Essays on Empirical Asset Pricing and Firm Investment Behaviour in Egypt

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Abstract

This thesis presents essays on empirical asset pricing and firm investment behaviour in Egypt. Chapters 2 and 3 investigate returns patterns and factor equity pricing models, whereas Chapter 4 examines state ownership effect on firm investment behaviour.

Chapter 2 contributes firstly by constructing a unique dataset of the cross section of the Egyptian stocks and an Egyptian version of Fama-French factors and stock portfolios. It also explores anomalies patterns in stock returns. Using portfolio sorts, it is found that anomalies patterns exist in average excess returns, especially the size and value patterns, with no investment effect for big stocks and profitability effect for micro stocks. However, cross sectional regressions on individual firms show the significant importance of the book-to-market ratio and profitability in predicting returns whilst momentum and asset growth are insignificant.

Chapter 3 tests factor models for the period 2003-2017 contributing to the limited literature on asset pricing for emerging markets. Factor spanning regressions and multi-factor Gibbons, Ross and Shanken (GRS) tests reject the Fama-French three (1993) and six-factor (2018) models in favour of the five-factor model (2015). Nevertheless, some metrics of dispersion and regression details offer better support to the three-factor model for other test assets than Size-Profitability portfolios, owing to its role in pricing micro stocks. Lastly, the investment and momentum factors are redundant in explaining average returns.

In Chapter 4, findings show that state ownership is accompanied with lower investment levels and poor investment efficiency for the period 2006-2017. State ownership reduces firm's financial constraints, which can be explained by soft budget constraints that state controlled firm may enjoy. However, state firms do not heavily use bank credit as a channel of softening the budget constraints. Channels of investment inefficiency associated with state ownership are mainly agency costs and soft budget constraints.

To my soul and to my loving parents and sister

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Declaration

I declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for an award at this, or any other, University. All sources are acknowledged as References.

I have presented a preliminary version of Chapters 2 and 3 (combined) at the Research Student Workshop at the Department of Economics and Related Studies, University of York in June 2018.

I have presented an earlier version of Chapter 3 at the MBF Rome 2018 conference (International Rome Conference on Money, Banking and Finance), and at the Young Finance Scholars (YFS) conference, University of Sussex, June 2019. I have also presented it as a poster at the Asset Pricing Workshop, University of York, June 2018 and at Money, Macro and Finance Research Group (MMF), PhD conference, City, University of London, May 2019.

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Chapter 1

Introduction

Asset pricing theory is the framework to understand the prices of assets or values of claims to uncertain future payments. The basic principle is that the price of an asset equals the expected discounted value of its future payoffs. The rate at which these payoffs are discounted should reflect the riskiness of them. This implies that assets with riskier payoffs should provide higher expected returns, as a compensation for holding extra risk, than assets with less risky payoffs. This basically explains why expected returns vary across assets or within one asset class such as stocks. Therefore, explaining the cross sectional variation of stock returns requires an understanding of the underling systematic risk factors that cause these riskier payoffs.

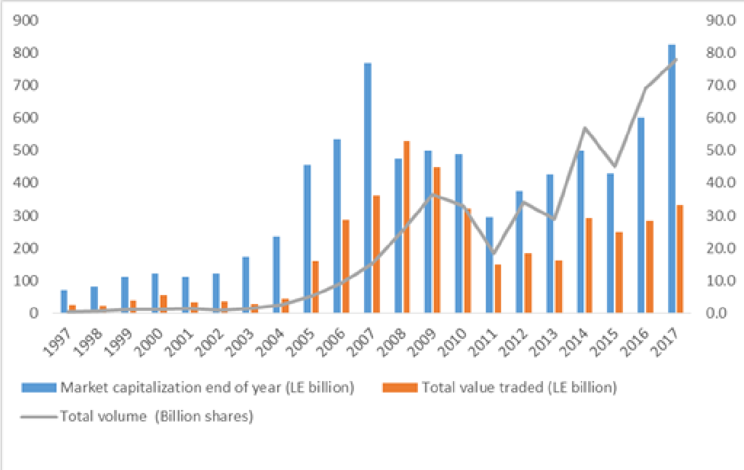
The literature developing and testing asset pricing models, and thus investigating the priced risk factors, focuses mainly on the US and some developed markets, with less attention given to emerging markets. The latter markets have different characteristics than developed markets such as small and imperfect capital market, less corporate governance enforcement, increased political and macroeconomic uncertainties as well as lower quality data. These characteristics pose challenges to standard asset pricing models that do not take them into account (Bekaert and Harvey, 2003), and impact the importance of factors in explaining returns. Therefore, careful investigations of asset pricing models in emerging markets can provide 'out of sample' tests of existing models and push in the direction of developing new models. Furthermore, exploring which factors are important in explaining returns, compared to those in developed markets, is also vital for understanding market return dynamics and determining an appropriate asset pricing model for an emerging market. Knowing the appropriate model is essential for various practical implications, particularly with an increasing interest of investing in emerging markets. It can be used in the calculation of the cost of capital for projects evaluation, performance evaluation for investment and mutual fund managers as well as portfolios choice especially when returns in these markets are less highly correlated with those of developed markets.

This thesis focuses on Egypt as a small emerging market, instead of targeting China in most existing studies, which can provide insights about emerging markets dynamics that can be generalized to other similar countries such as those in the Middle East and North Africa (MENA) region. This region becomes increasingly attracting to investors with an increased integration into world capital markets due to economic and financial sector reforms and fast growing stock markets. For example, portfolios and banks inflows surged over 2016-2018 accounting almost 20% of total portfolios flows to emerging markets, with a tripled flows' volume compared to the previous 8 years (Azour and Zhu, 2020).

The Egyptian stock market (EGX) has experienced a dramatic growth over the last two decades which open a huge opportunity for investors and researchers. For example, the market capitalization (end of year) grew by 380% from LE 172 to 825 billion during 2003-2017. For the same period, total value traded and total volume increased by 1049% and 5386%, respectively (see Figure 1.1). Despite the political tension which negatively affected the market in 2011, Egypt was one of the best five performers in years 2012, 2013 and 2014, according to Morgan Stanley (MSCI) Emerging market index (in US$ terms). Political risk may segment markets from the world capital market, however, it also creates expected return opportunities for global investors (Bekaert and Harvey, 2017). Recently, the market witnessed a remarkable trading activity for foreign investors, generating net equity inflows of more than LE 7 billion in 2016, recording a highest level in EGX history, which is 70% higher than the cumulative record in 8 years. In the same year, EGX was the best performer amongst emerging markets surging by 102% over the year, according to MSCI index-denominated in local currency terms. Moreover, the market capitalization jumped by LE 200 billion to surpass LE 800 billion for the first time since 2008, and trading volume reached its highest-ever level of 78 billion securities in 2017. The market recovery was mainly driven by the floating of the Egyptian pound, together with the adopted economic reform measures introduced by the IMF in 2016. Coupled with the EGX improvements, Egypt is considered the largest receipt of FDI in Africa reaching $7.4 billion in 2017, according to UNCTAD world investment report 2018. Therefore, it is important to have a deep understanding of the market and its risk factors to help investors exploiting market potentials.

EGX has also features that distinguish it from developed markets, and are mostly shared among other countries in the region. These features may challenge the existing asset pricing models as well as the investment behaviour. First, the Egyptian market

Fig. 1.1 EGX performance



Source: Various issues of annual reports of the Egyptian exchange (Table A.1)

is dominated by individual (retail) investors, accounting for 65% of the value traded in 2017 (EGX, 2017). Retail traders positively affect volatility as they behave as noise traders who might trade for non-informational reasons (Foucault et al., 2011), in contrast to institutional investors who mostly participate in price stabilizing activities. Actually, Metawa et al. (2019) find that behavioral biases[1] have significant effects on investment decisions in the Egyptian market. On the other hand, the largest domestic institutional investors are state-controlled investors such as insurance companies and pensions funds, and most of their investments are not dictated by a particular investment strategy, but are mainly residual block holdings after privatization process started in 1990s. However, foreign institutional investor participation in the Egyptian market has been increasing through direct and indirect investments, especially after the inclusion of Egypt in the MSCI Emerging Market index in 2001, and due to the fact that the market is open for foreigners with no taxes on capital gains so far. The market is increasingly attracting new foreign institutional investors, which are equal to 913 (1136) in 2016 (2017), according to the annual reports of the EGX.

Second, the EGX is relatively a small and less liquid market with restrictive short-selling constraints[2], which are common characteristics of many emerging markets. Although EGX is the largest in the MENA region, in terms of the number of listed firms followed by Kuwait and Saudi Arabia (Sourial et al., 2015), the number of listed firms in 2017 is only 222 firms (EGX, 2017). Most of trading activities are concentrated in few large and liquid firms especially those of the main market index (EGX30). Using a sample of 217 firms (in Chapters 2 & 3), the biggest 50 firms

[1]For example, investor sentiment, overreaction and underreaction, overconfidence and herd behavior.

[2]The financial regulatory authority decided to start allowing short-selling only in December, 2019.

represent, on average, 90% of market cap. Liquidity and short-selling constraints may cause the prices to deviate from fundamental values for a prolonged period of time.

Third, the EGX is characterized by concentrated ownership, with low free float, especially outside the listed firms of the EGX30. The majority of Egyptian firms are either state or family controlled, which can be related, on the one hand, to the country's legal origin as a civil law country (Omran, 2009). Civil law countries are characterized by weak corporate governance and protection of minority rights compared to common law countries; thus investors seek to own significant shareholdings to protect their interests and exercise controls (La Porta et al., 1999, 1998). On the other hand, state ownership in listed firms is in large part due to the fact that the Egyptian government was reluctant to leave control and maintained a high share in ownership of privatized firms (Ben Naceur et al., 2007). Using a sample of 120 actively traded firms, excluding banks and financial services, in the Egyptian stock market for 2006-2017 (in Chapter 4), the state controls more than 20% (50%) of a firm shares in 39% (27%) of sample observations. Concentration of ownership is usually accompanied with low free float. Actually, the sample's average ratio of free float share to outstanding shares is only 34.8%, however, it increased from 28% in 2006 to 39% in 2017.

