\alpha}}{1+\bar{\mu}\hat{\Omega}^{-1}\hat{\mu}}\right] \sim F(N, T-N-L)$$

where $\hat{\alpha}$ = N x 1 vector of estimated intercept; $\hat{\Sigma}$ = an unbiased estimate of the residual covariance matrix; $\bar{\mu}$ = L x 1 vector of the factor portfolios' sample means; $\hat{\Omega}$ = An unbiased estimate of the factor portfolios' covariance matrix; T= Number of observations; N= Number of regressions; and L= Number of explanatory factors in the regression.

Table 9 depicts GRS test results for the five asset pricing models under investigation. The GRS for the CAPM is the largest at 3.625 and p-value of 0.0085 (less than 1%) which suggests that the intercepts are different from zero. Accordingly, we reject the null hypothesis for the CAPM. This result indicates that the CAPM fails to explain the cross-sectional variation in stock returns in the Egyptian stock market. However, the associated p-values of the GRS for the remaining models are greater than 1% significance level. Thus, we do not reject the null hypothesis that the intercepts are jointly equal to zero for the remaining models at 1% significance level. Accordingly, all the above mentioned models, except the CAPM, are valid in the Egyptian stock market. Based on the GRS test, the best model in explaining stock returns is the one with the lowest GRS value and the highest p-value. Although the GRS values are very close for

Table 9
GRS test

	GRS-value	p-value
CAPM (1)	3.6258	0.0085
FF3 model (2)	2.5414	0.0446
E/P-augmented FF3 model (3)	2.5251	0.0458
Chan and Faff (2005) four-factor model (4)	2.7512	0.0324
Our proposed model (5)	2.5233	0.0459

Notes: This Table reports the GRS test for the models under investigation. CAPM is the capital asset pricing model. FF3 model is Fama and French three-factor model containing MKT, SMB and HML portfolios. E/P-augmented FF3 model is a four-factor model comprising MKT, SMB, HML and HEMLE portfolios. Chan and Faff (2005) is a four-factor model incorporating MKT, SMB, HML and IML portfolios. Our proposed model is a five-factor model containing MKT, SMB, HML, HEMLE and IML portfolios.GRS is the F-statistics testing the hypothesis that the intercepts in the regressions of the four size-B/M portfolios are jointly equal to zero. P-value is the associated p-value of the GRS test.

FF3 model, E/P-augmented FF3 model and our proposed model (models 2, 3 and 5, respectively), the proposed model (5) has the lowest GRS value and the highest p-value. Consequently, our proposed model, which incorporates market, size, B/M, E/P and liquidity factors, is the most well specified asset pricing model in the Egyptian stock market.

E. Evaluating Asset Pricing Models in Egypt

In this section, we evaluate different asset pricing models to determine the most well specified asset pricing model in the Egyptian stock market. The evaluation is based on the following criteria:

(1) Time series regression: (a) adjusted R-squared, (b) Standard Error of regression (S.E of regression), (c) Akaike Information Criterion (AIC), and (d) Schwarz Criterion (SC)
(2) The GRS-F statistics
(3) The Forecasting power of the model: (a) Root Mean Squared Error (RMSE), (b) Mean Absolute Error (MAE), and (c) Theil Inequality Coefficient (TIC)

The results in Table 10 show the average adjusted R^2, S.E of regression, AIC, SC, RMSE, MAE and TIC of each model. It is noteworthy that our proposed model (5) performs the best yielding the highest adjusted R^2 of 77.94%, the lowest S.E of regression of 5.54 and the lowest AIC and SC of 6.32 and 6.48, respectively. Adjusted R^2 increases on average by 2.91% across the board as we switch from Chan and Faff (2005) four-factor model (4) to our proposed model (5). It also improves on average by 4.37% as we shift from FF3 model (2) to the proposed model (5). Moreover, it surges on average for the proposed model by 63.36% compared to the CAPM. It is noteworthy that E/P-augmented FF3 model (3) achieves superior performance than Chan and Faff four-factor model (4), but yields lower results than our proposed model (5).The CAPM performs the worst among the competing models with the lowest adjusted R^2, the highest S.E regression, AIC and SC of 47.72%, 8.85, 7.18, 7.23, respectively.

