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Determinants of stock returns: Evidence from Egypt

Reem Abd El Maksoud Ahmed El Abd

The American University in Cairo

School of Business

Determinants of Stock Returns: Evidence from Egypt

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REEM ABD EL MAKSOUD EL ABD

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Dr. ALIAA BASSIOUNY

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DEDICATION

To my parents Sawsan and Abd El Maksoud.

To my dear brother Amr.

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ABSTRACT

This paper aims at identifying the determinants of stock returns in the Egyptian stock market. It does so by means of applying four different asset pricing models to the Egyptian stock returns: the CAPM, Fama-French three-factor model, Carhart four-factor model, and Fama-French five-factor model. The main findings of this thesis are that there is a significant size effect in the Egyptian stock returns, but there is no evidence of the presence of value or momentum effects. The results for operating profitability and investment are mixed therefore they need to be investigated further. Also, this paper provides evidence of the superiority of Fama-French five-factor model relative to the other asset pricing models tested.

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CHAPTER 1

INTRODUCTION

1.1 Overview of asset pricing models

Asset pricing models have always been a central focus of Finance literature and research. The reason for their importance is that they attempt to explain the variation in the cross-section of stock returns by means of regressing different stock portfolios on other risk-factor mimicking portfolios.

Understanding the determinants of stock returns has several practical uses. Firstly, by understanding the determinants of stock returns and the associated risks, investors (or their advisors) can perform portfolio construction and asset selection activities in a manner that maximizes their utility. Secondly, asset pricing models can be used to set benchmarks for portfolio performance; either by means of comparing the performance of different investors' portfolios over a given time period or analyzing different portfolios' performance over time. Thirdly, asset pricing models can guide and justify the choice of the appropriate discount rates used in capital budgeting decisions. One of the very popular methods of asset valuation is the Discounted Cash Flow (DCF) method which estimates asset values by forecasting future cash flows then calculating their present value by discounting these cash flows to the present using a discount rate that reflects their risk. Also decision makers often use hurdle rates to choose among new projects or to perform replace-or-renew analysis to existing projects or assets.

The most widely used asset pricing model is the Nobel Prize winning Capital Asset Pricing Model (CAPM) that was first derived by Sharpe (1964) and Lintner (1965b) based on the model of portfolio choice that was developed in 1959 by Markowitz. In this model, investors earn a return in time t due to investing in a pre-selected portfolio in time t-1. Markowitz model assumes that investors are risk-averse and that the portfolios that they construct are mean-variance efficient. According to the CAPM, an investor investing in asset i expects to earn R_i which is composed of a risk-free rate of return plus a risk premium that is a compensation for taking additional risk.

The CAPM represents the cornerstone of asset pricing models. Even though five decades have passed since it has been issued, it is still widely used by industry practitioners and academics. The reason for its popularity is that it offers powerful insights as to how to measure risk, and how risk and expected returns are related. Nevertheless, Fama and French (2004) argue that the CAPM suffers from empirical problems that may be due to having overly simplifying assumptions or to difficulties in performing sound tests on the model. In 1993, Fama and French construct a three-factor model that adds two additional factors to the market factor of the CAPM: a size factor and a value factor. Although Fama-French three-factor model captures the variation in stock returns due to size and book to market factors better than the CAPM, Fama and French (1993) describe the three-factor model as being far from complete. Subsequently, in 1997, Carhart being motivated by Fama and French (1996) findings, that Fama-French three-factor model isn't able to capture the continuation of short-term returns pattern that is documented by Jagadeesh and Titman (1993), adds a momentum factor to the three-factor model to enable it to capture this momentum pattern in stock returns. For years after that, Fama-French three factor model and Carhart four factor model have been extensively used in the US, in other developed and developing countries, and recently in developed and emerging market regions as well. Nevertheless, Avramov et al. (2006) find that Carhart four-factor model isn't able to capture all the momentum in average stock returns in the US market.

Afterwards, influenced by the dividend discount model, and the fact that many researchers have found profitability and investment patterns in stock returns in the US as well as in international markets, Fama and French (2015a) add two additional factors to the three-factor model: a profitability factor and an investment factor, to enable it to better capture the variation in stock returns. The most striking finding of Fama and French (2015a) is that adding profitability and investment factors to the three-factor model, makes the HML factor redundant. Even though the significance of the HML factor has been well established via numerous studies conducted in the US as well as worldwide.

This thesis attempts to use different asset pricing models to capture the variation in stock returns in the Egyptian market. This thesis applies the CAPM, Fama and French three-factor model, Carhart four-factor model and Fama and French five-factor model to the Egyptian Stock Market (EGX). To test these models, Left-Hand-Side test portfolios and Right-Hand-Side factor mimicking portfolios are constructed. To assess the models' Goodness of Fit, the adjusted $R^2$of each model is examined and to compare the pricing errors of each model; the Gibbson, Ross, and Shanken (GRS) test is performed.

This thesis attempts to answer two main research questions:

1- Are empirical asset pricing models able to capture the variation in average stock returns in the Egyptian stock market that is related to Size, Value, Momentum, Investment, and Profitability effects?
2- Does Fama-French five-factor model outperform Fama-French three-factor model?

To test those questions, the thesis uses stock prices data and accounting information obtained from Thomson Reuters Datastream. The dataset constitutes monthly prices of stock trading on the Egyptian stock exchange for the period June 2005 to July 2016, resulting in the tests being conducted using 132 observations.

The main findings of this thesis is that there is a significant size effect in the Egyptian stock returns, but there is not any evidence of the presence of value or momentum effects. The results for operating profitability and investment are mixed therefore they need to be investigated further. Fama-French five-factor model appears to be superior to the asset pricing models that precede it, owing to having a higher adjustedR^2, fewer significant intercepts, and a lower Sharpe ratio of the intercepts. The thesis also believes that constructing portfolios using Size-Operating Profitability dimensions result in the models being mis-specified, but using Size-Investment dimensions seems reasonable.

The thesis is structured as follows: Chapter 2 reviews past literature, Chapter 3 describes the methodology used, Chapter 4 examines the data and summary statistics, Chapter 5 comments on the results of the different asset pricing tests performed and on the results of the GRS test, and Chapter 6 concludes.

Chapter 2

Literature Review

2.1 From Markowitz Portfolio Theory to Fama-French Five-Factor Model

The effects of risk and uncertainty on security returns, portfolio management and capital budgeting decisions have always captured researchers' attention. In 1959, Markowitz showed that investors should only be rewarded for bearing systematic risk because security specific risk can be diversified away. The Asset Pricing Model that was developed by Sharpe (1964) and Treynor (1961), and extended and clarified by Lintner (1965a; 1965b) and Mossin (1966), describes the pricing of securities under market equilibrium. According to the CAPM, an investor investing in asset i should expect to earn $R_i$which is composed of the risk-free rate of return plus a risk premium that is a compensation for taking additional risk, assuming certain conditions [1]hold. The Sharpe- Lintner Capital Asset Pricing Model (the CAPM) can be stated as follows:

$$R_{iT} = RF_T + b_i(RM_T - RF_T) + e_i$$

Where R_{iT} is the return on security i in period T, RF_T is the return of a risk-free security of the period and $RM_T$is the return of the market portfolio in period T. The market sensitivity of security i is b_i which is the slope of the regression. The CAPM views that security returns are composed of return on a risk-free asset plus an equity risk premium, and that the systematic risk that the investor is exposed to is fully captured by b_i.

Studies conducted afterwards tried using the CAPM to explain the cross sectional variation in stock returns. Fama and MacBeth (1973) confirm that indeed no measure of risk systematically affects average return other than the CAPM beta. Jensen et al. (1972) establish the validity of the beta factor in explaining stock returns, however

[1]The assumptions of the CAPM: 1) Investors are risk averse and they seek to maximize their wealth taking investment decisions based solely on a security's mean and variance, 2) Markets are frictionless; meaning there are no taxes or transaction costs, 3) All investors have homogenous views regarding security returns and 4) All investors can borrow and lend at the risk-free rate.

they realize that the CAPM underestimates the returns of stocks with low levels of beta and overestimates the returns of stocks with high levels of beta.

Subsequent research uncovers additional factors that impact asset pricing in addition to beta. Litzenberger and Ramaswamy (1979) study the returns of common stocks between 1936 and 1977 and are able to find a significant positive relationship between pre-tax expected returns and dividend yield. Basu (1977) detects a risk-return puzzle. He finds that over the fourteen years examined, stocks with low PE ratio (Value stocks) tend to outperform stocks with high PE ratio (Growth stocks) on a risk-adjusted basis. Nonetheless, he interprets his findings as evidence of market inefficiency, that public information is not instantaneously reflected in stock prices.

Banz (1981) finds a size-effect in stock returns of the NYSE. He examines the relationship between stock returns and total market value and finds that small stocks outperform big stocks on a risk-adjusted basis. Basu (1983) verifies that stocks with high earnings yield, averagely, earn higher risk-adjusted returns than stocks with low earnings yield, even after controlling for differences in firm size. Rosenberg et al. (1985) find a positive relationship between US stock returns and Book/Price ratio in the period 1980-1984. Bhandari (1988) observes a positive relationship between Debt/Equity ratio and average stock returns.

Fama and French (1992) confirm the inadequacy of the CAPM in explaining average stock returns for the 1963-1990 period. They use Fama and MacBeth (1973) cross-sectional regression with the goal of evaluating the joint roles of market beta, size, earnings yield, leverage and book to market ratio in the cross section of average return of stocks trading on NYSE, AMEX and NASDAQ. They find that while market beta fails to explain average stock returns, size and book to market factors capture the variability in average stock returns that is related to size, earnings yield, book-to-market ratio and leverage. Fama and French (1992) rationalize the ability of size and book-to-market to capture the cross-sectional variation in stock returns that is associated with the other factors using the reasoning of Ball (1978) and Kiem (1983); that views size, leverage, earnings yield and book-to-market ratio as scaled versions of a firm’s stock price. Consequently, it’s sensible to expect that some of them are redundant.

Inspired by these findings, Fama and French (1993) propose a three-factor that uses the time-series regression approach of Jensen et al. (1972), with the intent of explaining the variation in stock returns. This model adds two additional risk factors to the CAPM: SMB (Small minus Big) and HML (High minus Low). The SMB factor represents the returns of a portfolio of small stocks minus the returns of a portfolio of big stocks, while the HML factor represents the returns of a portfolio of high B/M ratio minus the returns of a portfolio of low B/M ratio. The three-factor model is expressed as follows:

$$R_{iT} - RF_T = \alpha_i + b_i(RM_T - RF_T) + s_i SMB_T + h_i HML_T + e_i$$

Fama and French (1993) find that risk-factors mimicking portfolios related to size and book-to-market factors capture the variation in stock returns even if other factors are added to the regression. In addition, the intercepts of the regression models of the stock portfolios studied were close to 0, indicating that size and book-to-market factors are able to well-explain the variation in stock returns. Fama and French (1993) provide evidence that size and book-to-market are proxies for risk factors associated with stock returns. Fama and French (1997) use the three-factor model to explain industry returns.

Fama and French (1995) suggest that book-to-market ratio may be a proxy to relative distress. They observe that stocks of weak firms with low earnings, trade at a high book-to-market ratio, and have a positive slope on the HML factor. Whereas, stocks of strong firms with high earnings, trade at a low book-to-market ratio, and have a negative slope on the HML factor.

Fama and French (1996) use the three-factor model to explain returns of portfolios constructed using earnings yield (E/P), cash flow-to-price, and sales growth. These patterns in returns are called anomalies, because the CAPM fails to capture them. They find that strong firms with low earnings yield, low cash flow-to-price ratio, and high sales growth have negative slopes on the HML factor (like firms with low book-to-market ratio) indicating lower expected returns. Similarly, weak firms with high earnings yield, high cash flow-to-price ratio, and low sales growth have positive slopes on the HML factor (like firms with high book-to-market ratio) indicating higher future returns. Fama and French (1996) also find that the three-factor model is able to capture the reversal of long-term returns documented by De Bondt and Thaler (1985), but it fails to explain the continuation of short-term returns documented by Jagadeesh and Titman (1993). The reversal of long-term returns implies that stocks with low long-term past returns tend to exhibit higher future returns, while the continuation of short-term returns means that stocks with high past 12-months returns tend to achieve higher future returns.

Carhart (1997) augments the three-factor model by a fourth factor so as to be able to capture the continuation of short-term returns pattern. The model was motivated by the inability of the three-factor model to capture the variation in average stock returns for portfolios sorted on momentum (the return pattern that stocks with above-average returns in recent months tend to continue to outperform other stocks in consequent months). The fourth factor is WML Winners minus Losers which is constructed by subtracting the returns of a portfolio of Losers stocks from the returns of a portfolio of Winners stocks. Carhart four-factor model is expressed as follows:

$$R_{iT} - RF_T = \alpha_i + b_i(RM_T - RF_T) + s_i SMB_T + h_i HML_T + w_i WML_T + e_i$$

Fama and French (2006) remark that research to-date treat book-to-market ratio, profitability, and investment as distinct anomalies that affect average returns. Hence, they conduct their research with the goal of examining how these factors combine to explain the variation in stock returns. Guided by valuation theory, Fama and French (2006) predict that three factors impact average stock returns: Book-to-market ratio, firm profitability, and the firm’s rate of investment. Controlling for the other two factors, valuation theory implies the presence of a negative relationship between the rate of investment and expected stock returns, a positive relationship between firm profitability and expected stock returns, and a positive relationship between book-to-market ratio and expected stock returns. The work of Fama and French (2006) tends to support these predictions; however it’s not able to find a negative relationship between the rates of investment and expected stock returns.

Aharoni et al. (2013) relate the inability of Fama and French (2006) to find evidence of a negative relationship between the investment rates and expected stock returns, to performing their analysis on a per-share basis. When Aharoni et al. (2013) perform tests on a firm-level, they find that the predictions of the valuation theory are fulfilled.

Aharoni et al. (2013) relate the disparity of the results obtained when the analysis is performed on a per-share basis versus when it is performed on a firm-level basis, to the fact that if a firm's number of shares outstanding changes (due to new issuance or share-repurchases), it is likely that this will moderate the correlation between the expected change in investment per share and expected returns. So if a firm issues new stocks, while any change in book value per share can be attributed to the change of the firm's Book to Market ratio at the time of issuance, changes in the firm's book equity doesn't necessarily imply that book equity per share will change.

Novy Marx (2013) criticizes Fama and French (2006) for using earnings as a proxy for expected profitability. He finds evidence in favor of using a ratio of gross-profits-to-assets instead, arguing that when profitability is measured that way it has a similar explanatory power to book-to-market ratio. Novy Marx (2013) states that the performance of Fama-French three-factor model can be enhanced by controlling for profitability, especially for large firms with high liquidity in the US market.

Fama and French (2006) suggest that better proxies are needed for expected profitability and investment. Novy Marx (2013) and Aharoni et al. (2013) are able to identify these proxies. Novy Marx (2013) identify a proxy for profitability that has a strong relationship with average stock returns, while Aharoni et al. (2013) identify a proxy for investment that has a weaker relationship to average returns but still it's statistically significant. These findings led Fama and French (2015a) to realize that Fama and French three-factor model fails to capture the variation in stock returns that is due to investment and profitability factors. Consequently, Fama and French (2015a) propose a novel model that adds two additional factors to the three-factor model with the intent of capturing the variation in stock returns that is due to profitability and investment. The five-factor model can be expressed as follows:

$$R_{iT} - RF_T = \alpha_i + b_i(RM_T - RF_T) + s_i SMB_T + h_i HML_T + r_i RMW_T + c_i CMA_T + e_i$$

RMW_Trepresents the returns of a portfolio of firms with Robust profitability minus the returns of a portfolio of firms with Weak profitability, while CMA_Trepresents the returns of a portfolio of low-investment Conservative firms minus the returns of a portfolio of high-investment Aggressive firms. Fama and French (2015a) find that the five-factor model certainly outperforms the three-factor model. They also realize that adding investment and profitability factors to the three-factor model causes the HML factor to become redundant. However, they doubt that this finding may be sample-specific. The main problem of the five-factor model is its failure to explain the variation in the returns of small stocks which behave like the returns of firms that invest aggressively and have low profitability.

It's noteworthy that the variables used to construct the RHS factors in Fama-French five-factor model are correlated. Fama and French (1995) observe that value stocks tend to have low profitability and investment, on the other hand, growth stocks (especially large cap ones) tend to have high profitability and investment.