Given these features of the Egyptian market and potential opportunities it provides for global investors as well as the lack of research on emerging markets, the thesis is structured as follows. Chapter 2 and Chapter 3 are devoted to asset pricing, particularly exploring the cross sectional stock returns in the Egyptian stock market. Meanwhile, Chapter 4 focuses on ownership structure of listed firms (the last above mentioned feature) and explores the effect of state ownership on firm real (capital) investment behaviour.

Identifying risk factors that explain the cross sectional returns of the Egyptian stocks, and exploring whether they differ from those found to be important in the US market and some developed markets can be feasible by limiting the range of tested factor models. Given the plethora of factors that can be included in a factor model, this thesis focuses on factors that are widely known and motivated by theory. Motivated by valuation theory that relates the long run expected return to Book to market ratio (B/M), profitability and investment, Fama and French (2015) propose the five-factor model by adding profitability (robust minus weak, RMW) and investment (conservative minus aggressive, CMA) factors to the widely accepted three-factor model of Fama and French (1993). This is because the latter model was criticized for not explaining variations in returns due to profitability, investment and momentum (Novy-Marx, 2013; Titman et al., 2004). The importance of these two extra factor is also highlighted by the investment CAPM theory (Cochrane, 1991; Hou et al., 2015;

Zhang, 2017). The five-factor model was successful in capturing most of the value, profitability and investment patterns in average returns for North America, Europe and Asia Pacific, with an exception of Japan (Fama and French, 2017). Nevertheless, there are far less empirical investigation of this model for emerging markets. Fama and French (2018) add the momentum factor (winner minus loser, WML), which was proposed by Carhart (1997), to their five-factor model to satisfy popular demand due to strong momentum effect in the US market. However, momentum effect is mostly explained by behavioural approach rather than risk-based explanation (Daniel et al., 1998; Haugen and Baker, 1996). Hence, the five and six-factor models provide extra factors to be explored in the Egyptian market, besides market, size and value factors of the three-factor model (1993).

Most of the investigation of the Fama-French models are done for developed markets, with fewer evidences from emerging markets, which are constrained by the dearth of sufficiently high quality data. Some papers, for example, find similar return factors in emerging markets to those of developed markets such as size, value and momentum effect (Cakici et al., 2013; Rouwenhorst, 1999). Others document strong value effect but weak momentum and size effects (Cakici et al., 2016; Hanauer and Linhart, 2015). While investigation of the three and four-factor (carhart) models are more common in the literature, there are far less empirical investigation of the five-factor model for emerging markets. The outperformance of the five-factor model over the three-factor model was reported for Europen emerging markets (Zaremba and Czapkiewicz, 2017), Chinese market (Guo et al., 2017; Lin, 2017), Eastern Europe and Latin America, except for Asia (Foye, 2018). While Fama and French (2015) exhibit that the value factor is redundant after adding profitability and investment factors, Lin (2017) and Guo et al. (2017) show the redundancy of the investment factor for China, similar to what is observed in Europe and Japan (Fama and French, 2017), while Foye (2018) reports the redundancy of both size and investment factors for Asia, Eastern Europe and Latin America. This shows that the empirical evidences, especially for emerging markets, are apart from the debate in the US market around the motivation behind the investment factor and thus the redundancy of the value factor. While Fama and French (2015) motivate the investment factor by valuation theory, investment CAPM theory proponents (Hou et al., 2015; Zhang, 2017) argue that the value factor is a different manifestation of the investment factor; thus it is redundant. Accordingly, research should give more weight to the exploration of investment factor's redundancy, not the value factor, as it raises questions about the application of valuation and investment theories in emerging markets. Therefore, this thesis contributes to the debate on the validity of the five-factor model by investigating the Egyptian market given the above limited evidences confirming the the validity of the outperformance of the five-factor model in emerging markets. It also contributes to factors redundancy debate by exploring factors importance and checking factors redundancy in this market.

There are very limited studies that investigated multi-factor asset pricing models for the Egyptian market. Shaker and Elgiziry (2014) use a sample of 55 stocks for the period 2003-2007, and test the applicability of the CAPM, the three-factor model, the Carhart four factor model as well as a liquidity augmented factor model. They use only portfolios sorted on size and B/M as test assets, and Gibbsons, Ross and Shanken (1989) (GRS) test to compare models performance. They conclude that the three-factor model outperforms all other tested models, and thus no support for momentum and liquidity effects. Taha and Elgiziry (2016) extent the last study to cover the period of 2005-2013, and they confirm the significant size and value effects and insignificant momentum effect. A significant limitation to these studies is the small sample size used; hence lower diversification of portfolios.

Provided this background, Chapter 2 firstly aims to build a comprehensive and reliable dataset for cross section of the Egyptian stocks, and construct an Egyptian version of the Fama and French three, five and six factors. Data for Fama-French factors and stocks portfolios for the US market and some developed countries are publicly available at the Kenneth R. French-Data library. However, such portfolios for the Egyptian market, to the best of our knowledge, are not available at any source. Therefore, it is important to construct Fama-French factors and stocks portfolios using the Egyptian data. For data collection, the study mainly depends on Thomson Datastream (TDS), as a widely accepted database for non-US equity data, with its access to Worldscope database for corporate data. However, for a small emerging market, TDS has limitations regarding data coverage and quality of corporate data. Moreover, Ince and Porter (2006) and Schmidt et al. (2017) identify several problems with TDS data that requires careful screening procedures. Therefore, this chapter uses additional sources to increase the coverage of the sample and revise the Worldscope corporate data in addition to employing excessive static and dynamic screening of data. Consequently, the first contributions of this chapter are providing a unique dataset of the cross section of stocks, which is not available otherwise with this depth, breadth of variables and care in construction, and providing ready-made Egyptian version of Fama-French factors that will be available upon request.

Chapter 2 secondly intends to explore size, value, profitability, investment and momentum anomalies patterns in average returns of the Egyptian stocks. Exploring anomalies patterns in average returns provides a better understanding of the market, given the significant dearth in studies that investigate asset pricing models for the Egyptian stock market. It is also important to know whether anomalies patterns are similar to those observed in the US market, which can provide early insight about which risk factors are more important for pricing stocks. Another reason is that different characteristics of emerging markets such as liquidity, transaction costs and short-selling constraints could lead to abnormally higher returns on stock market anomalies (Zaremba and Czapkiewicz, 2017). For exploring anomalies patterns, this chapter uses both portfolio sorts and cross sectional regressions on individual stocks. Portfolio sorts are test assets portfolio returns constructed from 3×3 independent sorts on size and each of B/M, profitability and investment (and momentum) at the end of June each year (at the end of each month). These sorts show that value and size patterns in average return are significant for Egyptian stocks. Profitability, investment and momentum patterns exist, especially for small stocks. However, investment and profitability patterns are less strong and monotonic across the cells of the sorts compared to the value effect. Nevertheless, cross sectional regressions show the importance roles of mainly B/M and profitability in predicting stocks' returns. From the above, this chapter additionally contributes by providing an in-depth investigation of anomalies patterns, and showing that anomalies patterns exist as those in the US market albeit weaker. It emphasizes the role of size, value and profitability for stock returns in the Egyptian market, which is confirmed later in factor models analysis.

Chapter 3 tests whether the CAPM and the Fama-French asset pricing models; the three, five and six-factor models can explain the cross sectional stock returns in the Egyptian stock market for the period of July 2003-June 2017. It examines whether the Fama and French five (2015) and six (2018) factor models provide a better description of returns than the traditional three-factor model (1993). This is important to find the priced risk factors in the Egyptian market, and to ask whether the importance of factors varies in interesting ways from what is documented in the US and some developed markets. This chapter contributes to the literature by showing that factors' importance in explaining average stock returns varies between countries. It adds evidence on the redundancy of the investment factor in the Egyptian market, consistent with what is observed in some emerging markets and in contrast to value factor redundancy in the US market. It tries to interpret this redundancy using the empirical literature on asset growth effect and investment theory. In contrast to Shaker and Elgiziry (2014) and Taha and Elgiziry (2016) studies for the Egyptian market, this chapter provides a comprehensive analysis of asset pricing models (CAPM, Fama and French three, five and six-factor models) using a unique and larger dataset for the cross section of stock returns. It also adds to the literature an investigation of the recent Fama-French five and six-factor model for the Egyptian stocks, which is not done before for this market to the best of our knowledge. This helps enriching the empirical work on asset pricing in Egypt and the MENA region, which have limited research in this area. Finally, it contributes by showing the outperformance of the five-factor model among tested models, however, with limitations in competing with the three-factor model and in fully describing the cross sectional returns variations.

To test factor models, the chapter employs time series regression approach of Black et al. (1972) using four test assets environment; Size-B/M, Size-Profitability, Size-Investment and Size-Momentum portfolios. The idea behind time series regressions is that if a factor model explains stocks' expected returns, the time series regressions intercepts of test assets portfolios excess returns on the model's factors should be indistinguishable from zero. For comparing models performance, the chapter uses the GRS test and some metrics of dispersion, which focus on regression intercepts, as the left-hand-side (LHS) approach, following Fama and French (2015, 2016). It also utilises factor spanning regression, which draws inference using only factors, as the right-hand-side (RHS) approach. The latter approach was not employed in the mentioned two studies for the Egyptian market. This RHS approach is also useful to compare between nested models, as it can show the marginal contribution of a factor to the model's maximum Sharpe ratio (Fama and French, 2018).

Results indicate the good performance of the five-factor model in explaining average returns. GRS tests do not reject the five-factor model in most of the cases. Factor spanning regressions and multi-factor GRS tests reject the three and six-factor models in favour of the five-factor model. This is mainly due to the important role of the profitability factor which offers the model an additional explanatory power, while the role of the investment factor is insignificant. Although the five-factor model performs well according to metrics of dispersion, these metrics provide a better support to the three-factor model for other test assets than Size-Prof portfolios, as confirmed in regression details. The three-factor model remains able to explain average returns in other test assets except Size-Prof portfolios due to its role in pricing micro stocks, which pose a challenge to all factor models tested in this chapter. The five-factor model provides a good but incomplete description of the cross sectional variation of returns due to low average R^2. This less powerful performance of the five-factor model calls for the need of a better model that can fully explain the cross sectional returns of the Egyptian stocks. Results reveal that the priced factors in the Egyptian market are market, size, value and profitability. On the other hand, investment and momentum factors are insignificant in the Egyptian market, which confirm varying factors importance across countries. This provides information for investors and portfolio managers to improve their investment decisions in the Egyptian market.