As can be seen from Table 9, the proposed model (5) provides the lowest GRS-value of 2.5233 and the highest p-value of 0.0459 compared to other models.

The forecasting power measurements of the competing models indicate that our proposed model (5) performs the best, followed by E/P-augmented FF3 model (3). Both of them report the lowest RMSE, MAE, TIC among the rivals' models, reporting 5.36, 4.15 and 0.24, respectively for the former and 5.50, 4.24 and 0.24, respectively for the later. Among the old models, Chan and Faff (2005) four-factor model (4) yields better results, followed by FF3 model (2), reporting RMSE of 5.66 and 5.81, MAE of 4.28 and 4.42 and TIC of 0.25 and 0.26, respectively. Expectedly, the CAPM (1) is the worst in terms of the forecasting power performance recording RMSE of 8.76, MAE of 6.67 and TIC of 0.42. Therefore, the forecasting power measurements of the CAPM yield poor outcomes compared to other models.

These results confirm our conclusion that market, size, B/M, E/P and Liquidity factors are the most relevant factors affecting stock returns in the Egyptian stock market. Moreover, combining all these factors in one asset pricing model, yields better results than other models.

Table 10
Evaluation of asset pricing models

Criteria	CAPM (1)	FF3 Model (2)	E/P-augmented FF3 Model (3)	Chan and Faff four-factor model (4)	Our Proposed Model (5)
Adjusted R^2	47.71%	74.68%	76.97%	75.74%	77.94%
S.E. of regression	8.85	5.94	5.66	5.81	5.54
AIC	7.18	6.44	6.35	6.40	6.32
SC	7.23	6.54	6.49	6.54	6.48
RMSE	8.76	5.81	5.50	5.66	5.36
MAE	6.67	4.42	4.24	4.28	4.15
TIC	0.42	0.26	0.24	0.25	0.24

Notes: This Table evaluates the performance of the asset pricing models based on different criteria. CAPM is the capital asset pricing model. FF3 model is a three-factor model containing MKT, SMB and HML portfolios. E/P-augmented FF3 model is a four factor model consisting of MKT, SMB, HML and HEMLE portfolios. Chan and Faff four-factor model is a four factor model comprising MKT, SMB, HML and IML portfolios. The proposed model is a five-factor model incorporating MKT, SMB, HML, HEMLE and IML portfolios. The evaluation criteria are as follows: adjusted R^2, Standard Error of Regression (S.E of regression), Akaike Information Criterion (AIC), Schwarz Criterion (SC), Root Mean Squared Error (RMSE), Mean Absolute Error (MAE) and Theil Inequality Coefficient (TIC).

F. Robustness Test

We check the robustness of the proposed model by performing up and down market model. Up-down market model tests the soundness of the proposed model in different market periods. To perform the test, we split the sampling period into up (market excess returns are positive) and down (market excess returns are negative) market periods. Then a dummy variable (D), that takes a value of 1 during up market and a value of zero during down market, is added in the time series regression. Thus, the regression equation of up-down market model can be stated as follows:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + e_i HEMLE_t + l_i IML_t + \delta_i D_{up\text{-}down} + \varepsilon_{i,t}$$
$$t = 1,2,3,......,T$$

Table 11 shows the results of regressing four size-B/M portfolios excess returns on MKT, SMB, HML, HEMLE, IML and the dummy variable (D). The estimated coefficients on the dummy variable (δ_i) are insignificant indicating that the same outcomes hold during market upturns and downturns. The value of adjusted R^2 suggests that the model is stable in both up and down market periods. Average adjusted R^2 for the four independent variables is constant after adding the dummy variable; recording approximately 77.8%.