The interpretation of the explanatory power of the different risk factor mimicking portfolios used in asset pricing models is strongly debated. Fama and French (1996) present three different viewpoints. The first one, which is acknowledged by Fama and French (1993 and 1995) approves of the rationality of three-factor asset pricing models. They suppose that differences in expected stock returns are in fact risk premiums that although the CAPM fails to explain, other multi-factor models are able to do so. The second one, whom among its proponents are Chopra et al. (1992), Lakonishok et al. (1994), and MacKinlay (1995), argues that differences in expected stock returns are due to market inefficiencies apparent in the way information is incorporated into prices. This bias in pricing, leads to distorting the returns patterns, and as a result hides the true nature between risk and return. The third viewpoint says that the CAPM holds, and that the reason it's spuriously rejected can be attributed either to survivorship bias, as proposed by Kothari et al. (1995), or that anomalies are due to data snooping, as proposed by Black (1993) and Lo and MacKinlay (1990).

That's why international tests on the asset pricing models have a great role in daunting these doubts and proving the validity of the models. As Hou et al. (2011) assert; that developed and emerging markets that move independently from the US market can be used to verify the premiums associated with different risk factors. This thesis proceeds by exploring the evidence found in international markets.

2.2 International Tests of Asset Pricing Models

Value and Momentum effects have been documented in other developed and emerging markets as well. International tests of asset pricing models serve as out-of-sample tests, since all known asset pricing models have been constructed and had their explanatory power tested using data from the US market. Also evaluating the performance of asset pricing models and of investment strategies on other countries provides evidence on how cultural and institutional differences affect financial markets' efficiency.

Chan et al. (1991) attempt to analyze the ability of four fundamental factors to capture the variation in stock returns for the period 1971-1988 in Japan using different statistical specifications and estimation methods. The variables used in this study are earnings yield, size, book-to-market ratio, and cash flow yield. Of all variables considered, it's evident that book-to-market ratio and cash flow yield impact stock returns the most.

Fama and French (1998) find large value premiums for the period 1975 to 1995 in thirteen major markets. To conduct their tests, Fama and French (1998) sort stocks on book to market ratio, earnings yield, cash flow to price and dividend yield. Their ability to find value premium in emerging markets as well indicates that value premium is a real thing. Their tests show that the international CAPM model fails to capture the value premium in international returns, but a two-factor APT that attempts to explain stock returns using a market return factor and a relative distress factor does a better job, both; on a country level and on a global level.

Griffin (2003) tests country-specific and global versions of Fama and French three-factor model on firms in the US, Canada, UK and Japan for the period from January 1981 to December 1995. Regressions for individual stocks and for portfolios show that country-specific versions of the three-factor model fare better than global versions in terms of having a higher explanatory power and lower pricing errors. The findings of this article don't support extending the three-factor model to a global context. So applications such as determining the appropriate cost of capital, risk analysis or performance measurement should be performed using country-specific versions of the model.

Asness et al. (2009) explore value and momentum returns across different markets and different asset classes. Value and momentum still deliver abnormal returns. Asness et al. (2009) admire the effect of diversification on achieving better strategy performance and on the higher statistical power of the tests. The analysis shows that there is a positive correlation between value (momentum) in one class and value (momentum) in another class, and a negative correlation between value and momentum both within and across asset classes. Liquidity risk –whose importance increases after the liquidity crisis in 1998, has a positive relation with value and a negative relation with momentum.

Chui et al. (2010) examine the extent to which momentum pattern is due to behavioral biases. The paper uses the Individualism index developed by Hofstede (1980, 2001) to examine whether momentum returns are affected by cross-cultural differences. Their findings support the notion that culture affects the patterns of stock returns in different countries because individuals are subject to different biases and therefore they interpret information differently. Chui et al. (2010) find a strong positive relation between individualism and momentum profits. This finding is justifiable because, in less individualistic cultures investors tend to put more weight on the consensus of their peers than to relevant information, making them less likely to be able to make momentum profits. This also explains why herding behavior affects investment decisions among investors in these cultures.

Hou et al. (2011) investigate what fundamental factors affect global stock returns. They use fundamental factors that asset pricing literature found to be correlated with stock returns in the US, in developed markets, and in emerging markets. Their sample is composed of monthly stock returns of 49 countries for the period 1981-2003. They perform tests on the individual firm level and they construct factor-mimicking portfolios and use them to explain the cross-sectional and the time series variation in stock returns in portfolios sorted on countries, industries and fundamental characteristics (sorted on single and double characteristics). Their main finding is the viability of factor mimicking portfolios constructed on momentum and cash-flow-to-price, in addition to a global market factor, in explaining the variation in average stock returns.

Fama and French (2012) add to the work of Griffin (2003) and Hou et al. (2011). For instance, Griffin (2003) tests whether country-level or global versions of Fama-French three-factor model better explains returns on individual stocks or on stock portfolios in four countries. Fama and French (2012) use a larger sample of 23 countries. In addition, by examining how value and momentum returns differ across size groups, and whether the size patterns in these returns are captured by local and international versions of the asset pricing models, Fama and French (2012) fill in a gap in the work of Hou et al. (2011).

Fama and French (2012) analyze the stock returns of 23 developed markets in four regions with two objectives. The first goal is to explore size, value, and momentum patterns in the average returns of these markets. The second one is to evaluate the ability of Fama-French three-factor model and Carhart four-factor model to capture the variation in average stock returns for portfolios formed on size and value or size and momentum. They use two versions of the models, a local version and a global version, to examine whether asset pricing is integrated or segmented across regions. Like previous studies, Fama and French (2012) find a value premium in all regions examined, and they find momentum returns in all regions except in Japan. They also observe a reverse size effect with value premiums and average momentum returns declining as we go from small stocks to big stocks. However, this size pattern isn’t present in Japan. They don’t get much support for integrated asset pricing. Moreover, the performance of local models is satisfactory when explaining the variation in returns of portfolios formed on size and value in North America, Europe, and Japan, but they fail to explain returns of portfolios formed on size and momentum.

Cakici et al. (2013) examine value and momentum effects in 18 emerging markets for the period January 1990 to December 2011. They conduct their research with the aim of analyzing size patterns in value and momentum returns, and testing whether asset pricing in emerging markets is integrated with the US. They find value effect present in all markets examined, and they find momentum effect in all markets except in Eastern Europe. Contrary to the findings from developed markets, value effect is fairly similar across different size groups. Momentum effect, on the other hand, decreases as we go from small stocks to big stocks, similar to the pattern recognized in developed markets. Cakici et al. (2013) confirm the alleged negative correlation between value and momentum effects, and state that this finding is even more beneficial in the case of emerging markets given their higher volatility compared to developed markets. Similar to developed markets, integrated pricing doesn't find much support.

Hanauer and Linhart (2015) conduct a similar research to the ones conducted by Fama and French (2012) and Cakici et al. (2013). Their sample is comprised of stocks of four emerging market regions for the period July 1996 to June 2012. By analyzing the magnitudes of standard risk factors, they observe a strong and significant value effect, a strong and less significant momentum effect, and less pronounced size and market factors. They don't observe a size pattern in value and momentum returns, as value effect is present in all size groups, in addition, results are mixed in the case of momentum effect. Similar to the findings of Fama and French (2012) and Cakici et al. (2013), Hanauer and Linhart (2015) find that global models perform poorly. However, they find evidence in favor of the local four-factor model.

Several studies document the patterns of profitability and investment in average stock returns outside the US. Titman et al. (2013) find cross-country differences with respect to investment effect, that is firms with higher investment rates experience lower risk-adjusted stock returns. They deduce that investment effect is stronger in countries with more developed financial markets, and that other factors such as corporate governance and cost of trading are irrelevant. Another research conducted by Watanabe et al. (2013) confirms the presence of the investment effect in international equity markets. They find the investment effect robust in more developed countries with efficient financial markets. They also realize that the investment effect is not related to restrictions to arbitrage, protection granted to investors, or accounting quality. Moreover, Sun et al. (2014) investigate 41 countries over the period 1980 to 2010 with the intent of distinguishing between rational and behavioral justifications for the gross profitability effect in international markets. They detect that in most countries, firms with higher gross profitability experience higher stock returns than their counterparts. This observation prevails in developed countries with low levels of political risk, and in countries where firms can access capital easily.

Although these research papers are able to find evidence in favor of the presence of investment effect and profitability effect in international markets, none of them attempts to capture these effects using asset pricing models, or examines if profitability and investment patterns vary with respect to size. Thus, Fama and French (2015b) investigate whether Fama-French five-factor model is able to capture patterns in international stock returns related to size, book-to-market ratio, profitability, and investment. They test global and local versions of the model and typically the global version of the model performs poorly. The period covered by their study is from July 1990 to October 2015, and their sample includes stock returns in 23 developed markets that they classify to four regions. They find that for North America, Europe, and Asia pacific, there is a positive relation between average stock returns and book-to-market ratio, and there is a negative relationship between average stock returns and investment. Concerning Japan, there is a strong relation between average stock returns and book-to-market ratio, however, the relation between average stock returns and investment or profitability factors appears to be weak. They also note that, compared to Fama-French three-factor model, Fama-French five-factor model largely captures the patterns in average stock returns.

All in all, different variables are found to have explanatory power all over the world. The next section examines studies that have been performed on the Egyptian stock market.

2.3 Studies conducted on the Egyptian stock market

This section reviews past literature that was conducted on the Egyptian stock market. Omran and Pointon (2004) attempt to determine the cost of capital in Egypt, Shaker and El Giziry (2014) apply several asset pricing models to the Egyptian stock market and compare their explanatory power, and Taha and El Giziry (2016) propose an extended five-factor model in the Egyptian market.

Omran and Pointon (2004) research the factors that drive the cost of capital in the Egyptian market with the intent of coming up with a relevant cost of capital. To calculate the WACC (weighted average cost of capital): they use the market interest rate as the cost of debt, and they calculate three different estimates for the cost of equity using three different models. Then two different versions of the WACC are calculated, in the first one weights are calculated using the book values of debt and equity, and in the second one weights are calculated using the market values of debt and equity. As a result, 6 different WACC estimates are used in this study. To estimate the cost of equity, the researchers first use the inverse of the price-to-earnings ratio, then they use the Gordon Growth Model, then finally to avoid the uncertainty related to having to estimate the growth rate in the Gordon Growth Model, they use a third model that assumes that the cost of equity is equal to the rate of return on the equity financed portion of re-invested funds. The data used in this study was five years of data (ending in 1998) for a sample of 119 firms. The researchers rely on past literature to determine which factors to include in their regression models, and they perform step-wise regression to determine the most important factors that affect the cost of equity for different industries. They find evidence that growth and size factors are among the most important factors in determining the cost of capital.

Shaker and El Giziry (2014) apply five different asset pricing models to a sample of 55 firms in order to determine the ability of the models to capture the variation in average stock returns. The five models implemented in this study are: the CAPM, Fama-French three-factor model, Carhart four factor model, Chan and Faff four factor model, and a five-factor model that adds momentum and liquidity factors to Fama-French three-factor model. To perform these tests, Shaker and El Giziry (2014) use time series regression. They use monthly data for the 55 firms from January 2003 to December 2007, three-month T-bills rate as the risk-free rate, and monthly values of EGX30 as the market return. They construct the factor-mimicking RHS portfolios following the method used by Fama and French (1993), and they use the excess returns over the risk-free rate of the SL, SM, SH, BL, BM, and BH portfolios as the dependent variables. They conclude that Fama-French (1993) is indeed superior to the CAPM, and that the other models used in their research don't add much to Fama-French three-factor model. Their results show that the momentum factor is insignificant.

Taha and El Giziry (2016) propose a five-factor model to the Egyptian market. They investigate whether earnings-to-price, sales-to-price, dividends-to-price, liquidity, and momentum are priced risk factors that can be added to the three factors in Fama-French three-factor model. Their sample includes 55 companies over the period July

2005 to June 2013. They conduct their tests using OLS time series regression. They conclude that a five-factor model that incorporates the following factors: market, size, book-to-market, earnings-to-price, and liquidity, performs well in capturing the variation in stock returns in the Egyptian market. They include these factors in the five-factor model after finding evidence of the significance of size and value effects, the insignificance of momentum effect, the importance of liquidity effect, the redundancy of sales-to-price and dividends-to-price factors, and the observation that book-to-market doesn't replace earnings-to-price.

2.4 The contribution of this thesis

This thesis is different than studies that have been previously conducted on the Egyptian stock market in several ways. Firstly, it uses a larger dataset. This thesis uses monthly data for the period June 2005 to July 2016 resulting in using 132 observations in the asset-pricing tests. Also all stocks that were listed in any particular year are included in the sample (from July of year t to June of year t+1), as long as the stock has price and number of shares outstanding data on June of year t and December of year t-1, and book value and deferred taxes data on December (fiscal year end) of year t-1. Shaker and El Giziry (2014) use monthly data from January 2003 to December 2007 period, for 55 stocks of EGX100 index. So the tests in this thesis study a longer time period, and the larger number stocks result in having more stocks in the portfolios constructed[2].

Secondly, this thesis uses all the stocks that comply with the conditions stated in the previous point in constructing the market portfolio, and then calculates the value-weighted average returns on this portfolio to be used as the return on the market portfolio in the different asset pricing tests. On the other hand, Shaker and El Giziry (2014) use EGX30 index as a proxy for the market portfolio.

Thirdly, by ensuring that all stocks that were listed in any particular year are part of the sample, even if they're currently Dead or Suspended, this thesis avoids Survivorship bias. However, Shaker and El Giziry (2014) don't take this into consideration in using 55 stocks of the EGX100 index that is an index of the most active 100 stocks in the market.

[2]The numbers of stocks in the different portfolios used are presented in Chapter 4 of the thesis.

Fourthly, this thesis uses different portfolios to be used in constructing the RHS risk factor-mimicking portfolios, than the ones used in the LHS test portfolios. On the other hand, Shaker and El Giziry (2014) use the same portfolios in constructing the RHS factor and the LHS test portfolios. The RHS portfolios in both research works are constructed similarly, using median market capitalization to classify stocks to small and big stocks, and 30^{th} and 70^{th} BE/ME percentiles to classify stocks to three BE/ME groups: low, medium, and high. Then at the intersection of the two size groups and the three BE/ME groups six portfolios are constructed (SL, SM, SH, BL, BM, and BH). These portfolios are then used to construct the RHS factors. As dependent variables, Shaker and El Giziry (2014) use the excess return of these portfolios over the risk-free rate; hence, they use six portfolios. On the other hand, this thesis uses nine portfolios to construct the dependent variables. These portfolios are constructed using the 33^{rd} and 67^{th} percentiles breakpoints for size and BE/ME and at the intersection of the three size groups and three BE/ME groups nine portfolios are constructed (SL, SM, SH, ML, MM, MH, BL, BM, and BH). The excess returns over the risk-free rate of these portfolios are used as the dependent variables of the asset pricing models.

Also, this thesis fills a gap in existing research by attempting to test Fama-French five factor model on the Egyptian stock market. None of the previous studies has attempted to do so before.

Chapter 3

Methodology

This section explains the methodology followed to test the four different asset pricing models: the CAPM, Fama-French three-factor model, Carhart four-factor model, and Fama-French five-factor model. It also explains the GRS test and the Sharpe ratio of the intercepts$SR(\alpha)$.

3.1 Asset pricing models

CAPM

$$R_{iT} - RF_T = \alpha_i + b_i(RM_T - RF_T) + e_i$$

Fama-French three-factor model

$$R_{iT} - RF_T = \alpha_i + b_i(RM_T - RF_T) + s_i SMB_T + h_i HML_T + e_i$$

Carhart four-factor model

$$R_{iT} - RF_T = \alpha_i + b_i(RM_T - RF_T) + s_i SMB_T + h_i HML_T + w_i WML_T + e_i$$

Fama-French five-factor model

$$R_{iT} - RF_T = \alpha_i + b_i(RM_T - RF_T) + s_i SMB_T + h_i HML_T + r_i RMW_T + c_i CMA_T + e_i$$

Where R_{iT} is the returns of asset i in period t, RF_T is the risk-free rate in period t, RM_T is the return on the market portfolio, SMB_T is the size factor and it represents the returns of a diversified portfolio of small stocks minus the returns of a diversified portfolio of big stocks, $HML_T$is the value factor and it represents the returns of a diversified portfolio of high BE/ME ratio minus the returns of a diversified portfolio of low BE/ME ratio, WML_T is the momentum factor and it represents the returns of a diversified portfolio of winner stocks minus the returns of a diversified portfolio of loser stocks, $RMW_T$is the profitability factor and it represents the returns of a diversified portfolio of firms with robust profitability minus the returns of a diversified portfolio of firms with weak profitability, CMA_T is the investment factor and it represents the returns of a diversified portfolio of firms with conservative asset growth minus the returns of a diversified portfolio of firms with aggressive asset growth, and b_i, s_i, h_i, w_i, r_i , and c_i are regression slope coefficients.