Chapter 4 shifts the attention to firm real investment. It aims to investigate the effect of state equity ownership on firm capital investment, particularly the investment efficiency. It also intends to explore the channels of state's influence on investment efficiency. This chapter is motivated by the ownership structure of listed firms where the state (government) owns a significant share of business assets, as one of the characteristics of the Egyptian market. Moreover, the literature has become increasingly interested in exploring the role of the state as owner of business asset (Beuselinck et al., 2017; Boubakri et al., 2018; Chen et al., 2018), especially with an increase of state capitalism worldwide (Megginson, 2017), and due to the fact that some governments in emerging market and OECD countries retain control despite privatization waves (Bortolotti and Faccio, 2009; Boubakri et al., 2011). This has revived the debate about state vs. private ownership, and asks whether the effect of state ownership has changed and/or sources of state inefficiencies have disappeared. The focus on investment behaviour is induced by the Egyptian long history of state intervention in investment and the state's role in achieving social objectives (Loewe, 2013). Further motives are inspired by results from Chapters 2 and 3. It is found from portfolio characteristics in Chapter 2 that big firms are investing less despite being profitable. Moreover, the redundancy of investment factor in Chapter 3 raises questions around firms investment behaviour and the ability of managers to align their investment decision with the cost of capital as predicted by investment CAPM theory and Tobin's q theory. Therefore, disentangling the state effect, whose firms are usually old and big, is vital for better understanding of firm investment behaviour.

Chapter 4 employs an investment model following a standard q-theory of investment[3] and in the spirit of (Jaslowitzer et al., 2018; Stein, 2003) who allow to take into account two frictions/channels (agency costs and information asymmetry) that cause firm investment to deviate from the optimal level, and thus less efficient investments. This model is empirically compatible with investment-q equation[4], where the sensitivity of investment to q (growth opportunities) is used as a proxy for investment efficiency in line with recent investment literature (Chen et al., 2017, 2011; Jaslowitzer et al., 2018; McLean et al., 2012), and investment sensitivity to cash flow (CF) is used as a proxy for financial constraints following Fazzari et al. (1988). By interacting q and CF in the investment-q equation with a state variable and using OLS with firm fixed effects as an empirical specification, one can investigate the effect of the state

[3]Hubbard (1998), Hayashi (1982) and Wickens (2008).

[4]Fazzari et al. (1988), Baker et al. (2003) and McLean et al. (2012).

on the sensitivity of investment to both q (investment efficiency) and CF (financial constraints). State ownership will be associated with poor investment efficiency if it curtails a firm investment responsiveness to q. While other studies show poor investment efficiency associated with state ownership, they did not explore the exact channels of state influence. The investment-CF sensitivity provides a way to explore the channels of investment inefficiency. This is because higher sensitivity to cash flow can reflect either higher financial constraints or empire building preferences due to agency costs. Data for ownership structure has been manually collected for 120 actively traded firms in the Egyptian stock market from yearly disclosure reports of board of directors and shareholders structure for the period 2006-2017. State ownership is defined as the stock holdings by any type of government owned or controlled entity (detailed discussion on the construction of this variable is provided as an extension to the dataset in chapter 2).

State ownership is associated with agency costs and asymmetric information distortion channels which affect investment levels, and investment responsiveness to q and CF. For agency costs, the privatization literature shows that government ownership can be inconsistent with shareholder value maximization due to the non-economic objectives of the state, in addition to other principal-agent and principal-principal agency problems[5]. While agency costs in the investment literature can lead to either overinvestment or underinvestment as sub-optimal investments, it is still unclear in which direction can state influence investment. For asymmetric information, some papers argue that state ownership is associated with higher cost of external finance (Ben-nasr et al., 2012; Beuselinck et al., 2017; Borisova et al., 2015). However, soft budget constraints (SBC) theory (Kornai et al., 2003) suggests that state owned firms face lower financial constraints, due to enjoying different types of support such as implicit or explicit government guarantee, tax concessions, and preferential access to credit from state owned banks. A state firm can make use of SBC and overinvest (Kornai et al., 2003), or underinvest if it is rent seeker or risk averse (Boubakri et al., 2013; John et al., 2008). Therefore, it is still debatable in the literature how state ownership affects firms investment behaviour and financial constraints.

This research is the first to explore the state ownership effect on investment efficiency for the Egyptian market, away from privatization literature that only compare investment levels before and after privatization (Ben Naceur et al., 2007; Omran, 2004). Only one paper, to the best of our knowledge, has tackled the relation between ownership structure and investment efficiency (Rashed et al., 2018). However,

[5](Dixit, 1997; D'Souza and Nash, 2017; Hart et al., 1997; Jiang et al., 2010; La Porta et al., 2002; Shleifer, 1998; Shleifer and Vishny, 1994; Vickers and Yarrow, 1991; Young et al., 2008).

it does not explore the state ownership, and it uses an accounting-based measure of investment efficiency. The proposed measure in this chapter is believed to be more theory-based. Furthermore, few studies have investigated the relation between the state ownership and financial constraints in Egypt with contradictory results (Dang et al., 2018; Khlif et al., 2015). Due to the long history of the state as the largest investor in the economy, the banking sector used to concentrate its lending to the government (OECD, 2013; Raballand et al., 2015). However, it is still unclear whether listed firms with state ownership are facing increased or decreased financial constraints, and whether they are still benefiting from relation with banks to ease financial constraints.

This chapter contributes to the literature by investigating the effect of state equity ownership on investment efficiency for the Egyptian publicly listed firms, and by exploring the channels of influence. It provides evidences that state ownership negatively affects the sensitivity of investment to both Q and cash flow, and that both sensitivities can draw picture about investment behaviour and channels of investment inefficiency. It highlights the conservative investment behaviour of state firms, and indicates that channels of investment inefficiency are mainly agency costs (private costs and risk aversion) and SBC (rent seeking behaviour). This is in contrast to the popular view in the literature that state firms are taking risks benefiting form SBC and thus overinvest. It also contributes to the debate on the relation between state ownership and firms financial constraints and the extent to which state firms rely on bank credit to reduce financial constraints. This by showing that state ownership lowers firms financial constraints due to SBC, however, state firms do not heavily use bank credit as channel of softening the budget constraints. Finally, it presents evidence that the application of Tobin's Q theory in the Egyptian market is affected by firm ownership, which sheds a light on how this theory works in emerging markets.

Results show that state ownership is associated with poor investment efficiency. Indeed, the sensitivity of investment to growth opportunities evaluated at the mean level of state ownership is 90% below the sensitivity of firms without state ownership. State ownership also decreases firm's investment sensitivity to cash flow and thus reduces firm's financial constraints. This can be explained by the SBC that state controlled firms enjoy. However, it is found that state firms do not heavily use bank credit as a channel of softening the budget constraints. By dividing the sample into strategic and non-strategic sectors, it is shown that investment efficiency is lower in strategic sectors than non-strategic, whilst SBC are prevalent in strategic sectors. This confirms the influence of the state in strategic sectors, where it is reluctant to leave control. Result of lower investment efficiency accompanied with state ownership is robust to a narrow definition of state ownership and advanced method of estimation that tackle endogeneity problems and measurement error in q such as higher order cumulant estimators, system-GMM and entropy balancing technique. In addition, the study excludes other interpretation of investment sensitivity to q and CF that might drive the results such as price informativeness and asset tangibility.

Finally, Chapter 5 concludes by discussing the contribution of this work in light of its results, and by touching future avenues for research.

Chapter 2

Key Features and Patterns of Returns in Egyptian stocks

2.1 Introduction

Many patterns have been identified in the behaviour of stock returns in the empirical asset pricing literature. These patterns are considered anomalies because they are not explained by the basic asset pricing model; the capital asset pricing model (CAPM) of Sharpe (1964) and Lintner (1965). For instance, Banz (1980) shows that small stocks have unusually higher average returns while Rosenberg et al. (1985) find that stocks with higher book to market ratio (B/M) have higher average returns. Profitable firms have higher average returns (Haugen and Baker, 1996; Novy-Marx, 2013), and firms that invest more have lower stock returns (Aharoni et al., 2013; Anderson and Garcia-Feijóo, 2006; Titman et al., 2004). Add to this, the continuation of short term past returns, which is known as momentum, in which returns tend to follow last year returns for the next few months (Jegadeesh and Titman, 1993). Fama and French (1993) argue that the three-factor model; the market, size (small minus big, SMB) and value (high minus low, HML) factors, can explain the cross section of average returns. Nonetheless, it left some patterns unexplained such as profitability, investment and momentum. Fama and French (2015) introduce the five-factor model, motivated by the valuation theory, by adding profitability (robust minus weak, RMW) and investment (conservative minus aggressive, CMA) factors to the three-factor model. They highlight that this model performs better than the three-factor model in capturing the variation in average stock returns due to profitability and investment. Recently, they add a momentum factor, which was proposed by Carhart (1997), to the five-factor model (Fama and French, 2018).

The documentation of these patterns and the development of these multi-factor models, however, focus mainly on the US and some developed markets, with less attention given to emerging markets, which are constrained by the lack of sufficiently high quality data. Most of empirical studies depend on the well-known sources of data; the center for research in security prices (CRSP) and COMPSTAT datasets, or use the ready-made stock portfolios and Fama-French factors, which are publicly available in the Kenneth R. French-Data library for US and some developed markets. Alternatively, a widely accepted database for non-US equity data that has been used by many researchers, is Thomson Datastream (TDS) with its access to Worldscope database for corporate data. Nevertheless, Ince and Porter (2006) identify several problems with using TDS data which require handling its data with care. Ince and Porter (2006) and Schmidt et al. (2017) show that after careful screening of TDS data, inference from these data can be similar to those drawn from CRSP/COMPSTAT data. For a small and emerging economy, the problem is not just about the right screening procedures for the TDS data, but also about its coverage and the quality of corporate data. Therefore, building a dataset for a small emerging economy requires careful screening processes as well as the merging of different sources to overcome the limitations of TDS data. A reliable dataset is crucial for investigating the existence of returns anomalies as well as testing factor models for an emerging market. Exploring anomalies patterns is vital to know whether returns patterns in emerging markets, which have different characteristics than the developed markets, are similar to those documented in the US market. Moreover, it may give early insight about the risk factors that are more important for pricing stocks.