The results of this regression imply that adding a variable reflecting market circumstances does not have a significant impact on the coefficients on MKT, SMB, HML, HEMLE and IML portfolios. First, similar to the proposed model, all the intercepts, except that for S/H portfolio, are significant. Market betas are all significant at 1% level. The estimated coefficients on SMB are all significant at 1% level. Second, three out of four coefficients on HML are significant at 1% level, while the coefficient on B/H portfolio is significant at 5%. These results are similar to the proposed model except for the coefficient on B/L, which is significant at 5% level. Third, the results for the estimated coefficients on HEMLE are the same for both up-down market model and our proposed model. The coefficients on HEMLE for S/H and B/L are significant at 1% level, whereas they are significant at 5% level for S/L and B/H portfolios. Fourth, similar to our proposed model, the estimated coefficients on IML are significant for two out of four portfolios. Therefore, market fluctuations do not influence the soundness of the proposed model. Consequently, the proposed model performs well in explaining variation in stock returns in spite of the market directions.

Table 11

Time series regression of four size-B/M portfolios excess returns: July 2005- June 2013, 95 months, under up and down markets periods

Regression:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + e_i HEMLE_t + l_i IML_t + \delta_i D_{up\text{-}down} + \varepsilon_{i,t}$$

	α_i	β_i	s_i	h_i
S/L	-1.636	0.495	1.491	-0.642
	(-2.06)**	(3.75)***	(14.03)***	(-4.14)***
S/H	-0.302	0.569	1.323	0.528
	(-0.46)	(3.71)***	(12.51)***	(4.09)***
B/L	-1.731	0.708	0.513	-0.367
	(-1.75)**	(4.34)***	(4.75)***	(-2.59)***
B/H	-1.637	0.495	0.491	0.357
	(-2.06)**	(3.75)***	(4.62)***	(2.30)**
	e_i	l_i	δ_i	Adjusted-R^2
S/L	-0.302	-0.313	1.809	85.11%
	(-1.98) **	(-2.88)***	(1.06)	
S/H	-0.468	-0.136	0.959	84.33%
	(-2.87)***	(-1.28)	(0.664)	
B/L	-0.561	-0.114	0.379	71.46%
	(-3.38)***	(-1.03)	(0.211)	
B/H	-0.302	-0.313	1.809	70.42%
	(-1.98)**	(-2.88)***	(1.06)	

Notes: This Table checks the robustness of the proposed model during different market periods. S/L is the average monthly return on small size/low B/M portfolio in excess of the risk free rate. S/H is the average monthly return on small size/high B/M portfolio in excess of the risk free rate. B/L is the average monthly return on big size/low B/M portfolio in excess of the risk free rate. B/H is the average monthly return on big size/high B/M portfolio in excess of the risk free rate. The factor loading or sensitivities β_i, s_i, h_i, e_i, l_i and δ_i are the estimated coefficients on MKT, SMB, HML, HEMLE, IML portfolios and $D_{up\text{-}down}$ variable, respectively. D is a dummy variable that takes a value of 1 during up market and a value of zero during down market. Up-market periods (market excess returns are positive) and down-market periods (market excess returns are negative). t( ) indicates t-statistics. *, ** and *** denote statistical significance of the coefficients at the 10%, 5% and 1% significance level, respectively.