3.2 Portfolio Construction

RHS portfolios

The CAPM has only one RHS portfolio; Return on the market portfolio minus the risk-free rate. Return on the market portfolio (RM) is a value weighted return calculation on all stocks included in the portfolios from July of year t to June of year t+1 using market capitalization for June of year t. Therefore, any stock that has price and number of shares outstanding data on June of year t and December of year t-1, and book value and deferred taxes data on December (fiscal year end) of year t-1, is part of the market portfolio. The proxy of the risk-free rate is the one-month US Treasury bills rate.

Fama-French three-factor model has three RHS portfolios: RM-RF, SMB, and HML. SMB and HML factors are calculated as follows. Each June of year t, stocks are sorted ascendingly according to their market capitalization this month. Then using the median market capitalization as a break point, stocks are allocated to two size groups: Big and Small. Afterwards, stocks are independently sorted in an ascending order with respect to their BE/ME ratio. Similar to Fama-French (1993) approach, stocks whose BE/ME ratio are below the 30^{th} percentile are labeled Low, stocks whose BE/ME ratio are above the 70^{th} percentile are labeled High, and stocks between the 30^{th} percentile and the 70^{th} percentile are labeled Medium. At the intersection of the two size groups and the three BE/ME groups, six portfolios are constructed: SL, SM, SH, BL, BM, and BH. For each one of these portfolios, monthly value-weighted returns are calculated from July of year t to June of year t+1. To construct the SMB factor, I calculate the arithmetic mean of the three small stocks portfolios minus the arithmetic mean of the three Big stocks portfolios, and to construct the HML factor, I calculate the arithmetic mean of the two High BE/ME stock portfolios minus the arithmetic mean of the two Low BE/ME stock portfolios.

$$SMB_t{}^3 = \frac{\left(r_t^{S/L} + r_t^{S/M} + r_t^{S/H}\right) - \left(r_t^{B/L} + r_t^{B/M} + r_t^{B/H}\right)}{3}$$

$$HML_t = \frac{\left(r_t^{S/H} + r_t^{B/H}\right) - \left(r_t^{S/L} + r_t^{B/L}\right)}{2}$$

Carhart four-factor model adds a momentum factor to Fama-French three factor model. To calculate the momentum factor, I follow one of the 16 different strategies that Jagadeesh and Titman (1993) performed. I construct portfolios based on stocks' past six months continuously compounded returns lagged one month, and use a holding period of one year. Portfolios are formed based on their momentum returns on June of year t, and then they're held from July of year t to June of year t+1. I don't include overlapping portfolios over the holding periods.

Afterwards, WML factor is calculated in a similar manner to the HML factor. Stocks are ranked to three momentum groups based on their prior return: stocks that are below the 30^{th} percentile of prior return are labeled Losers, stocks that are above the 70^{th} percentile of prior return are labeled Winners, and stocks that are between the 30^{th} and the 70^{th} percentile of prior return are labeled Neutral. At the intersection of the two size groups and the three momentum groups, six portfolios are formed: SL, SN, SW, BL, BN, and BW. For each one of these portfolios, monthly value-weighted returns are calculated from January to June, then portfolios are rebalanced and monthly value-weighted returns are calculated from July to December. To construct the WML factor, I calculate the arithmetic mean of the two Winner stock portfolios minus the arithmetic mean of the two Loser stock portfolios.

$$WML_t = \frac{\left(r_t^{S/W} + r_t^{B/W}\right) - \left(r_t^{S/L} + r_t^{B/L}\right)}{2}$$

Fama-French five-factor model adds two additional factors to Fama-French three-factor model: profitability and investment. The operating profitability variable is calculated similar to Fama and French (2015), OP is calculated as Sales-COGS-SG&A-Interest and then it's divided by BE. Both variables are from December of

[3] Also referred to as SMB_{BM} , when constructing the factors of Fama-French five-factor model.

year t-1 and used to construct portfolios in June of year t. To calculate the profitability factor RMW, stocks are ranked to three groups based on their OP ratio: stocks whose OP ratio is below the 30th percentile are labeled Weak, stocks whose OP ratio is above the 70th percentile are labeled Robust, and stocks whose OP ratio is between the 30th and the 70th percentile are labeled Neutral. At the intersection of the two size groups and the three operating profitability groups, six portfolios are constructed: SW, SN, SR, BW, BN, and BR. For each one of these portfolios, monthly value-weighted returns are calculated from July of year t to June of year t+1. Two additional factors are then calculated: SMB_{OP} and RMW. To construct the SMB_{OP} factor, I calculate the arithmetic mean of the three small stocks portfolios minus the arithmetic mean of the three Big stocks portfolios, and to construct the RMW factor, I calculate the arithmetic mean of the two High OP/BE stock portfolios minus the arithmetic mean of the two Low OP/BE stock portfolios.

$$SMB_{OP} = \frac{\left(r_t^{S/R} + r_t^{S/N} + r_t^{S/W}\right) - \left(r_t^{B/R} + r_t^{B/N} + r_t^{B/W}\right)}{3}$$

$$RMW_t = \frac{\left(r_t^{S/R} + r_t^{B/R}\right) - \left(r_t^{S/W} + r_t^{B/W}\right)}{2}$$

I use total asset growth as a proxy for investment. The Investment ratio used to construct portfolios in June of year t is calculated as the percentage change in total assets from (December) fiscal year end year t-2 to (December) fiscal year end year t-1. To calculate the investment factor CMA, stocks are ranked to three groups based on their asset growth: stocks whose asset growth is below the 30th percentile are labeled Conservative, stocks whose asset growth is above the 70th percentile are labeled Aggressive , and stocks whose asset growth is between the 30th and the 70th percentile are labeled Neutral. At the intersection of the two size groups and the three asset growth groups, six portfolios are constructed: SC, SN, SA, BC, BN, and BA. Two additional factors are then calculated: SMB_{INV} and CMA. To construct the SMB_{INV} factor, I calculate the arithmetic mean of the three small stocks portfolios minus the arithmetic mean of the three Big stocks portfolios, and to construct the CMA factor, I calculate the arithmetic mean of the two Conservative asset growth stock portfolios minus the arithmetic mean of the two Aggressive asset growth stock portfolios.

$$SMB_{INV} = \frac{\left(r_t^{S/C} + r_t^{S/N} + r_t^{S/A}\right) - \left(r_t^{B/C} + r_t^{B/N} + r_t^{B/A}\right)}{3}$$

$$CMA_t = \frac{\left(r_t^{S/C} + r_t^{B/C}\right) - \left(r_t^{S/A} + r_t^{B/A}\right)}{2}$$

The SMB factor used in Fama-French five-factor model is the arithmetic average of the three SMB factors: SMB_{BM} ,SMB_{OP}, and SMB_{INV}.

$$SMB_t = \frac{SMB_{BM} + SMB_{OP} + SMB_{INV}}{3}$$

LHS portfolios

LHS portfolios are finer versions of the portfolios used to construct the RHS factors. I follow Davis et al. (2000) portfolio construction method, which they construct 3X3 two-dimensional portfolios, because the sample size in any given year is small, hence I wanted to ensure that portfolios are well-diversified.

To construct the LHS portfolios for Fama-French three-factor model, in June of year t stocks are sorted independently into three size groups and three BE/ME groups using the 33rd and the 67th percentiles as breakpoints for both variables. At the intersection of the three size and the three BE/ME groups, nine portfolios are constructed: SL, SM, SH, ML, MM, MH, BL, BM, and BH. The value weighted return of each portfolio is then calculated from July of year t to June of year t+1, then the excess returns of each one of the portfolios over the risk-free rate is used in the regression.

The LHS portfolios for the other models are constructed in a similar fashion. For Carhart model, LHS two-dimensional portfolios are constructed using size and momentum. Three different sets of 3X3 portfolios are used in Fama-French five-factor model: the first set of portfolios is constructed on size-BE/ME, the second set of portfolios is constructed on size-OP/BE, and the third set of portfolios is constructed on size-investment. In the CAPM regression, I run the model several times using the four different sets of LHS portfolios at hand.

3.3 The GRS test

This thesis uses the GRS test statistic that is proposed by Gibbson et al. (1989), to evaluate the performance of the different asset pricing models. The GRS test statistic is calculated as follows:

$$GRS = \left(\frac{T}{N}\right)\left(\frac{T-N-L}{T-L-1}\right)\left[\frac{\hat{\alpha}'\widehat{\Sigma}^{-1}\hat{\alpha}}{1+\bar{\mu}'\widehat{\Omega}^{-1}\bar{\mu}}\right]$$

Where T[4] represents the size of the sample, N[5] is the number of LHS portfolios, L[6] is the number of RHS portfolios, $\hat{\alpha}$ is an NX1 vector of the intercepts of the regression, $\hat{\Sigma}$ is the covariance matrix of residuals of the sample,$\bar{\mu}$ is an LX1 vector of the means of the explanatory factors, and $\hat{\Omega}$ is the covariance matrix of the explanatory factors in the sample.

The null hypothesis states that all regression intercepts (mispricing) are jointly equal to zero. The GRS test statistic follows an F distribution with degrees of freedom of N and T-N-L. If the null hypothesis is rejected, this means that the asset pricing model is an incomplete description of asset returns.

The thesis also reports separately $SR(\alpha)$, following the suggestions of Lewllen et al. (2010).

$$SR(\alpha) = \hat{\alpha}'\widehat{\Sigma}^{-1}\hat{\alpha}$$

$SR(\alpha)$ can be referred to as the intercepts' Sharpe ratio. It helps in estimating the precision of the alphas by combining the intercepts of the regression with the covariance matrix of the residuals. The lower the $SR(\alpha)$, the better the model is.

[4] T used in the GRS test of all models is 132.
[5] N used in the GRS test of all models is 9.
[6] For the CAPM L=1, for Fama-French 3-factor model L=3, for Carhart model L=4, and for Fama-French 5-factor model L=5.

Chapter 4

Data and Summary Statistics

4.1 Data

My stock prices and accounting data are from Thomson Reuters Datastream. The sample period is starting June 2005 to July 2016. All items are in USD and the US 1-month Treasury bill rate is used as a proxy for the risk-free rate. The reason I use USD currency is in order to control for the volatility inherent to the EGP foreign exchange rate. Also performing the analysis in USD allows risk-return relationship to be analyzed from the perspective of an international investor.

The sample is restricted to stocks that are categorized as common equity and that are listed on the Egyptian stock market. So, Egyptian stocks that are listed on foreign markets as well as investment types that are other than common equity, such as; ADRs, GDRs, and ETFs are not part of the sample. To avoid survivorship bias, Dead stocks and Suspended stocks are included in addition to Active stocks.

To be included in the sample from July of year t to June of year t+1, a stock must have the following: Price and number of shares outstanding data on June of year t and December of year t-1, and book value and deferred taxes data on December (fiscal year end) of year t-1.

As in Fama and French (1993, 2015), I form portfolios on June of each year t using accounting data from December of year t-1. This ensures that accounting data is known at the time of portfolio construction.

4.2 Variables Definitions

- Market Equity (ME) also referred to as Size in this thesis: It's calculated as adjusted closing price on the last trading day of the month multiplied by the number of shares outstanding (WC05301[7]).
- Book Equity (BE): Following Schmidt (2011), the book equity variable is calculated as the book value of common equity (WC03501) plus deferred taxes (WC03263). Firms with negative book value aren't included in calculating the breakpoints of BE/ME whether for the RHS or LHS portfolios. However, they're included in the RM market portfolios, as well as in calculating momentum, profitability, and investment factors.
- Book-to-Market ratio (BE/ME): To form portfolios in June of year t, BE from December of year t-1 (which is fiscal year end of the majority of firms trading on the Egyptian stock exchange), divided by ME calculated on December of year t-1.
- Operating Profit (OP): It's calculated as EBITDA (WC18198) minus interest expense (WC01251).
- Operating Profitability ratio (OP/BE): It's calculated using OP and BE in (December) fiscal year end of year t-1 to construct portfolios in June of year t.
- Investment: It's the growth in total assets (WC02999). The Investment ratio used to construct portfolios in June of year t is calculated as the percentage change in total assets from (December) fiscal year end year t-2 to (December) fiscal year end year t-1.

[7] The definition of the different Worldscope variables is available online at Worldscope database datatype definitions guide.

4.3 The Number of stocks used in each one of the different RHS and LHS portfolios

This section presents the number of stocks in each one of the different portfolios constructed.

Size-BM portfolios

Year	SL	SM	SH	BL	BM	BH	Total
2005	2	12	18	17	14	1	64
2006	3	23	21	26	14	7	94
2007	4	24	28	29	21	5	111
2008	7	26	27	29	21	9	119
2009	13	27	19	22	20	16	117
2010	15	21	25	21	28	11	121
2011	12	27	21	24	22	15	121
2012	12	29	22	26	21	16	126
2013	9	29	23	28	19	14	122
2014	12	28	22	25	22	15	124
2015	8	28	23	28	18	13	118

Table 1: Number of stocks in each one of the RHS Size-BM portfolios each year

Year	SL	SM	SH	ML	MM	MH	BL	BM	BH	Total
2005	1	7	13	4	11	7	16	4	1	64
2006	2	14	16	7	11	13	23	6	2	94
2007	4	9	24	9	17	11	24	11	2	111
2008	5	13	21	7	21	13	27	7	5	119
2009	10	13	16	9	14	16	20	12	7	117
2010	13	12	15	10	13	18	17	16	7	121
2011	8	15	17	12	12	17	20	14	6	121
2012	9	17	16	11	12	18	22	12	9	126
2013	6	19	15	9	14	19	25	9	6	122
2014	7	18	16	13	16	13	21	8	12	124
2015	6	18	15	9	14	17	24	8	7	118

Table 2: Number of stocks in each one of the LHS Size-BM portfolios each year

Size-Momentum portfolios

	SL	SN	SW	BL	BN	BW	Total
2005	5	12	4	7	6	8	42
2006	10	15	5	8	10	13	61
2007	17	14	15	12	21	13	92
2008	8	8	10	8	12	6	52
2009	12	19	23	21	23	10	108
2010	30	20	6	5	23	28	112
2011	20	26	14	17	22	22	121
2012	22	28	9	14	20	25	118
2013	24	25	11	12	24	25	121
2014	3	5	2	3	4	4	21
2015	25	23	12	11	26	24	121

Table 3: Number of stocks in each one of the RHS Size-Momentum portfolios each year

	SL	SN	SW	ML	MN	MW	BL	BN	BW	Total
2005	5	6	3	5	4	5	4	4	6	42
2006	10	8	2	6	5	10	4	8	8	61
2007	12	8	11	6	12	12	13	10	8	92
2008	7	5	5	5	6	7	5	7	5	52
2009	9	11	16	8	16	12	17	14	5	108
2010	20	11	6	13	17	8	3	11	23	112
2011	20	13	7	8	18	15	13	9	18	121
2012	20	16	3	10	19	11	9	10	20	118
2013	21	14	5	12	12	17	7	15	18	121
2014	3	3	1	2	2	3	2	2	3	21
2015	20	15	5	12	16	13	7	11	22	121

Table 4: Number of stocks in each one of the LHS Size-Momentum portfolios each year

Size-Operating Profitability portfolios

	SC	SN	SA	BC	BN	BA	Total
2005	9	6	4	3	8	8	38
2006	14	10	6	4	14	12	60
2007	13	18	7	10	13	16	77
2008	17	15	9	8	17	16	82
2009	18	15	9	8	18	17	85
2010	21	16	9	7	21	19	93
2011	23	19	9	8	22	22	103
2012	22	24	9	11	20	24	110
2013	13	21	11	14	16	16	91
2014	17	15	13	10	22	14	91
2015	15	17	10	10	17	15	84

Table 5: Number of stocks in each one of the RHS Size-OP portfolios each year

	SC	SN	SA	MC	MN	MA	BC	BN	BA	Total
2005	6	2	5	5	6	1	2	4	7	38
2006	11	5	4	8	8	4	1	7	12	60
2007	11	11	4	6	10	9	9	4	13	77
2008	11	10	6	11	10	7	5	8	14	82
2009	11	10	7	14	9	6	3	10	15	85
2010	15	10	6	14	10	7	2	11	18	93
2011	17	9	8	15	14	6	2	12	20	103
2012	17	15	4	12	16	10	7	7	22	110
2013	12	12	6	8	14	9	10	5	15	91
2014	14	8	8	8	13	10	8	10	12	91
2015	12	8	8	8	10	10	8	10	10	84

Table 6: Number of stocks in each one of the LHS Size-OP portfolios each year

Size-Investment portfolios

	SC	SN	SA	BC	BN	BA	Total
2005	7	8	3	4	6	8	36
2006	5	10	6	8	7	7	43
2007	12	15	5	7	10	16	65
2008	16	23	12	15	18	19	103
2009	19	21	14	14	22	19	109
2010	19	24	17	17	24	19	120
2011	22	17	19	13	30	16	117
2012	22	25	12	15	21	24	119
2013	20	19	18	15	26	17	115
2014	18	28	15	19	21	22	123
2015	19	23	17	17	24	19	119

Table 7: Number of stocks in each one of the RHS Size-Investment portfolios each year

	SC	SN	SA	MC	MN	MA	BC	BN	BA	Total
2005	3	6	3	6	2	4	3	4	5	36
2006	3	5	6	6	5	4	5	5	4	43
2007	11	10	1	7	6	8	4	5	13	65
2008	11	14	9	13	10	12	10	11	13	103
2009	16	13	7	8	15	14	12	9	15	109
2010	14	15	11	13	15	12	13	10	17	120
2011	18	8	13	12	15	12	9	16	14	117
2012	16	15	8	18	10	13	5	16	18	119
2013	14	10	14	14	15	10	10	14	14	115
2014	14	10	17	14	20	7	13	11	17	123
2015	13	13	13	16	14	11	10	14	15	119

Table 8: Number of stocks in each one of the LHS Size-Investment portfolios each year

4.4 Summary Statistics

This section summarizes the explanatory returns and the dependent returns used in the different asset pricing models. The average returns of the explanatory portfolios give an indication of the average return premium per unit of risk for the particular risk-factor that the RHS portfolio mimics. The average excess returns of the dependent variables represent the variation in stock returns that the asset pricing models attempt to explain.