Egypt is one of the small emerging markets that has attracted investors' attention recently. Over the last two decade, the Egyptian stock market (EGX) has experienced a tremendous growth. For instance, during the period of 2003-2017, market capitalization, total value traded and total volume grew by 380%, 1049% and 5385% respectively[1]. According to the Morgan Stanley price index (MSCI) - denominated in local currency - Egypt is the best performer in 2016 compared to other emerging markets, surging by 102% over the year. The EGX has witnessed the highest trading value in 7 years by 2016, surging by 56% from the year before. For the same year, the net foreign inflow was the highest in the EGX history, which is higher by 70% than the cumulative record over 8 years. Moreover, the Egyptian market has some features that differentiate it from developed markets, which may lead to different return dynamics and challenge existing factor models. First, the Egyptian market is dominated by individual investors attributing 65% of market value traded versus 35% for institu-

[1]For detailed EGX performance, see Appendix A.1

tional investors in 2017 (EGX, 2017). Individual investors affect market volatility as they behave as noise trader who are more likely to trade for non-informational reasons (Foucault et al., 2011). Second, EGX is a small and less liquid market with low free float and short-selling constraints. The number of listed firms in 2016 is 222 firms. Liquidity, free float and short selling constraints may hinder institutional investors from participating in price stabilizing activities, which might cause prices to deviate from their fundamental values for extended periods of time. Third, Egypt faced increased political and economic uncertainties after the political uprising in 2011 and the Arab spring in the region, which can affect the sources of the priced risks in the market.

In the light of the different characteristics of the Egyptian market, and the lack of research and high quality data for emerging markets, the objective of this chapter is fourfold. First, it aims to build a comprehensive and a reliable dataset for the cross-section of stocks of the Egyptian stock market together with the required variables to test the Fama-Frech three, five and six-factor models, leaving the formal testing of factor models to Chapter 3. Second, it seeks to construct an Egyptian versions of Fama-French factors and test assets portfolios on different characteristics, which are not publicly available at any source. Third, it intends to investigate some well-known anomalies; the size, value, profitability, investment and momentum patterns in average returns. Finally, it aims, on a different note, to provide a detailed discussion on the construction of state (government) ownership variable as an extension of the dataset, which is required in the analysis of Chapter 4.

In general, there were serious obstacles to the construction of the main dataset. First, compared to other studies on asset pricing, emerging markets time series are relatively short. In the Egyptian case, the earliest corporate data can be found is from 2002/2003. Second, the market is small and thus the key challenges are to collect data for as many listed firms as possible, and to collect and link data between multiple sources, despite their different representation and definitions. Lastly, the principal accessible source of data, Thomson Datastream (TDS) with an access to the Worldscope database, has some shortfalls. Therefore, much careful and time-consuming work was required to screen data, revise observation of the Worldscope database, and overcome the shortage of firm coverage of TDS; hence improving its reliability.

By constructing the dataset in that way, the chapter contributes firstly by providing a unique dataset of the cross section of stocks for the Egyptian stock market, with a longer time series and broad coverage. Detailed procedures for dataset construction are disclosed to provide a guidance for future researchers dealing with emerging markets.

The construction of the dataset ends up with a universe of 227 stocks, of which 217 stocks have available corporate data, and it covers the period of July 2003-June 2017. This dataset is not otherwise available in this depth, breadth of variables and care in construction[2]. Constructing an Egyptian version of Fama-french factors, which can be available upon request, is a further contribution. An important issue tackled is choosing a suitable breakpoints in portfolios construction that can enhance comparability with the US market on the one hand and take into account market characteristics on the other. The study considers some alternatives for portfolios constructions, however, it focuses on only one for the analysis. A last, but different, contribution regarding data in this chapter is the manual construction of a state ownership variable from the annual disclosure reports of 120 firms for the period 2006-2017.

This chapter also contributes by exploring size, value, profitability, investment and momentum patterns in average returns using a larger dataset, and given the dearth of studies that have investigated multi-factor asset pricing models in Egypt. Both portfolio sorts and cross sectional regressions on individual stocks are employed in this chapter to examine these patterns. Portfolio sorts are double-sorted portfolios returns constructed from 3×3 independent sorts on size and each of B/M, profitability and investment (and momentum) at the end of June each year (each month). Based on portfolio sorts, it is found that value and size patterns are vital in the Egyptian stock market. Profitability, investment and momentum effects exist, especially for small stocks. However, investment and profitability effects are less strong and monotonic across the cells of the sorts compared to the value effect. Interestingly, the study finds opposite profitability and investment patterns in average returns for micro and big stocks, respectively. On the other hand, cross sectional regressions show the significant importance of mainly B/M and profitability in predicting returns. Results indicate that anomalies patterns exists in the Egyptian market as those found in the US market but weaker. They also confirm the validity of using factor models in the market.

The rest of the chapter is organized as follows. Section 2 provides a detailed procedures for the construction of the dataset. Summary statistics of the dataset are presented in section 3. Section 4 presents the construction of stocks portfolios and Fama-French factors. Investigation of anomalies patterns in average returns and portfolio characteristics are discussed in sections 5 and 6. The last section is for conclusion.

[2]Indeed, previous studies for the Egyptian market that examine multi-factor models use a smaller sample size (55 stocks) (Shaker and Elgiziry, 2014; Taha and Elgiziry, 2016).

2.2 The construction of the dataset

The first novel contribution of this chapter is the construction of a comprehensive and reliable dataset for cross-section of stocks of the Egyptian stock market together with the required variables to test the Fama-French six-factor model (2018). Detailed procedures for the dataset construction are provided in this section; data sources, phases of sample preparation, screening procedures and the choice of variables. Afterwards, an overview of the final dataset is presented.

2.2.1 Data sources

The main data source is Thomson Datastream (TDS) which covers both active and dead stocks, with an access to the Worldscope database for corporate data. Other sources are used to increase the sample coverage such as the Osiris database, Egypt for information dissemination (EGID); which is the main official information source for EGX-listed companies in Egypt, Mubasher.info website[3] and Decypha financial intelligent platform[4].[5] Specifically, Osiris database is used to get some data back to 2001/2002 for some firms, as the Worldscope mainly provides corporate data for Egypt since 2005. Mubasher website is employed to collect data for new stocks out of Worldscope coverage (16 firms) since 2012. EGID and Decypha are used to collect market data for 51 stocks out of TDS coverage for the period (2004-2017), and to correct and fill missing observation of corporate variables for the whole dataset using individual firms financial statements. Final dataset covers the period of July 2003-June 2017. Monthly data are collected for market variables whilst annual data are for corporate variables.

2.2.2 Sample preparation

Sample preparation's process can be divided into two main phases. The first phase involves data collection from TDS as a starting point, with the help of Osiris and Mubasher sources. It discusses data retrieval from TDS, the choice of variables and its definitions in addition to static and dynamic screening of data. The second phase presents data collection from EGID and Decypha, and the obstacles of merging data from different sources.

[3]It is a platform for equity market news, data and analysis for Middle East and North African markets. https://english.mubasher.info/countries/eg

[4]A web financial intelligent platform for Middle East markets; https://www.decypha.com/

[5]Thanks to the DERS for providing the fund to buy data from EGID and Decypha.

2.2.2.1 Phase one: TDS and data collection

2.2.2.1.1 Retrieving data from TDS Manual differentiation between alive (active) and dead (delisted) stocks is done for many reasons. There is no alphabetic constituent lists maintained by TDS for alive Egyptian stocks like developed markets. Dead list "DEADEGY" maintained by TDS is not totally matched with dead stocks after excluding active firm from the universe of TDS' Egyptian stocks. Not all firms that cease trading are included in TDS dead list, or labelled as dead using ESTAT variable. After differentiation, 278 active stocks and 1116 dead stocks are used as a starting point.

2.2.2.1.2 Static screening for TDS data TDS may include many securities in equities' list, which are not common equity. Following Ince and Porter (2006), variables such as Type (='EQ'), GEOG, EXMNEM and NAME are used to exclude non-common equities, firms located outside Egypt and non-traded firms in the Egyptian market. The NAME variable is useful to search for suspicious words for non-common equities[6] while it offers clues about active/dead firms as extended name can include words such as "dead", "delisted" or "suspended". After static screening, the universe of equities/stocks becomes 268 for active list and 1116 for dead list.

2.2.2.1.3 Definitions and choices of variables The main variables of interest are prices (adjusted- unadjusted), return index, dividends, market value, number of shares, book equity, total assets, net income, and finally 3-month treasury bill (risk free rate). Variables definitions and data types are provided in Table A.2. Data is denominated in Egyptian pounds. The availability of variables affects the sample size, therefore, further filtering of the universe of stocks is required. The filtering process of available data for both active and dead lists is tackled next, and then the choice of variables.

Filtering the universe of stocks For market data, it is found that out of the universe of 268 stocks for active list, 176 stocks have data for adjusted prices[7] and thus data for return index (RI), market value (MV) and number of stocks, while the rest (92 stocks) have only data for unadjusted prices. Non-active trading was present in price series. Therefore, restrictions are imposed such as excluding stocks with no price change or only couples of changes for the whole monthly series. Newly listed stocks in 2016 are also excluded due to their short history following Karolyi and Wu

[6] Check Karolyi and Wu (2012) and Campbell et al. (2010) for further details.
[7] Adjusted for capital actions.

(2012). Consequently, the active list with adjusted prices is reduced to 154 stocks, whereas the one for unadjusted prices reaches 51 stocks. The latter list is the base for further data collection from other sources in the second phase, as they have already available corporate data in the Worldscope.