V. CONCLUSION

Considerable empirical evidences indicate that factors, which explain variation in stock returns, are allied to those documented in both emerging and developed markets. In this paper, in addition to market factor, we screen firm-specific characteristics that seem on grounds to proxy for exposure to source of systematic risk. These factors are chosen as variables based on past evidence seem to predict high average returns; hence they carry their own risk premia. These variables include firm size, price-based ratios (book-to-market equity, earnings-to-price, sales-to-price and dividends-to-price ratios), and liquidity and momentum factors. Then, we examine their significant power in explaining stock returns and propose a multi-factor asset pricing model with an application to Egypt. Factors are formed using Fama and French (1993) methodology. Ordinary Least Squares (OLS) time series regression is run using the HAC method-Newey and West (1987) using 55 companies during the period from July 2005 to June 2013. We document a negative relation between stock returns and both firm size and liquidity. However, the relationship between stock returns and B/M, E/P, S/P and D/P ratios are positive. Furthermore, the relationship between stock returns and prior returns is negative. We argue that a single-factor model seems inappropriate in describing the relationship between risk and returns. Market beta fails to capture cross-sectional variation in stock returns. We document significant size and value effects in Egypt. However, the size effect is stronger than the value effect. Additionally, the relationship between stock returns and both B/M and E/P ratio are statistically significant. Moreover, B/M ratio does not absorb the role of E/P ratio in explaining variation in stock returns. Liquidity plays an important role in describing stock returns. On the other hand, sales-to-price and dividends-to-price are considered redundant. Finally, there is no momentum effect in the Egyptian stock market. Therefore, we propose a five-factor model containing market factor, firm size, book-to-market ratio, earnings-to-price ratio and liquidity. The proposed model is evaluated compared to the CAPM, FF3 model, earnings-to-price-augmented FF3 model and Chan and Faff four-factor model. The results indicate that our proposed model performs the best in terms of adjusted R^2, Standard Error of Regression, Akaike Information Criterion (AIC), Schwarz Criterion (SC), Root Mean Squared Error (RMSE), Mean Absolute Error (MAE) and Theil Inequality Coefficient (TIC). Moreover, the proposed model has the lowest GRS value and the highest associated p-value. In addition, we test the robustness of the model (on up and down market periods) and find that market fluctuations do not influence the soundness of the proposed model. Consequently, the proposed model does a good job in explaining variation in stock returns in spite of the market direction. We conclude that a model, incorporating market factor, firm size, book-to-market ratio, earnings-to-price ratio and liquidity, provides a good description of the variations in stock returns compared to the competing models. It is recommended to use the proposed model for activities such as estimating the cost of capital, stock selection strategies and evaluating the performance of portfolio managers.

REFERENCES

Abbas, N., J. Kham, R. Aziz, and Z. Sumrani, 2015, "A Study to Check the Applicability of Fama and French, Three– Factor Model on KSE 100– Index from

2004-2014." *International Journal of Financial Research*, 6(1), 90-100.

Al–Jafari, M., and H. Altaee, 2011, "Testing the Random Walk Behavior and Efficiency of the Egyptian Equity Market." *Journal of Money, Investment and Banking*, 22, 132-146.

Al-Mwalla, A., M.A. Ahmed, and A. Fassal, 2010, "The Relationship between P/E Ratio, Dividend Yield Ratio, Size and Stock Returns in Jordanian Companies: A Co-integration Approach." *International Research Journal of Finance and Economics*, 49, 87-103.

Al-Mwalla, M., 2012, "Can Book-to-market, Size and Momentum be Extra Risk Factors that Explain the Stocks Rate of Return? Evidence from Emerging Market." *Journal of Finance, Accounting and Management*, 3(2), 42-57.

Amihud, Y., 2002, "Illiquidity and Stock Returns: Cross-Section and Time-Series Effects." *Journal of Financial Markets*, 5, 31-56.

Amihud, Y., and H., Mendelson, 1986, "Asset Pricing and the Bid-Ask Spread." *Journal of Financial Economics*, 17, 223-249.

Ammann, M., and M. Steiner, 2008, "Risk Factors for Swiss Stock Market." *Swiss Journal of Economics and Statistics*, 144(1), 1-35.

Artmann, S., P. Finter, and A. Kempf, 2011, "Determinants of Expected Stock Returns: Large Sample Evidence from the German Market." *Journal of Business Finance and Accounting*, 39(5-6), 758-784.

Ball, R., 1978, "Anomalies in Relationships between Securities' Yields and Yield-Surrogates." *Journal of Financial Economics*, 6, 103-126.

Banz, W., 1981, "The Relationship between Return and Market Value of Common Stocks." *Journal of Financial Economics*, 9, 3-18.