Explanatory Returns

In presenting the summary statistics of explanatory returns, this thesis presents the summary statistics of Fama-French five-factor model separately from the other models. This is because Fama-French five-factor model constructs the SMB factor differently. The summary statistics and the correlation matrix of the factors used in the CAPM, Fama-French three-factor model, and Carhart four-factor model is presented in tables 9 and 11. Whereas, the summary statistics and the correlation matrix of the factors used in Fama-French five-factor model is presented in tables 10 and 12.

	RMRF	*SMB*	*HML*	*HMLs*	*HMLb*	*HML s-b*	*WML*	*WMLs*	*WMLb*	*WML s-b*
Mean (%)	-0.82	1.01	8.93	-0.14	0.39	-0.53	-0.93	-0.21	-0.73	0.52
Std Dev(%)	8.10	6.43	1090.31	6.56	3.27	7.65	6.26	4.15	4.38	5.80
T-statistic	-1.16	1.80	0.09	-0.25	1.35	-0.80	-1.71	-0.57	-1.91	1.03

Table9: Summary statistics of explanatory variables used in CAPM, Fama-French 3-factor model, and Carhart model

As exhibited in table 9, the mean returns of the market factor is -0.82% (t=-1.16). There is a size premium of 1.01% (t=1.8), and a value premium of 8.93% (t=0.09). The means are not significant except for WMLb and SMB. Contrary to Fama and French (1993) findings, the value premium of Big stocks is larger than the value premium of Small stocks, 0.39% (t=1.35) versus -0.14% (t=-0.25), and the difference between the two premiums is -0.53% (t= -0.80). There is no evidence of momentum returns in the Egyptian stock returns, with the mean return of WML factor being -0.93% (t=-1.71). The mean return of WML factor is greater in Small stocks than in

Big stocks, -0.21% (t=-0.57) versus -0.73% (t=-1.91), and the difference between the two premiums is 0.52% (t= 1.03).

	SMB	*RMW*	*RMW s*	*RMW b*	*RMW s-b*	*CMA*	*CMAs*	*CMA b*	*CMA s-b*
Mean (%)	1.07	0.06	0.26	-0.20	0.47	-0.48	-0.13	-0.34	0.21
Std Dev (%)	5.68	6.37	4.10	3.71	4.53	6.76	4.62	4.22	5.71
t-statistic	2.16	0.10	0.73	-0.63	1.18	-0.81	-0.33	-0.94	0.42

Table 10: Summary statistics of explanatory variables used in Fama-French five-factor model

As exhibited in table 10, similar to the results of the factors used in Fama-French three-factor model, there appears to be a Size premium in the factors used in Fama-French five-factor model. The Size premium is close to 1.07% (t=2.16), and it is the only significant premium among all other variables that are listed in table 10. The results show a slight profitability premium of 0.06% (t=0.10), that is greater for small stocks than in Big stocks, 0.26% (t=0.73) versus -0.20% (t=-0.63), and the difference being 0.47 %,(t=1.18). There is no evidence of the presence of an investment effect in the mean returns of the explanatory variables with the mean return of portfolios used to construct CMA factor being -0.48% (t=-0.81). The mean return associated with the investment factor is greater for small Stocks than for Big stocks, -0.13% (t=-0.33) versus -0.34% (t=-0.94), and the difference between them is 0.21% (t= 0.42).

	RMRF	SMB*	HML	WML
RMRF	1.00	0.15	0.03	-0.22
SMB		1.00	0.19	-0.01
HML			1.00	-0.03
WML				1.00

Table 11: Correlation matrix between the explanatory variables used in CAPM, Fama-French three-factor model, and Carhart model

	RMRF	SMB	HML	RMW	CMA
RMRF	1.00	0.04	0.03	-0.39	-0.02
SMB		1.00	0.19	-0.09	-0.13
HML			1.00	-0.14	0.08
RMW				1.00	-0.19
CMA					1.00

Table 12: Correlation matrix between the explanatory variables used in Fama-French five-factor model

Table 11 shows that there is a negative correlation between the momentum factor and each one of: the market factor, the size factor, and the value factor. Table 12 shows that there is a negative correlation between the market factor and each one of: the profitability factor and the investment factor. It also shows a negative correlation between the size factor and each one of: the profitability factor and the investment factor. In addition, there is a negative correlation between the value factor and the profitability factor, and between the profitability factor and the investment factor. Factors that are positively correlated in table 11 and table 12, are much less than being perfectly positively correlated. So it can be assumed that the different portfolios used in the models are well-diversified.

Dependent Returns

	Means	Std Dev	t-Mean
1 (SL)	2.28%	21.81%	1.20
2 (SM)	-0.15%	11.25%	-0.15
3 (SH)	1.26%	11.57%	1.25
4 (ML)	0.47%	12.21%	0.44
5 (MM)	-0.63%	9.31%	-0.78
6 (MH)	-0.28%	9.72%	-0.33
7 (BL)	-0.94%	8.08%	-1.33
8 (BM)	-0.84%	8.60%	-1.12
9 (BH)	-0.25%	9.84%	-0.29

Table 13[8]: Summary statistics for the dependent variable (excess returns over the risk-free rate) for Size-BM portfolios

Table 13 presents summary statistics for the dependent variables when portfolios are constructed using Size-BM dimensions. The portfolios provide evidence that there is a negative relationship between size and average returns. For each level of BM ratio; mean returns decrease as we go from Small stocks to Big stocks. There is no evidence of Value effect in the mean returns examined. The presence of a value effect implies that stock returns should increase as we go low BM stocks to high BM stocks. However, this pattern isn't observed in the results presented in table 13. All of the mean returns presented are less than two standard errors from zero. This can be

[8]S, M, and B represent Small, Medium, and Big, while L, M, and H represent Low, Medium, and High BM

attributed to the high standard deviation of mean returns which range from 8.08% to 21.81%.

	Means	Std Dev	t-Mean
1 (SL)	0.97%	11.38%	0.97
2 (SN)	0.14%	13.88%	0.11
3 (SW)	1.40%	14.11%	1.14
4 (ML)	0.11%	11.23%	0.12
5 (MN)	0.89%	10.95%	0.93
6 (MW)	-0.16%	11.02%	-0.17
7 (BL)	0.00%	10.33%	0.01
8 (BN)	-0.19%	10.10%	-0.21
9 (BW)	-1.57%	8.64%	-2.08

Table 14: [9]Summary statistics for the dependent variable (excess returns over the risk-free rate) for Size-Momentum portfolios

Table 14 presents summary statistics for the dependent variable when portfolios are constructed using Size-Momentum dimensions. By examining the results, a clear size effect is observed with mean returns decreasing as we go from Small stocks to Big stocks for every category of momentum. There is no evidence of a momentum effects in the average stock returns. The presence of the momentum effect implies that returns should increase as we go from portfolios with low momentum returns to portfolios with high momentum returns. However, this pattern isn’t observed in the results presented in table 14. Most of the mean returns presented are less than two standard errors from zero. This can be attributed to the high standard deviation of mean returns which ranges from 10.10% to 14.11%. Only one portfolio is slightly greater than two standard errors away from zero. The Big-Winner portfolio (BW) is -2.08 standard errors away from the zero, and it has a standard deviation of 8.64%.

[9]S, M, and B represent Small, Medium, and Big, while L, N, and W represent Loser, Neutral, and Winner

	Means	Std Dev	t-Mean
1 (SW)	1.16%	14.44%	0.92
2 (SN)	0.22%	11.91%	0.22
3 (SR)	1.00%	13.90%	0.82
4 (MW)	-1.02%	10.67%	-1.10
5 (MN)	-0.31%	8.64%	-0.41
6 (MR)	1.38%	12.63%	1.25
7 (BW)	-1.46%	12.86%	-1.30
8 (BN)	2.17%	38.28%	0.65
9 (BR)	-1.38%	7.59%	-2.09

Table 15: [10]Summary statistics for the dependent variable (excess returns over the risk-free rate) for Size-OP portfolios

Table 15 presents summary statistics for the dependent variable when portfolios are constructed using Size-Operating Profitability dimensions. The size effect is evident only in portfolios with weak operating, where mean returns decreases from 1.16% in SW to -1.02% in MW to -1.46% BW. This pattern isn't observed in portfolios with neutral and robust operating profitability. A profitability effect is present in Middle and Big size groups only, where portfolios with high operating profitability have higher mean returns than portfolios with low operating profitability. Portfolios MR and BR have higher returns than portfolios MW and BW, 1.38% and -1.38% versus -1.02% and -1.46% respectively. Most of the mean returns presented are less than two standard errors from zero. This can be attributed to the high standard deviation of mean returns which ranges from 8.64% to 38.28%. Only one portfolio is slightly greater than two standard errors away from zero. The Big-Robust (BR) portfolio is -2.09 standard errors away from the zero, and it has a standard deviation of 7.59%.

[10]S, M, and B represent Small, Medium, and Big, while W,N, and R represent Weak, Neutral, and Robust Operating Profitability

	Means	Std Dev	t-Mean
1 (SC)	0.77%	13.88%	0.64
2 (SN)	0.14%	10.28%	0.16
3 (SA)	0.63%	16.10%	0.45
4 (MC)	-0.79%	9.36%	-0.97
5 (MN)	-0.61%	9.74%	-0.71
6 (MA)	-0.63%	9.55%	-0.76
7 (BC)	-1.38%	8.99%	-1.76
8 (BN)	-1.16%	7.56%	-1.76
9 (BA)	-1.04%	8.76%	-1.36

Table 16: [11]Summary statistics for the dependent variable (excess returns over the risk-free rate) for Size-Investment portfolios

Table 16 presents summary statistics for the dependent variable when portfolios are constructed using Size-Investment dimensions. By examining the results, a clear size effect is observed with mean returns decreasing as we go from Small stocks to Big stocks, for every category of investment. The investment effect is witnessed in the smallest size groups only where the mean returns of low investment portfolios are higher than the mean returns of high investment portfolios. The mean return of SC portfolio is 0.77% versus the mean return of SA portfolio which is 0.63%. All of the mean returns presented are less than two standard errors from zero. This can be attributed to the high standard deviation of mean returns which range from 7.56% to 16.10%.

I believe that the conflicting interpretation of the results of the mean returns of LHS and RHS factors can be attributed to the fact that LHS portfolios include the whole sample of stocks. On the other hand, RHS portfolios eliminate more than one third of the stocks in the sample (stocks with middle B/M, stocks with neutral momentum, stocks with neutral operating profitability, and stocks with neutral asset growth). A good idea might be to try constructing the RHS portfolios using 2X2 sorts instead of 2X3 sorts as Fama and French (2015) do.

[11]S, M, and B represent Small, Medium, and Big, while C,N, and A represent Conservative, Neutral, and Aggressive Asset growth (Investment)

Chapter 5

Results

This chapter presents the results of the different asset-pricing models performed in this thesis. Sections 5.1 to 5.4 present the results of the different models, and section 5.5 examines the results of the GRS test and compares the Sharpe ratio of the intercepts of the different asset-pricing models used.

5.1 The results of the CAPM

This thesis tests the CAPM using four different sets of portfolios to construct the dependent variable, which is the excess return of the portfolio over the risk-free rate. The four sets of portfolios used are: Size-BM portfolios (table 17), Size-Momentum portfolios (table 18), Size-Operating Profitability portfolios (table 19), and Size-Investment portfolios (table 20).

Table 17 presents the results of the CAPM when Size-BM portfolios are used to construct the dependent variables. The average adjusted R^2 of the model is 62.44%. Evidently, the RMRF factor leaves some of the variation in the cross-section of stock returns unexplained.

According to Merton (1973), the intercepts of a well-specified asset pricing model should be close to zero. By examining the results in table 17, it is observed that when Size-BM portfolios are used to construct the dependent variables, the number of significant alphas is three out of nine. When RMRF is the only independent variable used, a size effect appears in the intercepts with the intercepts of Small stock portfolios being greater than the intercepts of Big stock portfolios.

Looking at the coefficients of the market factor, all coefficients are close to one and have a strong statistical significance. By examining the sizes of the market coefficients, it’s observed that the Small-Low BM stock portfolio has a higher beta than the Big-High BM stock portfolio. This observation is consistent with theory, as riskier portfolios should offer higher returns to investors than what is offered by less risky ones.

	α		bi			
Portfolio	Coeff.	t-stat	Coeff.	t-stat	Adj R2 (%)	SE
1 (SL)	0.03	1.88* (0.06)	1.18	5.54 *** (0.00)	18.46	0.20
2 (SM)	0.01	1.14 (0.26)	1.07	13.65*** (0.00)	58.59	0.07
3 (SH)	0.02	3.15*** (0.00)	1.07	12.78*** (0.00)	55.33	0.08
4 (ML)	0.01	1.98** (0.05)	1.14	13.08*** (0.00)	56.48	0.08
5 (MM)	0.00	0.37 (0.71)	0.97	18.20*** (0.00)	71.60	0.05
6 (MH)	0.01	0.99 (0.32)	0.96	15.26*** (0.00)	63.90	0.06
7 (BL)	0.00	-0.87 (0.39)	0.97	45.48*** (0.00)	94.04	0.02
8 (BM)	0.00	-0.24 (0.81)	0.91	19.33*** (0.00)	73.99	0.04
9 (BH)	0.01	1.21 (0.23)	1.01	17.33*** (0.00)	69.56	0.05

Table 17: [12]The results of the CAPM using Size-BM portfolios to construct the dependent variables

Table 18 presents the results of the CAPM when Size-Momentum portfolios are used to construct the dependent variables. The average adjusted R^2 of the model is 56.34%. By examining the regression results, it is observed that using the excess returns of Size-Momentum portfolios as dependent variables produces the least-specified version of the CAPM tested in this thesis, with six of the nine alphas significant either at 1%, 5%, or 10% significance levels. Similar to the results in table 17, there is an evident size effect in the intercepts when the only explanatory variable used is RMRF, the intercepts of Small stock portfolios are larger than the intercepts of Big stock portfolios.

By examining the coefficients of the market factor, it's observed that all coefficients are close to one and have strong statistical significance. Also the market coefficient of the Small-Loser portfolio is larger than the market coefficient of the Big-Winner portfolio. This is consistent with theory as portfolios with higher risk should provide investors with higher returns than portfolios with lower risk.

[12]*** denotes the significance at 1%, ** denotes the significance at 5%, and * denotes the significance at 10%.

	α		bi			
	Coeff	t-stat	Coeff	t-stat	Adj R2 (%)	SE
1 (SL)	0.02	2.20** (0.03)	0.89	9.39*** (0.00)	39.93	0.09
2 (SN)	0.01	1.73* (0.09)	1.37	15.31*** (0.00)	64.04	0.08
3 (SW)	0.02	1.89* (0.06)	0.82	6.10*** (0.00)	21.64	0.12
4 (ML)	0.01	1.68* (0.09)	1.10	14.85*** (0.00)	62.63	0.07
5 (MN)	0.02	3.24*** (0.00)	1.11	16.22*** (0.00)	66.69	0.06
6 (MW)	0.01	1.21 (0.23)	1.08	14.83*** (0.00)	62.56	0.07
7 (BL)	0.01	1.62 (0.11)	1.04	16.07*** (0.00)	66.26	0.06
8 (BN)	0.01	1.30 (0.20)	1.03	16.68*** (0.00)	67.91	0.06
9 (BW)	-0.01	-1.82* (0.07)	0.80	12.79*** (0.00)	55.39	0.06

Table 18: [13]The results of the CAPM using Size-Momentum portfolios to construct the dependent variables

Table 19 presents the results of the CAPM when Size-OP portfolios are used to construct the dependent variables. The average adjusted R^2 of the model is 51.88%. By examining the results, it's observed that the number of significant alphas is four out of the nine portfolios used in the tests. There is a size effect in the intercepts in the results presented in Table 19 as well. The intercepts of Small stock portfolios are larger than the intercepts of Big stock portfolios. However, this pattern isn't observed in stock portfolios that have neutral operating profitability. The intercept of the SN portfolios is smaller than the intercept of BN portfolio, 0.01 versus 0.04. The coefficient of the market factor is close to one and has a high statistical significance in the nine portfolios tested. Also the market coefficient of the Small-Weak Operating profitability portfolio is larger than the market coefficient of the Big-Robust

[13]*** denotes the significance at 1%, ** denotes the significance at 5%, and * denotes the significance at 10%.