For the dead list, it is found that only 581 out of 1116 stocks have available data. Two restrictions are imposed. First, delisted firms up to 2005 are excluded, reducing the number of stocks to 233. The reasons behind this arbitrary choice is that the capital market authority in 2002 had introduced new listing rules, which result in a massive delisting of non-actively traded firms in the following years. This further allows to take into consideration available corporate data, the start date of the sample and to warrant that firms have a history of couples of years. Second, the same restriction imposed on active firms for no price changes is followed; therefore the dead list is extremely decreased to 40 stocks. Unfortunately, market data for 22 stocks are only available for MV and RI variables, among them only 16 stocks have corporate data. This results in a weak representation of dead stocks.

The choice of variables To test factor models, book-to-market ratio and measures for investment and profitability (as corporate variables) are required. Problems have been raised regarding the choice of profitability variable, which are related to the availability of data and different sources' definitions. Therefore, the choice of variables and the constraints faced are presented as follows.

The first variable of interest is book-to-market (B/M) ratio, which is used to construct the third factor in the Fama-French model (HML), after market and size factors. Data for book equity (BE) using datatype (WC03501) and market value (MV) are collected separately. This is to follow Fama and French (2015)'s definition of B/M as the book equity for the fiscal year ending in calendar year t-1, divided by the market equity at the end of December of t-1. Investment is the fifth factor in the Fama-French model. To form portfolios at June of year t, the change in total asset from the fiscal year ending t-2 to fiscal year ending t-1, divided by total assets at t-2 is employed following Fama and French (2015). Therefore, data for total assets (TA) using the datatype (WC02999) for investment factor is collected.

Operating profitability is the fourth factor in the Fama-French model. Problems have been raised regarding the choice of this variable. Fama and French (2015) define operating profitability as annual revenues minus cost of goods sold (COGS), selling, general and administrative expenses (SG&A) and interest expenses divided by book equity for last fiscal year ended in t-1, and that is to form portfolios in June of year t. They call it operating profitability, but it is the operating profitability minus interest expenses from an accounting perspective. The same definition could not be applied because the interest expenses variable (WC01251) is rarely available with lots of missing observations[8]. Therefore, the journey began to search for a substitute for this variable as follows.

First, one might think of using operating income (WC01250) from TDS, without excluding interest expense. Operating income is calculated, as net sales or revenues minus COGS, SG&A expenses, other operating expenses in addition to depreciation, depletion and amortization, as presented in Datastream manual. Nevertheless, using this variable involves some problems. For instance, Fama and French do not exclude depreciation and amortization or other operating expenses. This means they are not using the full definition of operating income (Revenues − all operating expenses − dep. and Amort.) according to COMPUSTAT manual. Moreover, ambiguity is found around the operating income calculation in TDS. In trying to subtract operating income' subcomponents from sales, it does not provide the same values of operating income[9]. Consequently, the accuracy of this variable is doubted.

Second, one might consider Fama-French components of operating profitability variable without excluding interests. In other words, sales minus COGS and SG&A. However, another problem is raised which is choosing the right deflator. In this case, using the book equity as profitability deflator, similar to Fama-French, might be misleading. Ball et al. (2015) show that in constructing the profitability measure, the numerator and denominator should be matched with respect to cash flow rights. For example, net income (flow to equity holder) is deflated by book or market value of equity while gross or operating profit (flow to both equity and debt holder) is deflated by total assets. Fama and French (2015), by deflating the profitability measure by book equity and subtracting interest expenses, are interested in profit from equity's perspective. Having said that, this suggested variable is better deflated by total asset to have a matched numerator and denominator, but it will be profitability from firm perspective not equity perspective in contrast to the Fama-French idea. Moreover, a different deflator can offer different explanatory power, so the choice of variable will be inclusive.

Third, one can suggest using gross profit (sales minus COGS), following Novy-Marx (2013). The author argues that gross profitability is the cleanest accounting measure of true economic profitability and it has the same power as B/M in explaining the cross-section returns. Nevertheless, some definitional problems arise. TDS and Osiris have

[8]Indeed, only 66 out of 133 stocks have interest expenses data, and 39 stocks have lots of missing observations, while 27 stocks do not have data for this variable at all.

[9]Datastream support team was contacted several times asking for the methodology for operating income's calculation after finding some errors, however, unconvinced answers are received.

different calculations for gross profit and COGS. For example, TDS calculates gross income (profit) (WC01100) as sales minus COGS and depreciation and amortization, while Osiris calculates it as operating revenues minus COGS, and this operating revenues includes other revenues than just sales[10]. On the other hand, the Mubasher website does not provide detailed data for revenues, COGS and SG&A, but it only presents data for gross profit and net income. Since the aim is to enlarge the sample by merging data from TDS with Osiris and Mubasher, the last two suggested variables can not be employed.

Lastly, one can exploit the basic profitability measure, which is the return on equity (ROE), calculated as net income (NI) divided by book equity. Novy-Marx (2013) uses ROE as one of the potential profitability variables in addition to gross profitability and free cash flow. Hou et al. (2015) adopt ROE as a profitability measure in their q-factor model. Furthermore, Guo et al. (2017) empirically use the ROE as the profitability variable for the Chinese market. The only profitability variable that is common among the three data sources is net income. Accordingly, this variable is chosen as the proxy for profitability. To form portfolio in June of each year t, ROE as earning for the fiscal year ending in t-1, divided by book equity at the end of t-1 is used.

After choosing variables, the sample covers so far 133 stocks from TDS (out of the TDS list with adjusted prices; 154 stocks), and 16 stocks from Mubasher for corporate variables (BE, TA, NI) since 2012. The summary of stocks' universe from phase one is presented in Panel (A) of Table A.3.

2.2.2.1.4 Dynamic screening of data The last step of the first phase of sample preparation is the dynamic screening of TDS data. Ince and Porter (2006) and Schmidt et al. (2017) argue that TDS data should be handled with care. To check for errors in returns calculated from the total return index, stock return calculated from the total return index (RI) is compared with self-created return data using prices and dividends (DDE) series, following these studies. If the difference between both returns is greater than 0.5 in absolute term, the return calculated from self-created returns is used, as long as the ratio of adjusted prices to unadjusted prices is the same as the previous month. Unchanged ratio of adjusted prices to unadjusted prices refers to no change in capital structure. Moreover, zero returns from the end of the sample to the first non-zero return are deleted, because TDS pads the time after the stock cease

[10]Regarding COGS, Osiris uses the COGS as reported in financial statements of the firms, while TDS deducts amortization of purchased intangible assets (included in COGS) and depreciation (difference of cash flow depreciation – amortization expenses), as reported by Datastream customer support team.

trading with the same latest value of trading. Nonetheless, carefulness is needed in dealing with emerging market data, as zero returns may reflect illiquidity not cease of trading. This criterion was likewise useful in handling dead/delisted stocks. For cash dividends, following Schmidt et al. (2017), cash dividend is divided by a fixed value (10), which is chosen arbitrary, if dividends is greater than half the adjusted prices[11]. Following Hou et al. (2011) and Karolyi and Wu (2012), monthly returns that fall outside 0.1% and 99.9% are treated as missing. Finally, February 2011 is omitted from time series owing to the EGX ceasing of trading due to the political uprising.

2.2.2.2 Phase two: using other sources and merging data

It was mentioned that collected TDS data relies on the list of firms with adjusted prices, while the list of 51 stocks is out of TDS coverage for market data. Therefore, EGID and Decypha sources are employed to collect market data for this list. The following procedures are implemented to merge data.

First, stocks' codes of TDS are employed to unify the whole dataset. Second, monthly adjusted prices at the closing price of the last day of the month are requested from Decypha to match TDS closing price definition. Decypha provides monthly adjusted prices at transaction dates. Therefore, to have a consistent monthly series with TDS, individual price series are padded with constant values equal to the value of the last trading month[12]. Third, TDS defines market value (MV) as unadjusted share price multiplied by the number of ordinary shares in issue. To have a consistent variable for MV for the whole dataset, TDS' unadjusted prices are used. The numbers of ordinary shares for 51 stocks are requested from EGID, but it only provides yearly values. Therefore, the frequency of the variable is converted from yearly to monthly through detecting the month at which the figures change. This is done by exploiting the monthly bulletins of the Egyptian stock market, and Decypha's corporate action information for individual firms[13]. Fourth, returns are calculated in the same way as the TDS sample using adjusted prices and dividends series. Cash dividends are requested from EGID, which provides cash dividends announcements per year. With the help of Decypha's corporate action information for individual firms, a series of cash dividends is built for each firm. To have a consistent cash dividends dates with TDS, the ex-Dividend date from EGID data and effective date from Decypha are

[11] Another check, Ince and Porter (2006) delete returns that is greater than 300% and reversed within one month, and $(1 + R_t)(1 + R_{t-1}) - 1$ is less than 50%. Nevertheless, there was no need to delete any returns according to this criterion.

[12] Limitation might exist if two sources adjust prices for corporate actions in different ways, which we have no access to information about it. Since returns are the main interest, this limitation can be of less importance.

[13] For Decypha, the completion date is applied to spot the change in the number of shares.

employed. One limitation is that cash dividends are not adjusted for corporate actions like the counterpart variable (DDE) in TDS. The only thing that could be done is to adopt the same screening criterion used with TDS sample, which is dividing dividends by fixed value (10), if it is greater than half the adjusted prices. This criterion helps in smoothing return series. Finally, individuals financial statements of firms are utilised to fill TDS missing observation for corporate variables which are book equity, total asset and net income, ensuring that the same definitions and units as TDS are used. Table A.3 presents a summary for the final constructed dataset.

In conclusion, using different data sources, a comprehensive and reliable dataset for active and dead individual stocks of the Egyptian stock market, as much as feasible, is constructed. This dataset overcomes the shortage of firm coverage of TDS. It increases the accuracy of corporate variable of TDS by correcting or filling missing values using firms financial reports. Static and dynamic screening techniques have been applied to overcome some flaws in the TDS data. This contributes to the uniqueness of the dataset.