Basu, S., 1977, "Investment Performance of Common Stocks in Relation to their Price Earnings Ratios: A Test of the Efficient Market Hypothesis." *The Journal of Finance*, 32, 663-682.

Basu, S., 1983, "The Relationship between Earnings Yield, Market Value, and Returns for NYSE Common Stocks: Further Evidence." *Journal of Financial Economics*, 12, 129-156.

Bhandari, L., 1988, "Debt/Equity ratio and Expected Common Stock Returns: Empirical Evidence." *The Journal of Finance*, 43, 507-528.

Black, F., 1972, "Capital Market Equilibrium with Restricted Borrowing." *The Journal of Business*, 45, 444–455.

Black, F., M.C. Jensen, and M. Scholes, 1972, "The Capital Asset Pricing Model: Some Empirical Tests." In: Studies in the Theory of Capital Markets, ed. by M.C. Jensen. Praeger, New York.

Brailsford, T., C. Gaunt, and M. O'Brien, 2012, "Size and Book-to-Market Factors in Australia." *Australian journal of management*, Available at: http://epublications.bond.edu.au/chanc_pubs/4

Cakici, N., F. Fabozzi, and S. Tan, 2013, "Size, Value and Momentum in Emerging Market Stock Returns." *Emerging Markets Review*, 16, 46-65.

Carhart, M.M., 1997, "On Persistence in Mutual Fund Performance." *The Journal of Finance*, 52 (1), 57-82.

Chan, L.K., and N.F. Chen, 1991, "Structural and Return Characteristics of Small and Large Firms." *Journal of Finance*, 46, 1467-1484.

Chan, H.W., and R.W. Faff, 2005, "Asset Pricing and the Illiquidity Premium." *The*

Financial Review, 40, 429-458.
Chen, A., and E.H. Tu, 2000. “Factor Models under Firm Characteristics in Emerging Markets: A study of Taiwan stock return.” *Working Paper*, Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=213320
Chen, L., and L.U. Zhang, 2009, “A Better Three-Factor Model that Explains More Anomalies.” *The Journal of Finance*, 2, 563-595.
Datar, V.T., N.Y. Naik, and R. Radcliffe, 1998, “Liquidity and Stock Returns: An Alternative Test.” *Journal of Financial Markets*, 1, 203-219.
Drew, M.E., and M. Veeraraghavan, 2003, “Beta, Firm size, Book to Market Equity and Stock Returns: Further Evidence from Emerging Markets.” *Journal of the Asia Pacific Economy*, 8, 354-379.
Fama, E., and J. MacBeth, 1973, “Risk, Return and Equilibrium: Empirical Tests. *Journal of Political Economy*, 81(3), 607-636.
Fama, E.F. and K.R. French, 1992. The Cross Section of Expected Stock Returns.” *The Journal of Finance*, 47(2), 427-465.
Fama, E.F., and K.R. French, 1993, “Common Risk Factors in the Returns on Stocks and Bonds.” *Journal of Financial Economics*, 33, 3-56.
Fama, E.F., and K.R. French, 1996, “Multifactor Explanations of Asset Pricing Anomalies.” *The Journal of Finance*, 51, 55-84.
Fama, E.F., and K.R. French, 1998, “Value versus Growth: The International Evidence.” *The Journal of Finance*, 53(6), 1975-1999.
Fama, E.F., and K.R. French, 2014, “A Five-Factor Asset Pricing Model.” *Working Paper*, Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2287202
Gibbons, M., S. Ross, and J. Shanken, 1989, “A Test of the Efficiency of a Given Portfolio.” *Econometrica*, 57, 1121-1152.
Jegadeesh, N., and S. Titman, 1993, “Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency.” *The Journal of Finance*, 48, 65-91.
Lam, K., F.K. Li, and S.M. So, 2010, “On the Validity of the Augmented Fama and French's (1993) Model: Evidence from the Hong Kong stock market.” *Review of Quantitative Finance and Accounting*, 35(1), 89-111.
Lam, S.K., and H.K. Tam, 2011, “Liquidity and Asset Pricing: Evidence from the Hong Kong Stock Market.” *Journal of Banking and Finance*, 35, 2217-2230.
Lesmond, D., J. Ogden, and C.A. Trzcinka, 1999, “A New Estimate of Transaction Costs.” *The Review of Financial Studies*, 12(5), 1113-1141.
L’Her, J.K., T. Masmoudi, and J.M. Suret, 2004, “Evidence to Support the Four-Factor Pricing Model from the Canadian Stock Market.” *Journal of International Financial Markets, Institutions and Money*, 14, 313-328.
Lintner, J., 1965, “The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets.” *Review of Economics and Statistics*, 47(1), 13-37.
Lischewski, J., and S. Voronkova, 2012, “Size, Value and Liquidity. Do They Really Matter on AnEmerging Stock Market?” *Emerging Markets Review*, 13, 8-25.
Liu, W., 2006, “A liquidity Augmented Capital Asset Pricing Model.” *Journal of Financial Economics*, 82, 631-671.
Malin, M., and M. Veeraraghavan, 2004, “On the Robustness of the Fama and French Multifactor Model: Evidence from France, Germany and the United Kingdom.” *International Journal of Business and Economics*, 3(2), 155-176.