Operating profitability portfolio. Hence, investors should earn higher returns if they choose to invest in the riskier portfolio.

	α		bi			
	Coeff	t-stat	Coeff	t-stat	Adj R2 (%)	SE
1 (SW)	0.02	2.65*** (0.009)	1.33	12.75*** (0.00)	55.22	0.10
2 (SN)	0.01	1.52 (0.13)	1.07	12.03*** (0.00)	52.32	0.08
3 (SR)	0.02	2.10** (0.04)	1.13	10.06*** (0.00)	43.32	0.10
4 (MW)	0.00	-0.26 (0.8)	1.08	16.13*** (0.00)	66.44	0.06
5 (MN)	0.00	0.78 (0.43)	0.83	14.22*** (0.00)	60.58	0.05
6 (MR)	0.02	2.33** (0.02)	0.90	8.02*** (0.00)	32.60	0.10
7 (BW)	-0.01	-0.70 (0.49)	1.07	10.49*** (0.00)	45.43	0.10
8 (BN)	0.04	1.46 (0.15)	2.47	6.98*** (0.00)	26.69	0.33
9 (BR)	-0.01	-2.58** (0.01)	0.86	26.59*** (0.00)	84.35	0.03

Table 19: [14]The results of the CAPM using Size-OP portfolios to construct the dependent variables

Table 20 presents the results of the CAPM when Size-Investment portfolios are used to construct the dependent variables. The average adjusted R^2 of the model is 61.49%. By comparing the results in this table to the results presented in tables 17 to 19, it's observed that Size-Investment portfolios produce the least mispricing among all other versions of the CAPM, with only one significant intercept. Also the adjustedR^2, is the second highest, slightly higher than the adjusted R^2 when Size-BM portfolios are used to construct the dependent variables. Similar to the results presented in the previous tables, it is observed that when only RMRF is used as an explanatory variable, there is

[14]*** denotes the significance at 1%, ** denotes the significance at 5%, and * denotes the significance at 10%.

an obvious size effect in the intercepts, with the intercepts of small stock portfolios being greater than the intercepts of big stock portfolios.

The coefficient of the market factor is close to one, and it has a high statistical significance in the nine portfolios tested. Also the coefficient of the market factor for the Small-Conservative investment portfolio is higher than the coefficient of the market factor for the Big-Aggressive investment portfolio. This ensures that investors who choose to invest in the riskier portfolio should expect to earn higher returns.

	α		bi			
	Coeff	t-stat	Coeff	t-stat	Adj R2	SE
1 (SC)	0.02	2.01** (0.047)	1.20	11.16*** (0.00)	48.52	0.10
2 (SN)	0.01	1.35 (0.18)	0.89	11.30*** (0.00)	49.15	0.07
3 (SA)	0.02	1.6 (0.11)	1.31	10.04*** (0.00)	43.24	0.12
4 (MC)	0.00	-0.16 (0.88)	0.87	12.94*** (0.00)	55.95	0.06
5 (MN)	0.00	0.46 (0.65)	1.01	17.47*** (0.00)	69.91	0.05
6 (MA)	0.00	0.27 (0.79)	0.94	15.23*** (0.00)	63.80	0.06
7 (BC)	-0.01	-1.6 (0.11)	0.99	22.45*** (0.00)	79.33	0.04
8 (BN)	0.00	-1.56 (0.12)	0.82	21.49*** (0.00)	77.86	0.04
9 (BA)	0.00	-0.73 (0.47)	0.86	14.84*** (0.00)	62.58	0.05

Table 20: [15]The results of the CAPM using Size-Investment portfolios to construct the dependent variables

[15]*** denotes the significance at 1%, ** denotes the significance at 5%, and * denotes the significance at 10%.

5.2 The Results of Fama-French three-factor model

Table 21 presents the results of Fama-French three-factor model. This model uses three explanatory factors: RMRF, SMB, and HML. The dependent variable used is the excess returns over the risk-free rate of the 3X3 Size-BM portfolios.

It's evident that Fama-French three-factor model has a better specification than the CAPM with only two significant intercepts, one of them having a weak significance. The average adjusted $R^2$is also higher (being 70.84%). The intercept of the Small-Low BM portfolio isn't significant when the model is performed on the Egyptian stock returns. In the test on the US market performed by Fama and French (1993), this portfolio represents a challenge to the three-factor model to the extent that it causes the model to be rejected.

Similar to the results obtained before, the coefficient of the market factor has strong significance in the nine portfolios constructed. By examining the SMB factor, it is observed that the SMB factor has strong significance in six out of the nine portfolios used in the model. It also has a weak significance in one portfolio and it's not significant in one portfolio. Similar to the results obtained by Fama and French (1993), the coefficients of SMB decrease as we go from Small to Big with the SMB coefficients of Small portfolios having positive loadings and the coefficients of Big portfolios having negative loadings.

By examining the significance of the HML factor in the model, it appears that there is no value effect in the Egyptian stock returns. The HML factor has a strong significance in one portfolio only out of the nine portfolios used in the regression. Actually this finding contradicts that of Taha and El Giziry (2016), who find a significant value effect in the Egyptian stock returns. They use BE/ME and E/P ratios in their attempt to explain the variation in stock returns, and eventually they find evidence that supports the significance of both factors, as well as one that suggests the failure of BE/ME to capture the variation in stock returns that is attributed to E/P. I think the reason for the divergence of the evidence in favor of/against the BE/ME ratio in Taha and El Giziry (2016) and in this thesis, can be attributed to using a different sample of stocks and constructing the HML factor differently.

5.3 The Results of Carhart four-factor model

The results of Carhart model are presented in tables 22 and 23. Carhart model employs four explanatory variables: RMRF, SMB, HML, and WML. For the dependent variable, this thesis uses the excess returns over the risk-free rate of two different sets of portfolios: the 3X3 Size-BM portfolios (table 22) and the 3X3 Size-Momentum portfolios (table 23).

Table 22 presents the results of Carhart model when Size-BM portfolios are used to construct the dependent variables. The average adjusted R^2 is slightly higher than that of the Fama-French three-factor model (71.22%). The model appears better-specified than the CAPM with significant alphas falling to one significant alpha only.

The results obtained for RMRF, SMB, and HML are close to what was discussed in the results of Fama-French three-factor model. Moving to WML factor, it's observed that when the excess returns over the risk-free rate of Size-BM portfolios is used in the model, the coefficients of WML factor is significant in five out of nine portfolios. There is a strong significance in one portfolio, significance in two portfolios, and a weak significance in two portfolios.

Table 23 presents the results of Carhart model when Size-Momentum portfolios are used to construct the dependent variables. Surprisingly, the average adjusted R^2 is lower when Size-Momentum portfolios are used to construct the dependent variables (65.13%), than when Size-BM portfolios are used (71.22%).

The results obtained for RMRF, SMB, and HML are close to what was discussed in the results of Fama-French three-factor model. Proceeding to WML factor, when the excess returns over the risk-free rate of Size-Momentum portfolios are used in the regression, slightly better results are obtained than when the excess returns of Size-BM portfolios are used in the regression. The coefficient of WML is significant in six portfolios: it has a strong significance in five out of the nine portfolios and it has significance in one portfolio.

	α		bi		si		hi			
	Coeff α	t-stat α	Coeff bi	t-stat bi	Coeff si	t-stat si	Coeff hi	t-stat hi	Adj R2 (%)	SE
1 (SL)	0.01	1.00 (0.32)	0.98	5.41*** (0.00)	1.58	6.67*** (0.00)	0.00	1.49 (0.14)	42.58	0.17
2 (SM)	0.00	0.17 (0.87)	1.00	14.37*** (0.00)	0.57	6.30*** (0.00)	0.00	-1.41 (0.16)	67.92	0.06
3 (SH)	0.01	2.38** (0.02)	0.97	14.66*** (0.00)	0.76	8.72*** (0.00)	0.00	-0.06 (0.95)	72.35	0.06
4 (ML)	0.01	1.16 (0.25)	1.06	13.67*** (0.00)	0.59	5.83*** (0.00)	0.00	0.36 (0.72)	65.96	0.07
5 (MM)	0.00	-0.79 (0.43)	0.92	20.05*** (0.00)	0.41	6.81*** (0.00)	0.00	0.31 (0.76)	79.45	0.04
6 (MH)	0.00	0.29 (0.77)	0.92	15.36*** (0.00)	0.34	4.27*** (0.00)	0.00	-1.41 (0.16)	67.91	0.06
7 (BL)	0.00	-0.52 (0.61)	0.97	46.42*** (0.00)	-0.05	-1.89* (0.06)	0.00	-1.63 (0.11)	94.33	0.02
8 (BM)	0.00	-0.18 (0.86)	0.92	19.03*** (0.00)	-0.02	-0.35 (0.73)	0.00	0.82 (0.41)	73.72	0.04
9 (BH)	0.01	1.85* (0.07)	1.04	18.73*** (0.00)	-0.25	-3.46* (0.00)	0.00	3.78*** (0.00)	73.36	0.05

Table 21: [16]The results of Fama-French three-factor model

[16]*** denotes the significance at 1%, ** denotes the significance at 5%, and * denotes the significance at 10%.

	α		bi		si		hi		wi			
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Adj R2 (%)	SE
1 (SL)	0.01	0.72 (0.47)	0.91	4.98*** (0.00)	1.57	6.67*** (0.00)	0.00	1.48 (0.14)	-0.39	-1.66* (0.10)	43.36	0.16
2 (SM)	0.00	-0.19 (0.85)	0.97	13.8*** (0.00)	0.57	6.33*** (0.00)	0.00	-1.47 (0.14)	-0.20	-2.18** (0.03)	68.83	0.06
3 (SH)	0.01	2.34** (0.02)	0.97	14.28*** (0.00)	0.76	8.68*** (0.00)	0.00	-0.06 (0.95)	0.00	-0.01 (0.99)	72.13	0.06
4 (ML)	0.01	0.94 (0.35)	1.04	13.13*** (0.00)	0.59	5.81*** (0.00)	0.00	0.34 (0.73)	-0.13	-1.31 (0.19)	66.16	0.07
5 (MM)	0.00	-1.1 (0.27)	0.91	19.41*** (0.00)	0.41	6.83*** (0.00)	0.00	0.28 (0.78)	-0.11	-1.89* (0.06)	79.86	0.04
6 (MH)	0.00	0.18 (0.86)	0.91	14.85*** (0.00)	0.34	4.24*** (0.00)	0.00	-1.41 (0.16)	-0.05	-0.64 (0.52)	67.76	0.06
7 (BL)	0.00	0.12 (0.91)	0.99	48.78*** (0.00)	-0.05	-1.89* (0.06)	0.00	-1.66 (0.10)	0.10	3.97*** (0.00)	94.92	0.02
8 (BM)	0.00	-0.56 (0.57)	0.89	18.44*** (0.00)	-0.03	-0.41 (0.68)	0.00	0.8 (0.42)	-0.14	-2.3** (0.02)	74.57	0.04
9 (BH)	0.01	1.64 (0.10)	1.03	18.1*** (0.00)	-0.25	-3.49*** (0.00)	0.00	3.77*** (0.00)	-0.08	-1.12 (0.26)	73.41	0.05

Table 22: [17]Results of Carhart model when Size-BM portfolios are used to construct the dependent variables

[17] *** denotes the significance at 1%, ** denotes the significance at 5%, and * denotes the significance at 10%.

	α		bi		si		hi		wi			
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Adj R2 (%)	SE
1 (SL)	0.00	0.69 (0.49)	0.73	9.15*** (0.00)	0.69	6.74*** (0.00)	0.00	-0.57 (0.57)	-0.45	-4.39*** (0.00)	60.03	0.07
2 (SN)	0.01	0.9 (0.37)	1.30	14.74*** (0.00)	0.42	3.71*** (0.00)	0.00	0.21 (0.83)	-0.14	-1.22 (0.23)	67.60	0.08
3 (SW)	0.02	1.55 (0.12)	0.79	6.48*** (0.00)	0.94	6.03*** (0.00)	0.00	-1.81* (0.07)	0.44	2.85*** (0.01)	40.31	0.11
4 (ML)	0.00	0.62 (0.54)	1.01	14.26*** (0.00)	0.28	3.04*** (0.00)	0.00	0.55 (0.58)	-0.32	-3.56*** (0.00)	68.00	0.06
5 (MN)	0.01	2.44** (0.02)	1.04	15.44*** (0.00)	0.21	2.43*** (0.00)	0.00	0.8 (0.42)	-0.20	-2.34** (0.02)	69.34	0.06
6 (MW)	0.00	0.35 (0.73)	1.02	14.58*** (0.00)	0.43	4.76*** (0.00)	0.00	-0.96 (0.34)	-0.05	-0.53 (0.60)	67.60	0.06
7 (BL)	0.00	0.73 (0.46)	0.96	16.15*** (0.00)	0.01	0.12 (0.90)	0.00	-0.7 (0.48)	-0.46	-6.03*** (0.00)	73.21	0.05
8 (BN)	0.01	1.25 (0.21)	1.03	15.93*** (0.00)	-0.03	-0.39 (0.70)	0.00	0.02 (0.98)	-0.03	-0.4 (0.69)	67.24	0.06
9 (BW)	0.00	-0.36 (0.72)	0.91	18.11*** (0.00)	-0.15	-2.32** (0.02)	0.00	-0.85 (0.40)	0.56	8.78*** (0.00)	72.85	0.05

Table 23: [18]Results of Carhart model when Size-Momentum portfolios are used to construct the dependent variable

[18] *** denotes the significance at 1%, ** denotes the significance at 5%, and * denotes the significance at 10%.

5.4 The Results of Fama-French five-factor model

Tables 24 to 26 present the results of Fama-French five-factor model. This model uses five explanatory variables: RMRF, SMB, HML, RMW, and CMA. The excess returns over the risk-free rate of three different sets of portfolios are used in this thesis: the 3X3 Size-BM portfolios (table 24), the 3X3 Size-OP portfolios (table 25), and the 3X3 Size-Investment portfolios (table 26).

Table 24 presents the results of Fama-French five-factor model when Size-BM portfolios are used to construct the dependent variables. The average adjusted R^2 of the model is 73.97%. This version of Fama-French five-factor model seems well specified with the number of significant alphas being one out of the nine portfolios employed. Similar to the results obtained from Fama-French three-factor model, the Small-Low BM portfolio doesn't challenge the five-factor model, either, when it's applied to the Egyptian stocks.

This section of the thesis focuses on HML, RMW, and CMA factors of the model because the results of the RMRF, and the SMB factor isn't dissimilar to what was discussed previously in the other models. When the Size-BM portfolios are used to construct the dependent variables in the model, the patterns observed in the regression coefficients of HML, RMW, and CMA factors in Fama and French (2015) don't appear when the model is applied in the Egyptian stock market. The only similarity between the results is the higher coefficient of CMA factor in case of high BE/ME compared to low BE/ME (although the difference doesn't range from strongly positive to strongly negative as in Fama and French (2015). HML factor has a strong significance in one out of the nine portfolios, and has significance in two out of the nine portfolios. RMW factor has a strong significance in three out of the nine portfolios and has significance in two out of the nine portfolios. CMA factor has a strong significance in two out of the nine portfolios and has a weak significance in one out of the nine portfolios.

Table 25 presents the results of Fama-French five-factor model when Size-Operating Profitability portfolios are used to construct the dependent variables. The average adjusted R^2 of the model is 63.70%. When comparing the results presented in table 25, with the results presented in tables 26 and 27, it is observed that the Size-OP version of the five-factor model has the lowest goodness of fit (judging by the average adjusted R^2), as well as having the most mispricing, four out of nine alphas are significant as opposed to only one significant alpha in each one of the other two tables.

When the Size-OP portfolios are used to construct the dependent variables, it's found that HML factor isn't significant in any portfolio. Also the significance of the RMW and CMA factors are close to the ones obtained when Size-BM portfolios are used. There are no patterns in the coefficients of HML or CMA. In the case of RMW factor, it's observed that portfolios with low profitability have RMW coefficients with negative loadings, while portfolios with high profitability have RMW coefficients with positive loadings.