2.2.3 Dataset overview

The final dataset consists of a universe of 227 stocks, of which 217 stocks have available corporate data as shown in Table A.3. This dataset is unique owing to its coverage, breadth of variables, and care in construction. Information about the available numbers of stocks per year for each of the sorting variables (size, B/M, investment and profitability) is presented in Table A.4. It shows the increased sample coverage in the second half of the sample period (2003-2017). Data on financial sector (banks, financial services and real estate) are included in the sample.

Financial firms are not excluded for several reasons. First, excluding financials decreases the universe of stocks to 160 stocks[14], and the time series coverage by one year. This would further lower the power of the tests given the small sample size. Second, banks, financial services and real estate sectors are of special importance in the Egyptian market. They constitute together 48% of the market capitalization by the end of 2016 (EGX, 2016). Third, there is no solid theoretical reason for excluding financial firms. The empirical motivation behind excluding financial firms is that they are most probably highly leveraged firms. This leverage does not have the same meaning as non-financial firms where high leverage more likely indicates financial distress. Nevertheless, Modigliani and Miller (1963) argue that leverage affects beta but it does not invalidate the CAPM. Baek and Bilson (2015) extend the Barber and Lyon (1997) study and show that size and value premiums exist in both financial

[14]Not all of these stocks have corporate data.

and non-financial firms, suggesting that the Fama and French three-factor model can be used to identify common variation in returns of financial firms. Accordingly, the analysis is done using the whole sample. At the same time, a robustness check for factor models using non-financial firms is conducted, and similar conclusions are reached.

2.2.4 Extension to the dataset

One of the main extension to the dataset is the variable of state (government) ownership of firms, which is required for the analysis of Chapter 4. Only the construction of this variable is discussed in this chapter as follows. Data on yearly ownership structure are hand collected from disclosure reports of board of directors and shareholder structure for individual firms (December issues) for the period 2006-2017. Theses annual reports are purchased from Egypt for information dissemination (EGID) for 120 firms of actively traded firms in the Egyptian market, excluding banks and financial services[15]. The starting year is 2006 because ownership structure data is only available starting from this year.

Disclosure requirements for the EGX have changed since 2014, which require some choices whilst assembling the data. Early disclosure reports for the period of 2006-2013 required a firm to disclose the names of its shareholders whatever the number of shares they hold and their percentage of firm's capital. The classification of shareholders was divided into 6 main categories: individual, managerial, public sector (and/or public sector enterprises), private sector, employment association and investment fund (above 5%). Public and private sectors categories were divided into holding companies, companies, banks, insurance companies, investment funds and other institutions. Since 2014 the firm is required to disclose names of only shareholders holding more than 5% of firm's capital and the percentage for each of them, without any classification as in the older form. To handle these changes in disclosure requirements, a new time series are constructed for whole series 2006-2017, which identify shareholders only owning more than 5% of the company's shares. Moreover, classification of early form is followed by matching names of shareholders, given that ownership structure does not change frequently. If a new shareholder appears after 2014, tracking the identity of this shareholder is checked by using search engines or firms' websites.

Defining government ownership: Data on public sector and public sector enterprises section provides clear data for direct government ownership. It includes stock holdings by any type of government owned or controlled entity which is the definition used by the study for state ownership. The detailed items for this section are

[15]However, the study keeps real estate firms due to this sector importance in the Egyptian market.

as follow. Holding companies: refers to holding companies that is run by public sector enterprises ministry or other ministries. Companies: refers to companies affiliated to ministries, holding companies or other entities controlled by the government. State owned financial entities: are represented by three items; banks, insurance companies and investment funds. Public investment funds are very few and are mainly insurance funds for public sector, private sector or various authorities' employees. Lastly, other institutions: includes other national government ministries, public authorities or organizations. This definition of state ownership, as any type of government owned or controlled entities that hold the firm stocks, is consistent with Borisova et al. (2015) and Jaslowitzer et al. (2018)[16].

2.3 Summary statistics

Summary statistics of the main dataset are provided in this section. Return statistics are presented first, then the statistics of firms' corporate (sorting) variables.

2.3.1 Return statistics

Table 2.1 presents summary statistics of monthly returns for the equal-weight (EW) and value-weight (VW) market, micro, small, big and all excluding micro stocks for July 2003 to June 2017. Big stocks represent the top 90% of market capitalization at the end of June each year, meanwhile micro stocks represent the bottom 2%. Statistics include averages, standard deviation, median, skewness, kurtosis, and Jarque-Bera and Cumby-Huizinga chi-square values for normality and autocorrelation tests, respectively. On average, micro stocks represent 42% of all sample firms, but constitute only 2% of market capitalization. Micro stocks average return (2.7%) has a large influence on EW market return (2.3%), whereas big stocks return (2.85%) is deriving the VW market return (2.9%) and all stocks excluding micro stocks. Micro stocks have higher returns than small and big stocks in both EW and VW returns, which refer to the size effect of Banz (1980). Average VW market return (2.9%) is higher than its EW counterpart at 2.3%, which reflects the dominance of big firms in the Egyptian market. Micro stocks are volatile and dominate overall volatility, reflected in high standard deviation for micro stocks than small and big stock in either EW or VW returns. Generally, average and standard deviation of returns are higher compared to the US market. For

[16]However, Borisova et al. (2015) and Jaslowitzer et al. (2018) employ the ultimate ownership (voting rights) not just the direct ownership (cash flow rights). There is no problem in using direct ownership, as Boubakri et al. (2011) show that observable government ownership is not significantly different from ultimate ownership in emerging markets as most privatizations are gradual and do not involve a transfer of control rights.

US, average monthly VW (EW) market return is 0.94% (1.36%), while average VW (EW) big stocks return is 0.92% (1.07%), and the highest standard deviation is for micro stocks at 6.99% (Fama and French, 2008)[17].

Table 2.1 Summary statistics of returns

	Equal-weight average returns					Value-weight average returns				
	Market	Micro	Small	Big	Ex.Micro	Market	Micro	Small	Big	Ex.Micro
Count	167	167	167	167	167					
Firms	176	75	51	50	101					
Mean	2.30	2.71	2.13	1.93	1.96	2.90	4.43	3.70	2.85	2.84
std	8.37	10.10	8.43	8.19	7.82	7.97	11.73	9.03	8.25	7.96
Min	-26.76	-26.33	-27.31	-27.87	-27.01	-23.15	-26.00	-21.86	-23.29	-23.15
Med	2.12	1.66	1.98	1.82	1.96	2.61	3.12	2.70	2.52	2.43
Max	27.30	31.08	25.77	41.42	33.38	36.11	40.18	32.51	40.09	36.31
Skewness	-0.06	0.14	0.05	0.47	0.14	0.36	0.45	0.42	0.52	0.38
Kurtosis	3.78	3.49	3.92	6.30	4.94	4.62	3.67	3.60	5.19	4.68
JB	4.31	2.23	5.97*	82.11***	26.72***	21.91***	8.74**	7.50**	40.95***	23.51***
Actest (1)	4.03**	4.0**	2.88*	4.70**	3.52*	7.18***	5.22**	3.28*	7.06***	7.39***

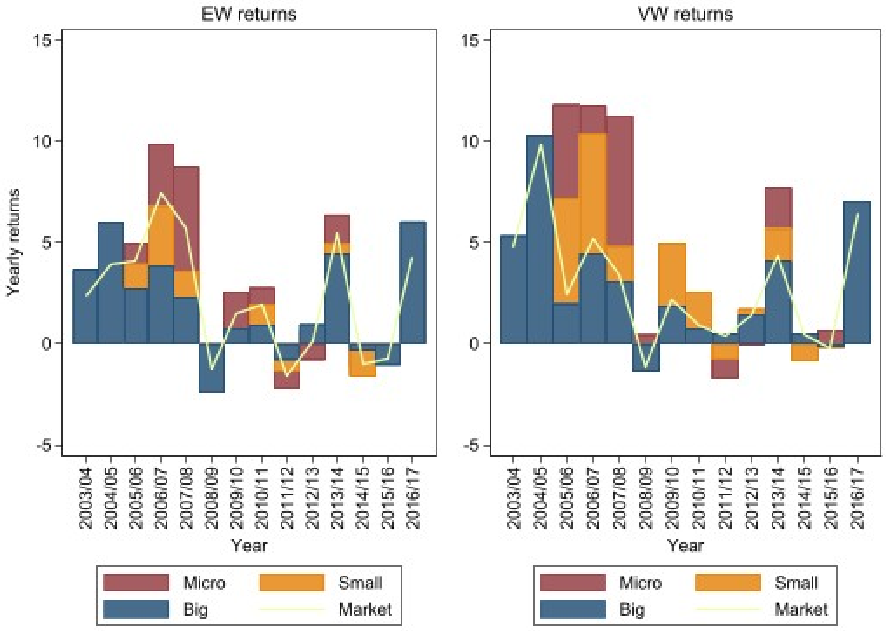
This table reports time-series averages and standard deviation and other statistics of monthly equal-weight and value-weight returns for all stocks in the data set (Market), and for Micro, Small, Big and all excluding micro (Ex.Micro) stocks for July 2003 to June 2017. Stocks are assigned to each size group at June each year. Big stocks are those in the top 90% of market cap. Micro stocks are those in the bottom 2%. Counts are the number of monthly observations. Firms presents the average of yearly number of firms in each size group. JB is the Jarque-Bera asymptotic test for normality under the null hypothesis of normality. Actest is the Cumby and Huizinga (1990, 1992)'s test for autocorrelation, at lags (1), under the null hypothesis that time series is a moving average of known order q (here, q=0). *,** and *** refer to significance levels of 10%, 5% and 1%, respectively.

The statistical distributions of returns indicate positive skewness, which is preferred to investors, except for EW market return (-0.06). The positive skewness values are higher for VW returns and for big stocks for EW returns. Series exhibit levels of Kurtosis, which indicate that big shocks of either signs are likely to be present. Kurtosis is higher for big stocks than smaller stocks at 5.19 (6.30) for VW (EW) returns. The Jarque-Bera test for normality confirms the significant non-normality of returns for all size categories for VW returns and for small and big stocks for EW returns at 95% confidence level. The dependence of the stock returns is also challenged. The null hypothesis of no serial correlation (lag=1) for most of the series is rejected. Serial correlation is common in emerging markets due to infrequent trading and slow diffusion of information into prices (Bekaert and Harvey, 2002). However, serial correlation at higher lag than 1 does not exist. Stock return statistics confirm some of the well-known facts about emerging markets, which are high return, risk and dependency or predictability of returns.