Markowitz, H.M., 1959, *Portfolio Selection: Efficient Diversification of Investment,* Wiley, New York.

Merton, R.C., 1973. "An Intertemporal Asset Pricing Model." *Econometrica*, 41, 867-887.

Minović, J., and B. Živković, 2012. "The Impact of Liquidity and Size Premium on Equity Price Formation in Serbia." *Economic Annals*, LVII(195), 43-78.

Nartea, G., C. Gan, and J. Wu, 2008, "Persistence of Size and Value Premia and the Robustness of the Fama–French Three Factor Model in the Hong Kong Stock Market." *Investment Management and Financial Innovations*, 5(4), 39-49.

Newey, K., and D. West, 1987, "A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix." *Econometrica*, 55, 703-708.

Noda, R., R. Martelanc, and E. Kayo, 2014, "The Earnings/Price Risk Factor in Capital Asset Pricing Models." Annual Conference, Port of Spain, Trinidad and Tabago.

Reinganum, R., 1981, "Misspecification of Capital Asset Pricing: Empirical Anomalies Based on Earnings Yields and Market Values*." Journal of Financial Economics*, 9, 19-46.

Rosenberg, B., K. Reid, and R. Lanstein, 1985, "Persuasive Evidence of Market Inefficiency." *Journal of Portfolio Management*, 11, 9-17.

Ross, S.A., 1976, "The Arbitrage Theory of Capital asset pricing." *Journal of Economic Theory*, 13, 341-360.

Rouwenhorst, K.G., 1998. "International Momentum Strategies." *The Journal of Finance*, 1, 267–284.

Rouwenhorst, K.G., 1999, "Local Returns Factors and Turnover in Emerging Stock Markets." *The Journal of Finance*, 54, 1439-1464.

Shaker, M., and K. Elgiziry, 2014, "Comparison of Asset Pricing Models in the Egyptian Stock Market." *Accounting and Finance Research*, 3(4), 24-30.

Sharpe, W.F., 1964, "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk." *The Journal of Finance*, 19(3), 425–442.

Shum, W., and G.Y.N. Tang, 2005, "Common Risk Factors in Returns in Asian Emerging Stock Market." *International Business Review*, 14, 495-717.

Unlu, U., 2013, "Evidence to Support Multifactor Asset Pricing Models: The Case of the Istanbul Stock Exchange." *Asian Journal of Finance and Accounting*, 5(1), 197-208.

Zhang, Q., 2007, "What Kind of Asset Pricing Model Works in Emerging Markets?" A Case for the Chinese Stock Market. M.A thesis, Dalhousie University.