Table 26 presents the results of Fama-French five-factor model when Size-Investment portfolios are used to construct the dependent variables. The average adjusted R^2 of the model is 75.57%. The Size-Investment version of the model seems well specified with the number of significant alphas being one out of the nine portfolios employed.

When the Size-Investment portfolios are used to construct the dependent variables, HML factor is also not significant in any portfolio. There are no patterns in any of the coefficients other than in the coefficient of the CMA factor, where stock portfolios with low investment load positively on the CMA factor and stock portfolios with high investment load negatively on the CMA factor. The significance of the CMA factor improves compared to the other versions of the five-factor model. The factor is strongly significant in six out of the nine portfolios, and is weakly significant in one out of the nine portfolios. Regarding the significance of the RMW factor, it is strongly significant in two out of the nine portfolios, significant in one out of the nine portfolios, and weakly significant in two out of the nine portfolios.

Among the main findings of Fama and French (2015), are the redundancy of the HML factor as a result of adding two extra factors to Fama-French three-factor model, and the challenges imposed by the Small-Low BM portfolio over the three-factor model as well as the five-factor model. When the five-factor model is applied in Egypt, it doesn't affect the HML factor as it isn't significant even in the three-factor model.

Also, the Small-Low BM portfolio doesn’t challenge asset pricing in the Egyptian stock market.

Now, in order to judge which model performs better, the thesis examines the GRS test-statistic of the different models as well as the Sharpe ratio of the intercepts. These results are presented in the coming section.

	α		bi		si		hi		ri		ci			
	Coeff α	t-stat α	Coeff bi	t-stat bi	Coeff si	t-stat si	Coeff hi	t-stat hi	Coeff ri	t-stat ri	Coeff ci	t-stat ci	Adj R2	SE
1 (SL)	0.02	1.04 (0.3)	1.07	5.24*** (0.00)	1.49	5.41*** (0.00)	0.00	2.08** (0.04)	-0.16	-0.59 (0.56)	0.15	0.64 (0.52)	36.68	0.17
2 (SM)	0.00	-0.38 (0.7)	1.03	15.36*** (0.00)	0.79	8.76*** (0.00)	0.00	-1.22 (0.22)	-0.05	-0.52 (0.6)	-0.10	-1.26 (0.21)	74.46	0.06
3 (SH)	0.01	2.43** (0.02)	0.99	16.26*** (0.00)	0.99	12.05*** (0.00)	0.00	0.04 (0.97)	-0.16	-2.07** (0.04)	0.21	3.04*** (0.00)	80.17	0.05
4 (ML)	0.01	1.03 (0.31)	1.16	14.08*** (0.00)	0.71	6.41*** (0.00)	0.00	1.03 (0.3)	0.14	1.33 (0.19)	0.00	-0.01 (0.99)	67.43	0.07
5 (MM)	-0.01	-1.53 (0.13)	0.94	21.57*** (0.00)	0.55	9.45*** (0.00)	0.00	0.80 (0.43)	-0.05	-0.95 (0.34)	-0.09	-1.80* (0.07)	84.28	0.04
6 (MH)	0.00	-0.36 (0.72)	0.89	16.26*** (0.00)	0.61	8.27*** (0.00)	0.00	-2.31** (0.02)	-0.2	-2.83*** (0.01)	0.08	1.31 (0.19)	77.40	0.05
7 (BL)	0.00	0.01 (0.99)	0.99	46.99*** (0.00)	-0.12	-4.08*** (0.00)	0.00	-1.30 (0.20)	0.07	2.45** (0.02)	0.02	0.72 (0.47)	95.07	0.02
8 (BM)	0.00	-0.71 (0.48)	0.85	17.49*** (0.00)	0.03	0.49 (0.63)	0.00	0.58 (0.56)	-0.19	-2.98*** (0.00)	-0.20	-3.60*** (0.00)	76.87	0.04
9 (BH)	0.01	1.65 (0.10)	0.95	15.92*** (0.00)	-0.19	-2.3** (0.02)	0.00	2.86*** (0.00)	-0.21	-2.68*** (0.01)	0.05	0.70 (0.49)	73.39	0.05

Table 24: [19]Results of Fama-French five-factor model when Size-BM portfolios are used to construct the dependent variables

[19]*** denotes significance at 1%, ** denotes the significance at 5%, and * denotes the significance at 10%.

	α		bi		si		hi		ri		ci			
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Adj R2 (%)	SE
1 (SW)	0.01	1.62 (0.11)	1.17	16.20*** (0.00)	1.22	12.53*** (0.00)	0.00	0.30 (0.76)	-0.40	-4.19*** (0.00)	0.12	1.44 (0.15)	81.98	0.06
2 (SN)	0.00	0.20 (0.84)	1.02	12.87*** (0.00)	0.76	7.09*** (0.00)	0.00	-1.07 (0.29)	-0.08	-0.77 (0.44)	-0.28	-3.09*** (0.00)	68.22	0.07
3 (SR)	0.01	1.51 (0.13)	1.19	10.22*** (0.00)	0.68	4.34*** (0.00)	0.00	-0.66 (0.51)	0.22	1.44 (0.15)	0.21	1.61 (0.11)	49.71	0.10
4 (MW)	-0.01	-2.13** (0.03)	0.92	18.58*** (0.00)	0.59	8.75*** (0.00)	0.00	0.49 (0.63)	-0.45	-6.93*** (0.00)	0.14	2.47** (0.01)	84.46	0.04
5 (MN)	0.00	0.42 (0.67)	0.84	13.98*** (0.00)	0.28	3.38*** (0.00)	0.00	-0.13 (0.89)	0.05	0.68 (0.50)	0.23	3.31*** (0.00)	64.85	0.05
6 (MR)	0.01	1.73* (0.09)	0.99	8.83*** (0.00)	0.74	4.87*** (0.00)	0.00	-0.05 (0.96)	0.36	2.48** (0.01)	0.20	1.55 (0.12)	43.30	0.10
7 (BW)	-0.01	-0.97 (0.33)	0.76	8.57*** (0.00)	-0.19	-1.55 (0.12)	0.00	0.46 (0.64)	-1.02	-8.73*** (0.00)	-0.17	-1.63 (0.11)	65.32	0.08
8 (BN)	0.06	2.08** (0.04)	2.66	7.09*** (0.00)	-1.60	-3.17*** (0.00)	0.00	0.65 (0.52)	0.49	1.00 (0.32)	-0.17	-0.39 (0.70)	30.79	0.32
9 (BR)	-0.01	-2.48** (0.01)	0.89	25.53*** (0.00)	0.00	0.09 (0.93)	0.00	-0.12 (0.90)	0.11	2.41** (0.02)	0.00	0.08 (0.94)	84.61	0.03

Table 25: [20]Results of Fama-French five-factor model when Size-OP portfolios are used to construct the dependent variables

[20]*** denotes significance at 1%, ** denotes the significance at 5%, and * denotes the significance at 10%.

	α		bi		si		hi		ri		ci			
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Adj R2	SE
1 (SC)	0.00	0.74 (0.46)	1.12	17.42*** (0.00)	1.43	16.44*** (0.00)	0.00	-0.06 (0.95)	-0.12	-1.48 (0.14)	0.41	5.57*** (0.00)	84.52	0.05
2 (SN)	0.00	-0.03 (0.97)	0.83	14.15*** (0.00)	0.92	11.58*** (0.00)	0.00	-0.49 (0.63)	-0.13	-1.72* (0.09)	0.29	4.31*** (0.00)	76.62	0.05
3 (SA)	0.00	0.45 (0.65)	1.24	10.08*** (0.00)	0.99	5.95*** (0.00)	0.00	-0.86 (0.39)	-0.14	-0.84 (0.40)	-0.38	-2.71*** (0.01)	57.97	0.10
4 (MC)	0.00	-0.39 (0.70)	0.84	12.49*** (0.00)	0.24	2.69*** (0.00)	0.00	-1.45 (0.15)	-0.09	-1.06 (0.29)	0.34	4.43*** (0.00)	62.97	0.06
5 (MN)	0.00	-1.04 (0.30)	0.99	19.87*** (0.00)	0.60	8.86*** (0.00)	0.00	-0.86 (0.39)	0.01	0.15 (0.88)	0.08	1.43 (0.16)	80.99	0.04
6 (MA)	0.00	-0.85 (0.40)	0.87	14.34*** (0.00)	0.40	4.86*** (0.00)	0.00	-0.32 (0.75)	-0.21	-2.63*** (0.01)	-0.11	-1.55 (0.12)	71.12	0.05
7 (BC)	-0.01	-2.05** (0.04)	1.02	24.68*** (0.00)	0.22	3.89*** (0.00)	0.00	-0.18 (0.86)	0.11	2.02** (0.05)	0.30	6.4*** (0.00)	84.76	0.04
8 (BN)	0.00	-1.4 (0.17)	0.85	20.49*** (0.00)	0.02	0.31 (0.76)	0.00	-0.11 (0.91)	0.09	1.68* (0.10)	0.09	1.97* (0.05)	78.12	0.04
9 (BA)	0.00	-1.3 (0.20)	0.87	20.46*** (0.00)	-0.05	-0.88 (0.38)	0.00	-1.34 (0.18)	-0.19	-3.5*** (0.00)	-0.40	-8.29*** (0.00)	83.06	0.04

Table 26: [21]Results of Fama-French five-factor model when Size-Investment portfolios are used to construct the dependent variables

[21]*** denotes significance at 1%, ** denotes the significance at 5%, and * denotes the significance at 10%.

5.5 The Results of the GRS tests

Table 27 presents the results of the GRS test and the SR(α). When the Size-Momentum and Size-OP portfolios are used to construct the dependent variables in the CAPM, the null hypothesis of the GRS-test is rejected at the 5% significance level. The SR(α) of these two versions of the CAPM are the highest among all other models. Also, in the case of the five-factor model, when Size-Operating Profitability is used to construct the dependent variable, the null hypothesis of the GRS-test is rejected at the 10% significance level. The SR(α) of this version of the model is much higher than the other two versions of the five-factor model.

For all other models, the high p-value implies that the GRS test cannot reject the models. Therefore these models offer better description of the variation of stock returns in the Egyptian market. Furthermore, by examining SR(α) it's possible to observe that Fama-French five-factor model has a lower SR(α) compared to the CAPM, Fama-French three-factor model and Carhart model. Hence, Fama-French five-factor model seems to offer a better explanation of the average variation in stock returns in the Egyptian market compared to the other models.

	GRS	p-value	SR(α)
CAPM			
Size-BM	1.6269	0.1148	0.3456
Size-Momentum	2.2029	0.0262	0.4021
Size-OP	2.4261	0.0143	0.4220
Size-Investment	1.4541	0.1727	0.3267
Fama-French 3-factor model	1.2765	0.2566	0.3111
Carhart model			
Size-BM	1.3246	0.2313	0.3214
Size-Momentum	1.3300	0.2286	0.3220
Fama-French 5-factor model			
Size-BM	0.3439	0.9583	0.1623
Size-OP	1.8285	0.0700	0.3741
Size-Investment	1.0076	0.4380	0.2777

Table 27: The results of the GRS test and the SR(α)

CHAPTER 6

CONCLUSIONS

This thesis endeavors to explain the variation in stock returns in the Egyptian market using four different asset pricing models: the CAPM, Fama-French three-factor model, Carhart four-factor model, and Fama-French five-factor model. Results show that the CAPM captures the variation in stock returns that is due to the market factor. However, the model is far from being well-specified as manifested by the large number of significant alphas, the rejection of the null hypothesis of the GRS test in two of the four versions of the model, as well as the relatively high Sharpe ratio of the intercepts.

Fama-French three factor model succeeds in capturing the variation in stock returns due to the size effect. However, this thesis fails to find evidence of the significance of the value effect due to BE/ME ratio in the Egyptian stock market. For future research, other variables can be used to test the presence of the Value effect in the Egyptian stock market, such as: E/P, CF/P, D/P, as well as sales growth. The results obtained from Fama-French three-factor model and Carhart four-factor model are fairly close. This can be due to the failure to identify a momentum effect in the Egyptian stock returns. The adjusted R^2, as well as the Sharpe ratio of the intercepts of both models are close.

This thesis finds evidence in favor of the superiority of Fama-French five-factor model over the other three models. This superiority is established by the higher adjusted R^2, the fewer significant intercepts, and the lower Sharpe ratio of intercepts. It's noteworthy that almost all models in which the thesis used Size-OP to construct the dependent variables, turned out not well-specified and not having high goodness of fit, having a larger number of significant alphas and lower adjusted R^2 than their counterparts. A good idea would be to try constructing the profitability factor in the five-factor model using Gross Profitability as Novy-Marx (2013) suggested, as opposed to Sales-COGS-SG&A-Interest as Fama and French (2015) do. Then again, constructing portfolios using Size-Investment criteria seems reasonable, as these portfolios appear to have the least mispricing in all models in which they were employed, indicated by the least number of significant alphas.

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APPENDIX

A. Stocks used in the dataset of this thesis

Expanded Name	Base Date	Status	Sector
Great Britain Auto	7-Mar-07	Active	Automobiles and Parts
Arab Banking	14-Jun-02	Dead	Banks
Egypt American Bank	30-Dec-96	Dead	Banks
National Bank of Kuwait	30-Sep-96	Active	Banks
Bank of Alexandria	12-Dec-06	Active	Banks
Blom Bank Egypt	13-Mar-07	Dead	Banks
Commercial International Bank (Egypt)	30-Sep-96	Active	Banks
Credit Agricole Egypt	28-Jan-99	Active	Banks
Ahli United Bank Egypt	3-Feb-99	Dead	Banks
Egyptian Gulf Bank	22-Nov-94	Active	Banks
Al Baraka Bank Egypt	20-Jun-02	Active	Banks
Faisal Islamic Bank of Egypt EGP	18-Jun-02	Active	Banks
Housing and Development Bank	6-Feb-98	Active	Banks
Misr International Bank (Mibank)	30-Sep-96	Dead	Banks
National Development Bank	30-Sep-96	Active	Banks
Piraeus Bank Egypt	1-Jul-02	Dead	Banks
Qatar National Bank Alahly	19-Mar-96	Active	Banks
Suez Canal Bank	5-Dec-94	Active	Banks
Abou Kir Fertilizers	30-Sep-96	Active	Chemicals
Egyptian Financial and Industrial	30-Sep-96	Active	Chemicals
Egyptian Chemical IND	27-Aug-96	Active	Chemicals
Kafr El-Zait Pesticides	14-Aug-96	Active	Chemicals
Misr Chemical Industries	30-Sep-96	Active	Chemicals
Samad Misr - Egyfert	24-Oct-02	Active	Chemicals
Sidi Kerir Petrochemicals	23-Jun-05	Active	Chemicals
Ameriyah Cement	30-Sep-	Dead	Construction and Materials

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Acrow Misr	2-Feb-99	Active	Construction and Materials
Alexandria Cement	30-Sep-96	Active	Construction and Materials
Arab Ceramic	7-Oct-96	Active	Construction and Materials
Misr Beni Suef Cement	13-Mar-01	Active	Construction and Materials
El EZZ Porcelain (Gemma)	29-Oct-01	Active	Construction and Materials
Helwan Cement	6-Jan-04	Dead	Construction and Materials
Lecico Egypt	21-Jun-01	Active	Construction and Materials
Misr Cement (Qena)	19-Jun-02	Active	Construction and Materials
Misr Conditioning (Miraco)	6-Feb-98	Active	Construction and Materials
National Cement	30-Sep-96	Active	Construction and Materials
Orascom Construction IND	11-Mar-99	Active	Construction and Materials
Paint and Chemical Industries (Pachin)	27-Aug-96	Active	Construction and Materials
Arabian Cement	25-Mar-14	Active	Construction and Materials
Sinai Cement	30-Oct-01	Active	Construction and Materials
Suez Cement	30-Sep-96	Active	Construction and Materials
South Valley Cement	3-Feb-99	Active	Construction and Materials
Torah Cement	30-Sep-96	Active	Construction and Materials
Elsaeed Contract and Real Estate	6-Feb-98	Active	Construction and Materials
Egyptian Electric Cable	30-Sep-96	Active	Electronic and Electrical Equipment
Elswedy Electric	15-Jun-06	Active	Electronic and Electrical Equipment
Arabia Investments Development Finance	4-Jun-10	Active	Financial Services (Sector)
Al Arafa Investment and Consulting	16-Jan-07	Active	Financial Services (Sector)
American Group	30-Nov-10	Active	Financial Services (Sector)
Citadel Capital	4-Dec-09	Active	Financial Services (Sector)
Export Development Bank of Egypt	25-Oct-94	Active	Financial Services (Sector)
EFG Hermes Holdings	30-Oct-01	Active	Financial Services (Sector)
Egyptian Kuwaiti Holding	2-Jul-02	Active	Financial Services (Sector)
El Ahli Investment and Development	3-Feb-99	Active	Financial Services (Sector)
El Orouba Securities Brokerage	14-May-08	Active	Financial Services (Sector)