Figure 2.1 displays the average monthly returns of the EW and VW market, micro, small and big stocks by year. The figure confirms that the market VW (EW) return

[17] I am aware that comparison might not be perfectly valid due to different time frame, especially with a long time series for the US market (1963-2005).

Fig. 2.1 Average returns by year



This figure shows the average yearly returns of equal-weight and value-weight micro, small, big and all (market) stocks. The left panel is for EW returns and the right panel is for VW returns. To match the procedure that stocks are assigned to each size group at June each year, a year represents months from July to June of the following year. For example, year 2003/2004 is for the average of monthly data from July 2003 to June 2004. Detailed numbers are available in Table A.5 in the appendix.

is following big (micro) stocks. Both panels show that the Egyptian market was hit badly in years 2008, 2011 and 2015 due to external and local shocks. For example, the global financial crisis (2008), the political uprising in Egypt (or Arab spring in the region) and US and Europe debt crises accelerated in 2011, and the gloomy picture highlighted in 2015 about the world growth, currency war, falling oil prices, as well as the political tension in the region. Micro and small stocks were hit hard during the political uprising in 2011 than big stocks, whilst big stocks were mostly affected during the 2008 financial crisis. Despite the political tension, Egypt was one of the best five performers in 2012, 2013 and 2014 according to Morgan Stanley (MSCI) Emerging market index. The remarkable performance in 2016 was reflected in an increase in market capitalization by 40% from the previous year to exceed LE 600 billion for the first time since the financial crisis in 2008, which can be partially attributed to the floating of the Egyptian pound.

Correlations of returns The dataset provides a good representation of the Egyptian stock market. This can be proven by the statistics and correlations of the returns of constructed VW or EW market portfolio (which is average returns using all stocks; the market return in Table 2.1) and the returns of the main Egyptian market indices;

EGX30, EGX70 and EGX100. EGX30 index is the benchmark index, which tracks the performance of the top 30 liquid and active companies. It is weighted by market capitalization and adjusted by free floating. EGX70 price index, introduced in 2009, follows up the performance of the 70 active companies, after excluding the 30 most active constituent-companies of EGX30. EGX100 price index tracks the performance of the 100 active companies, including both the constituent-companies of EGX30 and EGX70 indices. EGX70 and EGX100 indices are not weighted by market capitalization. Taking the point of view of international investors, the monthly returns of the standard and poor's S&P/IFCI price index for Egypt in both Egyptian pounds and US dollars are added. The latter is beneficial for better comparison with international indices returns in US dollars such as S&P 500, S&P/IFCI Asia, S&P/IFCI Europe and S&P Pan Arab.

Panel A of Table 2.2 presents the return statistics of VW and EW market portfolios, the main Egyptian market indices, and some international and regional indices for the period of July 2003-June 2017. The mean returns are higher than 2% for the VW and EW market portfolios, the value-weight EGX30 index and S&P/IFCI Egypt index denominated in Egyptian pounds. This confirms the dominance of large firms in the Egyptian stock market. S&P/IFCI Egypt index in dollar terms has lower return at 1.60% compared to local currency counterpart, which may reflect other factors such as currency risk. Compared to the world, the average return of this index is higher than averages of S&P 500 and other regional indices in Asia, Europe and Arab countries, which reflects the attractiveness of investing in the Egyptian market. Correlation coefficients between indices returns are reported in Panel B of Table 2.2. The value-weight market portfolio (VW-MKT) is highly correlated with the main market index; EGX30 and S&P/IFCI Egypt index at 96% and 93%, respectively. Its correlation with EGX70 and EGX100 is lower but still high at 84% and 92%, respectively. This is because the latter indices are not value-weighted, and have instead higher correlation with EW-MKT returns, add to this that EGX70 excludes the performance of the top 30 firms (EGX30 constituents). Therefore, the constructed VW market portfolio is believed to be representative of the market, and it is preferred for factor analysis since it includes all stocks and depends on total return. Correlations coefficients also refer to possible international portfolio diversification benefits by investing in the Egyptian market. The correlation between S&P/IFCI Egypt ($) and S&P 500 is only 36%, while its correlation with Asia and Europe regions are at 52% and 50%. This observation is consistent with earlier evidences of the segmentation of the Egyptian stock market and potential benefits of portfolio diversification (Cheng et al., 2010; Haikal and Barakat, 2019; Mansourfar et al., 2010).

Table 2.2 Descriptive statistics and correlation of the monthly market returns

Panel (A): Descriptive statistics of markets returns

	Count	Mean	std	Med	Min	Max
VW-MKT	167	2.90	7.97	2.61	-23.15	36.11
EW-MKT	167	2.30	8.37	2.12	-26.76	27.30
EGX30	167	2.19	9.80	2.19	-29.28	36.58
EGX70	112	0.19	10.26	0.98	-29.02	32.39
EGX100	136	0.66	8.94	1.06	-28.67	32.61
S&P/IFCI Egypt	167	2.24	10.08	2.00	-30.63	39.76
S&P/IFCI Egypt ($)	167	1.60	10.14	1.64	-32.03	45.39
S&P500 ($)	167	0.60	3.89	1.07	-16.94	10.77
S&P/IFCI Asia ($)	167	1.01	6.27	1.15	-24.54	17.34
S&P/IFCI Europe ($)	167	0.73	8.35	0.95	-35.06	22.46
S&P Pan Arab ($)	149	0.23	6.00	0.51	-23.79	16.15

Panel (B): Correlation coefficients of markets returns

	VW-MKT	EW-MKT	EGX30	EGX70	EGX100	S&PEG	S&PEG($)	S&P500	Asia	Euro	Arab
VW-MKT	1										
EW-MKT	0.85	1									
EGX30	0.96	0.74	1								
EGX70	0.84	0.96	0.76	1							
EGX100	0.92	0.95	0.86	0.97	1						
S&P EG	0.93	0.71	0.98	0.75	0.85	1					
S&P EG($)	0.74	0.58	0.82	0.56	0.65	0.83	1				
S&P500($)	0.42	0.42	0.42	0.46	0.48	0.40	0.36	1			
S&P Asia($)	0.54	0.50	0.52	0.49	0.54	0.50	0.52	0.76	1		
S&P Europe($)	0.54	0.49	0.53	0.49	0.52	0.50	0.50	0.68	0.79	1	
S&P Arab($)	0.56	0.45	0.57	0.52	0.54	0.56	0.53	0.45	0.47	0.50	1

This table presents monthly return summary statistics of the constructed value-weight (VW-MKT) and equally-weight (EW-MKT) market portfolios, the main Egyptian market indices (EGX30, EGX70, and EGX100), and other international and regional indices in Panel (A), and the pairwise correlation coefficients between them in Panel (B). VW-MKT and EW-MKT portfolios returns are without deducting the risk free rate. Statistics cover the period of July 2003-June 2017. EGX30 tracks the performance of top 30 active and liquid companies, EGX70 includes active 70 firms beyond the top 30 and EGX100 follows up the performance of firms in both indices. Standard and poor's indices are denominated in US dollar except S&P/IFCI Egypt which presented in both local currency and US dollars. The source of indices data is Datastream.

2.3.2 Firm characteristics

Firm characteristics are presented in Table 2.3. The small value of sample size median at 315 million Egyptian pounds confirms the large number of small stocks in the sample. Median B/M ratio for the whole sample is 0.77 (The average of annual median values is 0.84). This ratio can be comparable to the averages of median B/M ratios for emerging markets (Asia, Eastern Europe, and Latin America) at around 0.75 (Cakici et al., 2013). The median of investment variable is 6% (the same as the average of annual median values). This value is relatively close to Titman et al. (2013)'s study, where they show that the time series averages of annual medians of asset growth for Egypt is 8% for the period of 2004-2010, whereas the values for Japan, US, UK and Turkey, amongst other, are at 3.5%, 6%, 9% and 48.2%. Lastly, the median of net income to book value (ROE) ratio is 0.11 (0.13 after excluding negative earnings). Because it is not easy to explain the figures on its own, and these statistics are most probably dominated by small stocks, it is important to build portfolios sorted on these variables and size, and then check their patterns across portfolios.

Table 2.3 Firm characteristics

Years	Size				B/M				Investment				ROE			
	Med	std	Min	Max	Med	std	Min	Max	Med	std	Min	Max	Med	std	Min	Max
2003	159.5	882	2.1	5413	1.33	1.92	0.12	10.50	0.04	0.43	-0.24	2.79	0.09	0.18	-0.57	0.62
2004	157.5	1673	2.2	12554	1.11	1.25	0.08	9.36	0.04	0.17	-0.46	0.68	0.11	0.18	-0.70	0.40
2005	188.0	6251	3.5	64619	0.95	1.19	0.05	6.75	0.06	0.24	-0.33	1.40	0.14	0.19	-0.74	0.52
2006	261.5	5800	4.6	52875	0.62	1.23	0.05	8.12	0.04	0.29	-0.21	1.75	0.15	0.27	-1.49	0.87
2007	457.5	9150	5.1	79937	0.54	0.71	0.07	4.76	0.09	0.52	-0.39	2.93	0.15	0.19	-0.47	0.98
2008	766.1	8678	10.0	72852	0.45	0.41	0.03	2.17	0.12	0.41	-0.39	2.43	0.17	0.18	-0.46	0.96
2009	542.5	4954	10.0	41019	0.83	1.10	0.10	8.40	0.10	0.69	-0.49	4.92	0.16	0.29	-1.95	0.90
2010	391.9	5384	14.5	47061	0.63	0.82	0.06	6.53	0.06	0.25	-0.34	1.34	0.11	0.19	-0.97	0.49
2011	397.0	5575	17.0	56338	0.63	0.63	0.08	4.34	0.08	0.50	-0.37	3.36	0.11	0.19	-0.92	0.47
2012	308.4	5005	7.2	51936	1.06	1.42	0.19	9.62	0.03	0.16	-0.53	0.49	0.07	0.26	-2.01	0.53
2013	194.1	4624	6.6	50317	0.90	1.12	0.10	9.12	0.03	0.19	-0.33	1.22	0.07	0.18	-0.71	0.54
2014	345.5	5830	7.0	56204	0.82	1.23	0.06	10.97	0.05	0.21	-0.26	1.61	0.09	0.31	-0.29	2.47
2015	271.4	6328	5.4	59382	0.80	1.54	0.08	14.24	0.05	0.20	-0.22	1.16	0.08	0.18	-0.41	1.17
2016	246.4	5377	3.6	45959	1.12	1.21	0.08	9.21	0.04	0.31	-0.53	1.88	0.07	0.27	-1.50	0.55
Whole	315	5901	2.10	79937	0.77	1.18	0.03	14.24	0.06	0.37	-0.53	4.92	0.11	0.23	-2.01	2.47