Egyptians Abroad Investments	15-Jan-99	Active	Financial Services (Sector)
GMC Group for Industrial Commercial	1-Oct-07	Active	Financial Services (Sector)
Grand Investment Capital	1-Sep-09	Active	Financial Services (Sector)
International Company for Investment and Development	14-Feb-06	Active	Financial Services (Sector)
Marseille Almasreia	4-Apr-12	Active	Financial Services (Sector)
Naeem Holding	22-Nov-06	Active	Financial Services (Sector)
Pioneers Holding	23-Jun-08	Active	Financial Services (Sector)
Porto Group	21-Oct-15	Active	Financial Services (Sector)
Prime Holding	23-Apr-08	Active	Financial Services (Sector)
Telecom Egypt	14-Dec-05	Active	Fixed Line Telecommunications
Ajwa for Food Industries	18-Oct-94	Active	Food Producers
Alexandria Flour Mills	6-Feb-98	Active	Food Producers
Bisco Misr	22-Jan-99	Dead	Food Producers
Cairo Poultry	3-Jan-95	Active	Food Producers
Delta Sugar	24-Feb-98	Active	Food Producers
Arabian Food Industries	21-Mar-16	Active	Food Producers
East Delta Flour Mills	11-Oct-96	Active	Food Producers
Egyptian Starch and Glucose	30-Sep-96	Active	Food Producers
Egypt Poultry	20-Oct-94	Active	Food Producers
El Nasr for Manufacturing Agricultural	18-Jan-07	Active	Food Producers
Extracted Oils Derivatre	30-Sep-96	Active	Food Producers
Edita Food Industries	2-Apr-15	Active	Food Producers
International Agricultural Products	3-Jul-02	Active	Food Producers
Juhayna Food Industries	9-Jun-10	Active	Food Producers
Atlas Land and Agriculture	22-Jan-13	Active	Food Producers
Middle and West Delta Flour Mills	11-Oct-96	Active	Food Producers
Middle Egypt Flour Mills	30-Sep-96	Active	Food Producers
Misr Oil	12-Aug-96	Active	Food Producers
North Cairo Mills	30-Sep-96	Active	Food Producers

National Company for Maize Products	15-May-06	Active	Food Producers
South Cairo and Giza Mills and Bakeries	30-Sep-96	Active	Food Producers
Upper Egypt Flour Mills	11-Oct-96	Active	Food Producers
Advanced Pharmaceutical Packing	23-Jun-10	Active	General Industrials
El Ahram Print	15-Sep-08	Active	General Retailers
Misr Duty Free Shops	6-Feb-98	Active	General Retailers
Cleopatra Hospital	19-Apr-16	Active	Health Care Equipment and Services
Medical Packaging	29-Nov-11	Active	Health Care Equipment and Services
Nozha International Hospital	8-Aug-02	Active	Health Care Equipment and Services
Delta Industries (Ideal)	3-Feb-99	Dead	Household Goods and Home Construction
Olympic Group Financial Investments	15-Jan-99	Dead	Household Goods and Home Construction
Oriental Weavers	15-Jan-99	Active	Household Goods and Home Construction
Arab Valves	14-Feb-07	Active	Industrial Engineering
El EZZ Aldekhela Steel Alexandria	14-Mar-96	Active	Industrial Metals and Mining
Egypt Iron and Steel	27-Aug-96	Active	Industrial Metals and Mining
EZZ Steel	5-Oct-99	Active	Industrial Metals and Mining
Egypt Aluminium	3-Feb-99	Active	Industrial Metals and Mining
Misr National Steel	22-Feb-07	Active	Industrial Metals and Mining
United Arab Shipping	7-Jan-99	Active	Industrial Transportation
Canal Shipping Agencies	18-Jun-02	Active	Industrial Transportation
General Silos and Storage	19-Aug-98	Active	Industrial Transportation
Egyptian Media Production City	7-Apr-00	Active	Media
Asek Company for Mining	24-Jan-05	Active	Mining
Global Telecom	8-Aug-00	Active	Mobile Telecommunications
Orange Egypt for Telecommunications	3-Aug-98	Active	Mobile Telecommunications
Orascom Telecom and Media Companies	20-Jan-12	Active	Mobile Telecommunications
Vodafone Egypt Telecom	19-Dec-03	Active	Mobile Telecommunications
Delta Insurance	30-Sep-96	Active	Nonlife Insurance
Mohandes Insurance	30-Sep-96	Active	Nonlife Insurance
Alexandria Mineral Oils	29-Sep-	Active	Oil and Gas Producers

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Maridive and Oil Services	9-Jun-08	Active	Oil and Gas Producers
Natural Gas and Mining Project (Egypt Gas)	13-Jan-99	Active	Oil Equipment and Services
National Drilling	17-Jun-08	Active	Oil Equipment and Services
Arab Polivara Spinning and WVG	18-Jun-02	Suspended	Personal Goods
Alexandria Spinning and WVG	30-Sep-96	Active	Personal Goods
Arab Cotton Ginning	14-Apr-99	Active	Personal Goods
El Nasr Clothes and Textiles (Kabo)	30-Sep-96	Active	Personal Goods
Nile Cotton Ginning	8-Feb-99	Suspended	Personal Goods
Alexandria for Pharmacy	30-Sep-96	Active	Pharmaceuticals and Biotechnology
Amreyah Pharmaceuticals Industries	6-Feb-98	Dead	Pharmaceuticals and Biotechnology
Cairo Pharmaceuticals	24-Aug-98	Active	Pharmaceuticals and Biotechnology
Egyptian International Pharmaceuticals (Epico)	30-Sep-96	Active	Pharmaceuticals and Biotechnology
Memphis Pharmaceuticals	11-Oct-96	Active	Pharmaceuticals and Biotechnology
Nile Pharmaceuticals	30-Sep-96	Active	Pharmaceuticals and Biotechnology
Medinet Nasr Housing	30-Sep-96	Active	Real Estate Investment and Services
Cairo Investment and Real Estate Development	17-Sep-02	Dead	Real Estate Investment and Services
Development and Engineering	6-Feb-98	Active	Real Estate Investment and Services
Egyptians Housing Development	14-Apr-99	Active	Real Estate Investment and Services
El Kahera Housing and Development	30-Sep-96	Active	Real Estate Investment and Services
Emaar Misr for Development	3-Jul-15	Active	Real Estate Investment and Services
Heliopolis Housing	30-Sep-96	Active	Real Estate Investment and Services
Ismailia Development and Real Estate REIT	8-Aug-11	Active	Real Estate Investment and Services
Mena Tourism and Real Estate Investment	7-Jan-99	Active	Real Estate Investment and Services
Namaa for Development and Real Estate Investment Company	10-Sep-08	Dead	Real Estate Investment and Services
North Africa Real Estate	10-Dec-12	Active	Real Estate Investment and Services
Palm Hills Developments Sae	8-May-08	Active	Real Estate Investment and Services
Egyptian Real Estate Consort	10-Oct-08	Active	Real Estate Investment and Services
Six of October Development and Investment	7-Jan-99	Active	Real Estate Investment and Services

Talaat Moustafa Group	28-Nov-07	Active	Real Estate Investment and Services
United Housing and Development	30-Sep-96	Active	Real Estate Investment and Services
Raya Holding for Technology and Communications	16-May-05	Active	Software and Computer Services
Sues Canal Company for Technology Settling	12-Dec-06	Active	Support Services
Eastern Tobacco	30-Sep-96	Active	Tobacco
El Shams Pyramids for Hotels and Touristic Projects	24-Sep-08	Active	Travel and Leisure
Egyptian for Tourism Resorts	15-Jul-02	Active	Travel and Leisure
Guezira Hotels and Tourism	21-Aug-02	Dead	Travel and Leisure
Misr for Hotels (Hilton)	27-Aug-96	Active	Travel and Leisure
Orascom Hotel Holdings (OHH)	7-Jan-99	Dead	Travel and Leisure
Orascom Hotels and Development	25-Jan-99	Active	Travel and Leisure
Pyramisa Hotels	26-Aug-02	Active	Travel and Leisure
Semiramis Hotels	19-Mar-99	Dead	Travel and Leisure
Transoceans Tours	21-Mar-07	Active	Travel and Leisure
General Siles and Storage	5-Feb-98	Dead	Unclassified

B. Portfolio breakpoints and Market Capitalization

Size Breakpoints			
	33 per	Median	67 per
Jun-05	40517.75	135490.6	302633.4
Jun-06	44644.8	107261.1	279409.7
Jun-07	70143.31	194526	385445.9
Jun-08	146994.9	369294.4	502453.4
Jun-09	83224.87	161574.2	337783.1
Jun-10	59356.08	140215.5	369777.6
Jun-11	60274.35	147963	385527.8
Jun-12	39806.18	94862.23	233470
Jun-13	32777.64	82580.42	207618.3
Jun-14	50465	126365.8	302610
Jun-15	39725.1	76602.73	270343.1

BE/ME Breakpoints				
	30 per	33 per	67 per	70 per
Dec-04	0.435399	0.478019	1.085087	1.101904
Dec-05	0.25893	0.267794	0.786443	0.840837
Dec-06	0.334597	0.354087	0.699056	0.71543
Dec-07	0.330178	0.354681	0.629123	0.69222
Dec-08	0.569498	0.585427	1.056191	1.104478
Dec-09	0.468723	0.495833	0.773616	0.831149
Dec-10	0.452795	0.489097	0.867753	0.882146
Dec-11	0.680658	0.716587	1.270883	1.342324
Dec-12	0.638049	0.692601	1.226448	1.296829
Dec-13	0.69598	0.715454	1.142368	1.196645
Dec-14	0.594317	0.603092	0.978463	0.992907

Momentum Breakpoints				
	30	33	67	70
Jun-05	0.057649	0.058559	0.09668	0.104621
Jun-06	-0.00881	-0.0045	0.038023	0.039902
Jun-07	-0.00489	-0.00106	0.042153	0.046403
Jun-08	-0.17062	-0.10824	0.168478	0.186175
Jun-09	-0.03557	-0.03382	0.011761	0.016898
Jun-10	-0.0505	-0.04539	-0.00061	0.001547
Jun-11	-0.04833	-0.04785	-0.01471	-0.01137
Jun-12	-0.0299	-0.02789	0	0
Jun-13	-0.04975	-0.04905	-0.02555	-0.02282
Jun-14	-0.30299	-0.28872	0.009851	0.016683
Jun-15	-0.05141	-0.04987	-0.01736	-0.01614

Operating Profitability Breakpoints				
	30	33	67	70
Dec-04	0.206509	0.218399	0.336255	0.344155
Dec-05	0.184197	0.1879	0.347464	0.364615
Dec-06	0.122132	0.128956	0.382242	0.393845
Dec-07	0.223053	0.228662	0.349583	0.385061
Dec-08	0.150422	0.15846	0.297603	0.310821
Dec-09	0.130949	0.139177	0.290432	0.299371
Dec-10	0.09775	0.113399	0.257444	0.280555
Dec-11	0.067679	0.080739	0.210779	0.22301
Dec-12	0.022997	0.038708	0.222769	0.238518
Dec-13	0.088802	0.103758	0.266285	0.291177
Dec-14	0.094631	0.110027	0.235563	0.241507

Investment Breakpoints				
	30	33	67	70
Dec-04	-0.19973	-0.19715	-0.09848	-0.08833
Dec-05	0.030838	0.039394	0.115707	0.127149
Dec-06	0.069907	0.072686	0.22385	0.265934
Dec-07	0.054395	0.072304	0.171299	0.197576
Dec-08	0.110497	0.134132	0.279792	0.317454
Dec-09	-0.00844	-0.00069	0.137704	0.155151
Dec-10	0.002504	0.00636	0.113573	0.128942
Dec-11	-0.02374	-0.01255	0.090157	0.101899
Dec-12	-0.05581	-0.04636	0.025901	0.03406
Dec-13	-0.03515	-0.02368	0.064882	0.067988
Dec-14	-0.10831	-0.10467	-0.01717	-0.00874

Percentile Breakpoints used for the different variables (Size, BE/ME, Momentum returns, Operating Profitability, and Investment)

	Market Cap of RHS (Size-BM) portfolios					
	SL	SM	SH	BL	BM	BH
Jun-05	109762.9	560790.2	626138.7	21660090	6057570	321120.5
Jun-06	87393.11	805284.8	818141.2	35391124	11479836	1552751
Jun-07	205870.4	1876747	1405158	50183538	13489295	6595403
Jun-08	2226106	7449603	4619893	75607872	27039232	11781195
Jun-09	1038700	2077957	1284594	40806335	27031258	8171412
Jun-10	635917.6	1032449	1525861	31199047	27684396	5949759
Jun-11	470506.5	1463289	1038094	34497909	12542151	12589749
Jun-12	359685	915176.6	804541.1	24213434	15111440	5589463
Jun-13	290863.9	684260.8	696939.5	26937260	7872325	3928917
Jun-14	526341.4	1245452	1140737	30880986	14603144	9468313
Jun-15	255775	825412.8	791472.3	24764833	9931534	7782948
	% of Total Market Cap					
	SL	SM	SH	BL	BM	BH
Jun-05	0.3742%	1.9116%	2.1344%	73.8358%	20.6493%	1.0946%
Jun-06	0.1743%	1.6062%	1.6319%	70.5923%	22.8981%	3.0972%
Jun-07	0.2791%	2.5445%	1.9051%	68.0399%	18.2891%	8.9422%
Jun-08	1.7294%	5.7873%	3.5890%	58.7365%	21.0056%	9.1523%
Jun-09	1.2918%	2.5842%	1.5976%	50.7477%	33.6167%	10.1622%
Jun-10	0.9348%	1.5177%	2.2430%	45.8625%	40.6959%	8.7461%
Jun-11	0.7516%	2.3375%	1.6583%	55.1070%	20.0348%	20.1109%
Jun-12	0.7654%	1.9474%	1.7120%	51.5248%	32.1563%	11.8941%
Jun-13	0.7198%	1.6933%	1.7246%	66.6590%	19.4809%	9.7225%
Jun-14	0.9096%	2.1523%	1.9714%	53.3673%	25.2366%	16.3628%
Jun-15	0.5767%	1.8611%	1.7845%	55.8370%	22.3925%	17.5481%

	Market Cap of LHS (Size-BM) portfolios								
	SL	SM	SH	ML	MM	MH	BL	BM	BH
Jun-05	4484.48	190935.3	193001.3	640619.4	1664413	636177.9	23380980	2303740	321120.5
Jun-06	10227.6	331981.8	268088.7	1077437	1380410	1436135	40961771	3875715	792765.1
Jun-07	81029.52	434019	717216.6	2272880	3565740	1821537	48561547	10531265	5770776
Jun-08	1519392	4767509	3251194	2607377	8026444	5274803	75916461	17247109	10113611
Jun-09	459440.6	578759	659074.8	1630099	2631319	2988205	40711434	23919347	6832577
Jun-10	466529.5	404606.5	540793.3	1985224	2066626	2389955	33993105	15218337	10962253
Jun-11	175956.6	537105	598252.5	2390102	1490827	2678663	34057955	10015541	10657297
Jun-12	124800	367108.2	337307.3	1378460	1284280	1829382	24985388	12354290	4332726
Jun-13	100528.9	237538.2	281087.3	1002424	1150337	1762121	26918876	6093624	2864029
Jun-14	118754.1	470483.7	517188.7	2153929	2259861	1621856	31735147	6598709	12389045
Jun-15	117365.5	317434.3	332264	1121080	1690935	1587074	25700839	6136708	7348276
	% of Total Market Cap								
	SL	SM	SH	ML	MM	MH	BL	BM	BH
Jun-05	0.0153%	0.6509%	0.6579%	2.1838%	5.6737%	2.1686%	79.7021%	7.8531%	1.0946%
Jun-06	0.0204%	0.6622%	0.5347%	2.1491%	2.7534%	2.8646%	81.7037%	7.7306%	1.5813%
Jun-07	0.1099%	0.5885%	0.9724%	3.0816%	4.8345%	2.4697%	65.8408%	14.2785%	7.8241%
Jun-08	1.1803%	3.7037%	2.5257%	2.0256%	6.2354%	4.0978%	58.9762%	13.3985%	7.8568%
Jun-09	0.5714%	0.7198%	0.8196%	2.0272%	3.2724%	3.7162%	50.6297%	29.7466%	8.4971%
Jun-10	0.6858%	0.5948%	0.7950%	2.9183%	3.0379%	3.5132%	49.9697%	22.3709%	16.1145%
Jun-11	0.2811%	0.8580%	0.9556%	3.8180%	2.3814%	4.2789%	54.4042%	15.9988%	17.0240%
Jun-12	0.2656%	0.7812%	0.7178%	2.9333%	2.7329%	3.8928%	53.1675%	26.2892%	9.2198%
Jun-13	0.2488%	0.5878%	0.6956%	2.4806%	2.8466%	4.3605%	66.6135%	15.0793%	7.0873%
Jun-14	0.2052%	0.8131%	0.8938%	3.7223%	3.9054%	2.8028%	54.8434%	11.4036%	21.4103%
Jun-15	0.2646%	0.7157%	0.7492%	2.5277%	3.8125%	3.5784%	57.9475%	13.8364%	16.5681%

Market Capitalization of the (Size-BM) RHS and LHS portfolios expressed in Million USD, and as a % of Total Market Capitalization

	Market Cap of RHS (Size-Momentum) portfolios							Market Cap of LHS (Size-Momentum) portfolios								
	SL	SN	SW	BL	BN	BW		SL	SN	SW	ML	MN	MW	BL	BN	BW
Jun-05	338106.9	899381.6	326059.6	2948038	6394549	11876603	Jun-05	234856	249428.3	99820.02	898905.6	703340.9	951927	2282991	6003208	11358261
Jun-06	345499.7	708818.1	399863.6	9771203	12513725	13293793	Jun-06	263001.5	212907.2	62537	879130.7	460242.5	1771848	9102293	12159906	12121037
Jun-07	892328.7	1084657	1153605	17499818	32087032	15318900	Jun-07	383597.7	279321.8	390944.9	1144992	3110834	2877416	23168867	22883885	13796481
Jun-08	1214667	1273469	3269883	14622692	33593027	21001210	Jun-08	948417.2	920472.2	2398389	4077171	3382986	1824969	10949183	27014630	23458729
Jun-09	846878.1	1582176	1789943	26861814	33227082	11499834	Jun-09	355335.3	544060.4	772763.9	1528231	3271674	2125568	25843518	30975132	10391445
Jun-10	1443995	1249539	239449.3	2314949	20027137	40892281	Jun-10	730309.4	356451.1	202622.8	1595395	2970601	1598136	2098444	16796685	39818708
Jun-11	2514686	4265179	3459636	11362656	19379342	19867067	Jun-11	2217755	3621329	729388.6	4079302	4742846	5390196	8362618	12331397	19373734
Jun-12	583723.4	936094.9	464318	8813541	7285451	27419355	Jun-12	441337.2	298372.6	49501.63	1048708	1991822	1229400	8076738	5761832	26604772
Jun-13	542941.8	714245.1	474693.7	4036737	19706753	15068560	Jun-13	331887.2	239121.1	89094.73	1232222	1124704	1650374	5820043	15887082	14169404
Jun-14	566905.2	563435.7	353367.7	6454709	4930628	9724057	Jun-14	226562	228133.7	15800	988799	875414.8	1545369	5847555	3401738	9463730
Jun-15	688570.8	758817.7	457271.6	5044660	13987882	24952087	Jun-15	369370	345992.6	83701.22	1263118	1919011	1390525	4298286	10006191	26213094
	% of Total Market Cap							% of Total Market Cap								
	SL	SN	SW	BL	BN	BW		SL	SN	SW	ML	MN	MW	BL	BN	BW
Jun-05	1.4840%	3.9476%	1.4312%	12.9398%	28.0675%	52.1298%	Jun-05	1.0309%	1.0948%	0.4381%	3.9456%	3.0872%	4.1783%	10.0207%	26.3498%	49.8547%
Jun-06	0.9330%	1.9140%	1.0798%	26.3852%	33.7908%	35.8972%	Jun-06	0.7102%	0.5749%	0.1689%	2.3739%	1.2428%	4.7845%	24.5789%	32.8354%	32.7305%
Jun-07	1.3115%	1.5942%	1.6956%	25.7213%	47.1616%	22.5158%	Jun-07	0.5638%	0.4105%	0.5746%	1.6829%	4.5723%	4.2292%	34.0537%	33.6348%	20.2781%
Jun-08	1.6201%	1.6985%	4.3613%	19.5034%	44.8057%	28.0110%	Jun-08	1.2650%	1.2277%	3.1989%	5.4380%	4.5122%	2.4341%	14.6038%	36.0315%	31.2888%
Jun-09	1.1171%	2.0871%	2.3612%	35.4341%	43.8307%	15.1697%	Jun-09	0.4687%	0.7177%	1.0194%	2.0159%	4.3158%	2.8039%	34.0909%	40.8601%	13.7076%
Jun-10	2.1823%	1.8885%	0.3619%	3.4986%	30.2674%	61.8013%	Jun-10	1.1037%	0.5387%	0.3062%	2.4112%	4.4895%	2.4153%	3.1714%	25.3852%	60.1788%
Jun-11	4.1327%	7.0095%	5.6856%	18.6737%	31.8485%	32.6500%	Jun-11	3.6447%	5.9514%	1.1987%	6.7040%	7.7945%	8.8584%	13.7433%	20.2657%	31.8393%
Jun-12	1.2828%	2.0572%	1.0204%	19.3694%	16.0111%	60.2590%	Jun-12	0.9699%	0.6557%	0.1088%	2.3047%	4.3774%	2.7018%	17.7501%	12.6627%	58.4688%
Jun-13	1.3391%	1.7617%	1.1708%	9.9565%	48.6059%	37.1660%	Jun-13	0.8186%	0.5898%	0.2197%	3.0392%	2.7740%	4.0706%	14.3549%	39.1849%	34.9483%
Jun-14	2.5092%	2.4938%	1.5641%	28.5694%	21.8236%	43.0399%	Jun-14	1.0028%	1.0097%	0.0699%	4.3766%	3.8747%	6.8400%	25.8820%	15.0565%	41.8877%
Jun-15	1.5005%	1.6536%	0.9965%	10.9931%	30.4818%	54.3745%	Jun-15	0.8049%	0.7540%	0.1824%	2.7525%	4.1818%	3.0302%	9.3666%	21.8051%	57.1225%

Market Capitalization of the (Size-Momentum) RHS and LHS portfolios expressed in Million USD, and as a % of Total Market Capitalization

	Market Cap of RHS (Size-OP) portfolios					
	SW	SN	SR	BW	BN	BR
Jun-05	528018.6	569286	155177.6	1752991	3150424	18151925
Jun-06	393703.6	413041.2	273688.5	903163.5	8773743	19013421
Jun-07	772734.5	1223949	625038.1	19867107	9984175	27644940
Jun-08	2641253	5383582	1420711	8957445	31609826	55537498
Jun-09	1813042	1119098	609655.6	2593549	25912938	36641026
Jun-10	1211424	841440	403434	2309400	29104369	21356479
Jun-11	1276640	1228505	513156.1	4364395	23128823	28542448
Jun-12	738409.4	828722.7	493537.2	4320762	10539519	28061758
Jun-13	277169.8	641202.3	410184.4	7921273	14602641	11412725
Jun-14	806270.6	943128.3	762233.8	14051980	15713639	15258272
Jun-15	466108.4	575142.9	458970.1	7023391	11886033	8682202
	% of Total Market Cap					
	SW	SN	SR	BW	BN	BR
Jun-05	2.1722%	2.3420%	0.6384%	7.2116%	12.9605%	74.6752%
Jun-06	1.3225%	1.3874%	0.9193%	3.0337%	29.4710%	63.8661%
Jun-07	1.2854%	2.0359%	1.0397%	33.0469%	16.6076%	45.9845%
Jun-08	2.5024%	5.1005%	1.3460%	8.4864%	29.9476%	52.6171%
Jun-09	2.6395%	1.6292%	0.8876%	3.7758%	37.7248%	53.3431%
Jun-10	2.1936%	1.5236%	0.7305%	4.1817%	52.7000%	38.6707%
Jun-11	2.1618%	2.0803%	0.8690%	7.3905%	39.1656%	48.3328%
Jun-12	1.6415%	1.8423%	1.0972%	9.6054%	23.4302%	62.3834%
Jun-13	0.7860%	1.8182%	1.1631%	22.4620%	41.4081%	32.3626%
Jun-14	1.6961%	1.9840%	1.6035%	29.5610%	33.0566%	32.0987%
Jun-15	1.6022%	1.9770%	1.5777%	24.1421%	40.8569%	29.8441%

	Market Cap of LHS (Size-OP) portfolios								
	SW	SN	SR	MW	MN	MR	BW	BN	BR
Jun-05	97410.98	42882.12	200677.6	924174.5	1193365	334694.4	1455272	2242115	17817230
Jun-06	150235.4	103975	79644.48	918446.8	1140555	585560.3	378400	7133217	19280727
Jun-07	409497.3	463305.4	112606.9	1109597	2698202	2030454	20714181	5769090	26811010
Jun-08	978153.2	4100650	684930.2	5267112	20420320	7691877	8445553	8824994	49136726
Jun-09	624528.1	524158.4	325663.3	2549928	2155685	1458394	1695935	22812071	36542946
Jun-10	633548.8	357857.9	186521.5	2254724	1647111	1193277	1012392	22279852	25661261
Jun-11	595317	365607.6	341918.1	2913119	2427654	1245701	2539299	15906168	32719183
Jun-12	371411.3	314205.8	87721.61	1428486	2032625	1115381	3601356	7953805	28077718
Jun-13	216811.7	180659.8	84605.61	930200.2	1414855	764771.8	9950807	9556480	13130858
Jun-14	488651.7	215293.8	291048.9	1176117	2332156	1510335	14258167	12011814	15251940
Jun-15	211779.3	137531.5	251636.5	742782.2	1294312	1480959	7421302	9428596	8122948
	% of Total Market Cap								
	SW	SN	SR	MW	MN	MR	BW	BN	BR
Jun-05	0.4007%	0.1764%	0.8256%	3.8020%	4.9094%	1.3769%	5.9868%	9.2238%	73.2983%
Jun-06	0.5046%	0.3493%	0.2675%	3.0851%	3.8311%	1.9669%	1.2710%	23.9605%	64.7640%
Jun-07	0.6812%	0.7707%	0.1873%	1.8457%	4.4882%	3.3775%	34.4559%	9.5963%	44.5974%
Jun-08	0.9267%	3.8850%	0.6489%	4.9901%	19.3465%	7.2874%	8.0014%	8.3609%	46.5529%
Jun-09	0.9092%	0.7631%	0.4741%	3.7123%	3.1383%	2.1232%	2.4690%	33.2105%	53.2003%
Jun-10	1.1472%	0.6480%	0.3377%	4.0827%	2.9825%	2.1607%	1.8332%	40.3427%	46.4654%
Jun-11	1.0081%	0.6191%	0.5790%	4.9330%	4.1109%	2.1094%	4.3000%	26.9350%	55.4056%
Jun-12	0.8257%	0.6985%	0.1950%	3.1756%	4.5187%	2.4796%	8.0061%	17.6819%	62.4189%
Jun-13	0.5984%	0.4986%	0.2335%	2.5675%	3.9052%	2.1109%	27.4656%	26.3772%	36.2430%
Jun-14	1.0280%	0.4529%	0.6123%	2.4742%	4.9061%	3.1773%	29.9948%	25.2691%	32.0854%
Jun-15	0.7280%	0.4727%	0.8650%	2.5532%	4.4491%	5.0906%	25.5099%	32.4098%	27.9217%

Market Capitalization of the (Size-OP) RHS and LHS portfolios expressed in Million USD, and as a % of Total Market Capitalization

	Market Cap of RHS (Size-Investment) portfolios							Market Cap of LHS (Size-Investment) portfolios								
	SC	SN	SA	BC	BN	BA		SC	SN	SA	MC	MN	MA	BC	BN	BA
Jun-05	922236	677032.5	90350	5525678	6835232	11390777	Jun-05	260504.5	320782.5	90350	1196603	485969.1	1166679	5186654	6341665	10392097
Jun-06	575566.9	927605.8	489458.8	9091423	12660632	11787386	Jun-06	233607.9	299761.9	344491.8	2081455	852247.2	1266435	9228690	10555380	10670002
Jun-07	899297	1460436	821533.8	10514613	14818104	32016213	Jun-07	385946.6	507722.7	69118.28	1885276	1735026	3054999	9436114	11949335	31506659
Jun-08	4378384	4116814	3812984	39431634	35267140	33463207	Jun-08	3959578	1808446	2852112	19865774	3683208	7607208	22433963	30904912	27354963
Jun-09	1076399	1667904	1229850	14334912	31254734	26360339	Jun-09	649325.6	589914.6	345110.8	1771596	2828450	2335403	15144039	24482072	27778228
Jun-10	1077815	1122779	928233.3	27827812	15427342	21578048	Jun-10	484513.2	493963.5	433452.6	1825715	2772546	1778144	27887861	9563584	22722250
Jun-11	1040907	1183556	848100.8	12939807	35235997	11156234	Jun-11	666353.5	273070.9	409938.4	1789526	2717882	2209629	12735085	28074629	13528489
Jun-12	715455.8	859480.1	424240.3	8192031	15925003	19582855	Jun-12	290857.2	386489.4	126904.8	2122068	871442.1	1457962	6537944	13514749	20390648
Jun-13	549534.1	663769.1	450065	6193397	15381234	15928328	Jun-13	209975.8	194932.9	233906.1	1300220	1369075	1083281	9054851	9805313	15914774
Jun-14	796872.4	1814877	467737.8	13780078	20095995	25770607	Jun-14	377374.8	321500.1	482361.8	2479425	2827469	1276501	12265190	17709790	24986555
Jun-15	579767.9	854215.5	510541.7	8026919	18817320	17675612	Jun-15	237216.1	297319.7	266277	2278973	1222813	1453992	9519001	13547283	17641501
	% of Total Market Cap							% of Total Market Cap								
	SC	SN	SA	BC	BN	BA		SC	SN	SA	MC	MN	MA	BC	BN	BA
Jun-05	3.6250%	2.6612%	0.3551%	21.7193%	26.8667%	44.7728%	Jun-05	1.0239%	1.2609%	0.3551%	4.7034%	1.9102%	4.5858%	20.3867%	24.9267%	40.8473%
Jun-06	1.6199%	2.6106%	1.3775%	25.5865%	35.6316%	33.1739%	Jun-06	0.6575%	0.8436%	0.9695%	5.8580%	2.3985%	3.5642%	25.9728%	29.7066%	30.0292%
Jun-07	1.4857%	2.4127%	1.3572%	17.3709%	24.4805%	52.8930%	Jun-07	0.6376%	0.8388%	0.1142%	3.1146%	2.8664%	5.0471%	15.5891%	19.7411%	52.0511%
Jun-08	3.6344%	3.4173%	3.1651%	32.7315%	29.2746%	27.7772%	Jun-08	3.2868%	1.5012%	2.3675%	16.4902%	3.0574%	6.3146%	18.6220%	25.6536%	22.7068%
Jun-09	1.4177%	2.1968%	1.6198%	18.8806%	41.1657%	34.7193%	Jun-09	0.8552%	0.7770%	0.4545%	2.3334%	3.7254%	3.0760%	19.9463%	32.2454%	36.5868%
Jun-10	1.5859%	1.6521%	1.3658%	40.9461%	22.6999%	31.7502%	Jun-10	0.7129%	0.7268%	0.6378%	2.6864%	4.0796%	2.6164%	41.0345%	14.0720%	33.4337%
Jun-11	1.6680%	1.8966%	1.3590%	20.7353%	56.4638%	17.8773%	Jun-11	1.0678%	0.4376%	0.6569%	2.8676%	4.3553%	3.5408%	20.4073%	44.9881%	21.6787%
Jun-12	1.5656%	1.8807%	0.9283%	17.9260%	34.8475%	42.8518%	Jun-12	0.6365%	0.8457%	0.2777%	4.6436%	1.9069%	3.1904%	14.3065%	29.5734%	44.6194%
Jun-13	1.4031%	1.6947%	1.1491%	15.8131%	39.2716%	40.6684%	Jun-13	0.5361%	0.4977%	0.5972%	3.3197%	3.4955%	2.7658%	23.1190%	25.0351%	40.6338%
Jun-14	1.2704%	2.8933%	0.7457%	21.9686%	32.0377%	41.0843%	Jun-14	0.6016%	0.5125%	0.7690%	3.9528%	4.5076%	2.0350%	19.5535%	28.2335%	39.8343%
Jun-15	1.2478%	1.8384%	1.0988%	17.2754%	40.4984%	38.0412%	Jun-15	0.5105%	0.6399%	0.5731%	4.9048%	2.6317%	3.1293%	20.4867%	29.1563%	37.9678%

Market Capitalization of the (Size-Investment) RHS and LHS portfolios expressed in Million USD, and as a % of Total Market Capitalization