This table reports the descriptive statistics of firm characteristics (or sorting variables). Size is measured as market value (market equity) at the end of June, year t. Book to market ratio is book equity for the fiscal year ending in calendar year t-1, divided by market equity at the end of December of t-1. The investment ratio is the change in total assets from the fiscal year ending in year t-2 to the fiscal year ending in t-1, divided by t-2 total assets. The ROE, which is the alternative profitability measure, is earnings for the fiscal year ending in t-1, divided by book equity at the end of year t-1. B/M statistics are excluding firms with negative book value each year. B/M, Investment and ROE statistics are winsorized each year at 0.5 and 99.5%.

Summary statistics have shown that the Egyptian stock market shares the characteristics of emerging markets of high return and risk and to some extent the dependency of returns. Investing in Egypt provides benefits for international portfolio diversification. The constructed VW market portfolio and hence the dataset are representatives of the market. For a more meaningful discussion of firm characteristics and return patterns, the study intends next to construct portfolios double-sorted on size and anomaly variables and check their patterns across portfolios.

2.4 Construction of portfolios: Factors and test assets

To test factor models and to explore the Egyptian market returns dynamics in more details, it is important to group stocks into portfolios[18]. The main challenge in constructing factors or test assets portfolios is the choice of breakpoints that are related to famous Fama-French breakpoints to enhance comparability whilst taking into account market characteristics. For example, it is noticed from summary statistics a large tail of small stocks. Add to this the fact that the main stock market index EGX30 represents only top 30 liquid and active companies. Therefore, the choice of breakpoints is inspired by Fama and French (2012, 2016) for international data and studies for the UK (Gregory et al., 2013) and Australian (Chiah et al., 2016) markets, which are characterized by a large tail of small stocks, as well as for emerging markets (Cakici et al., 2016). In this section, the construction of factors and test assets portfolios with the choice of breakpoints are discussed. MATLAB codes are developed from scratch to construct these portfolios.

2.4.1 Factors portfolios

Six factors are considered, which will be used as explanatory variables (RHS) in asset pricing regressions as proposed by Fama and French (1993, 2015, 2018). These factors are the market factor (MKT), the small minus big (SMB) size factor, the high minus low (HML) value factor, the robust minus weak (RMW) profitability factor, the conservative minus aggressive (CMA) investment factor and the winner minus loser (WML) momentum factor.

Factors returns are for portfolios constructed from 2×3 independent sorts on size and each of other anomaly variables (B/M, investment and profitability) at the end of each June following Fama and French (2015)[19]. This results in six portfolios for each size-BM, size-Prof and size-INV sorts. Size is measured as market value (market

[18] Grouping stocks into portfolios helps reducing measurement error in betas. Portfolios betas would be measured more accurately since they tend to be more stable over time.

[19] June is chosen as portfolio formation date, as approximately 75% of firms in sample report at 31 December, and thus to allow for 6 month for accounting information to be available.

equity) at the end of June of year t. Other anomaly (corporate) variables are defined earlier in the choice of variables. For breakpoints, in the spirit of Gregory et al. (2013) and Fama and French (1993, 2016), the median of 100 big firms is used to divide stocks into big and small, and the 30th-70th percentiles of 100 big firms is used as B/M, profitability and investment breakpoints. This choice is motivated by the observation that on average the biggest 50 firms (or the median of biggest 100 firms) corresponds to 90% of market cap in the sample. The 100 biggest firms may best resemble the NYSE[20]. Alternative portfolios using different choices of breakpoints are discussed in the Appendix A.3, which will be considered for further robustness checks. Each year, firms with negative book value and negative ROE are excluded from Size-BM and Size-Prof portfolios' formation, respectively. As market and corporate data are collected separately, an added restriction is that if corporate data is available, the firm should be alive for at least 6 month in order to be included in portfolios formation[21].

For size-BM portfolios, the independent size and B/M sorts result in six portfolios (S/L, S/N, S/H, B/L, B/N and B/H), where S and B refer to small and big, whilst L, N and H stand for low, neutral and high B/M ratios. Monthly value-weight (VW) returns for each portfolio are computed from July of year t to June of year t+1. The size factor (SMB_{BM}) is constructed as the average return on three small portfolio minus the average return on three big portfolios; SMB_{BM}= (SL+SN+SH)/3 -(BL+BN+BH)/3. The value factor, HML, is the average of two high B/M (value) portfolio returns minus the average of two low B/M (growth) portfolio returns, HML= (SH+BH)/2 - (SL+BL)/2, or the average between value premium on small and big stocks [(SH-SL) + (BH-BL)]/2 = (HMLs + HMLB)/2. The second representation is valuable to check the value premium for big and small stocks, separately. Similarly, VW Size-INV and Size-Prof portfolios are constructed by independent size and investment and profitability sorts respectively. They produce another two size factors; SMB_{INV} and SMB_{Prof} and investment and profitability factors; CMA and RMW. RMW and CMA are constructed in the same way as HML except the second sort is profitability (robust minus weak) and investment (conservative minus aggressive). $RMW = (RMW_S + RMW_B)/2$ and $CMA = (RMW_S + RMW_B)/2$. The size factor for the Fama and French five-factor model is then calculated as the average of the size factor for each sorts; $SMB = (SMB_{BM} + SMB_{INV} + SMB_{Prof})/3$.

[20]Fama and French (1993) use NYSE breakpoints, then apply it to the whole sample of NYSE, AMEX and NASDAQ.

[21]6 months are used because usually stocks become dead by the end of December, and portfolio returns are computed from July to June. Therefore, this restriction allows dead stocks to be included in portfolio formation in their last year.

The momentum factor, WML, is defined as HML except that it is updated monthly instead of annually, and the lagged momentum replaces B/M. The value-weight portfolios for month t+1, formed at the end of month t, come from the intersection of the independent 2×3 sorts on size (market cap at the end of month t) and the lagged momentum returns (a stock's average monthly return from t-11 to t-1, following Fama and French (2018)). Skipping the return for the month before the return to be explained is common in the momentum literature to avoid the one month reversal in stock return that might be related to micro-structure or liquidity issues. Monthly observations from July 2003 to June 2004 are lost in the computation of momentum. $WML = (WML_S + WML_B)/2$. Finally, the market factor (MKT) is the excess return on the market portfolio, which is calculated as value-weight returns of all stocks in the sample minus the 3-month treasury bill rate (r_f).

2.4.2 Double-sorted portfolios (Test assets)

Test assets portfolios returns are average returns of portfolios formed to produce large spreads in size, B/M, profitability, investment or momentum, and they are the LHS portfolios, to be explained, by factor models. They are constructed from 3×3 independent sorts on size and each of B/M, profitability and investment (and momentum) at the end of June each year (at the end of each month). The study uses 3×3 instead of 5×5 portfolios in the Fama-French model due to the small sample size and the skewed distribution of the underlying sorting variables[22]. However, it is better than earlier studies for Egypt that use only 2×2 portfolios such as Taha and Elgiziry (2016). The 90% and 98% of market cap are chosen as breakpoints to build three size groups; micro, small and big inspired by Fama and French (2008)[23]. The choice of 98% is driven by the notion that the biggest 100 firms in the sample constitute almost 98% of market cap, on average. A further reason is that EGX indices are EGX20-Cap, EGX30, EGX50, EGX70, and EGX100. Hence, these micro stocks lie beyond biggest 100, and they may suffer from illiquidity/ microstructure anomalies or may be out of the tradable universe of investors. As before, the 30th-70th percentiles of the biggest 100 firms are used as B/M, profitability, investment and momentum breakpoints. For each portfolios, monthly VW excess returns over r_f are computed from July of year t to June of year t+1, except for momentum portfolios that are re-balanced monthly.

[22]The study has tried 5×5, 4×4, 4×3, and 3×4, but empty cells appear especially in early years of the sample (2003-2007). Therefore, it is decided to stick to 3×3 portfolios.

[23]They use the 20th and 50th percentiles of NYSE stocks, where big portfolio constitutes approximately 90% of market cap, while micro firms constitute 3% of market cap. In other words, they employ the 90% and 97% as breakpoints.

2.5 Descriptive statistics of portfolios

The double-sorted portfolios (test assets) provide one way to investigate anomalies patterns in returns, which is referred to as portfolio sorts. Specifically, this section examines the size, B/M, profitability, investment and momentum patterns in average returns of these portfolios by examining return patterns across the sort. Afterwards, the exploration of these portfolios characteristics is discussed.

2.5.1 Size, B/M, profitability, investment and momentum patterns in average excess returns

Examination of the size, B/M, profitability, investment and momentum (anomalies) patterns in average excess returns for 3 × 3 VW test assets portfolios is presented in this section. Table 2.4 reports monthly percent excess return means and standards deviations of these portfolios. For Size-B/M nine portfolios (Panel A), size effect is shown clearly in each B/M column. Micro stocks have the highest average returns followed by small then big stocks. M-B refers to the difference in average returns between micro and big stocks for each column. The largest size spread is for high B/M group at 1.55% (significant at 10%). For each size row, the relation between average return and B/M is highlighted, which is known as the value effect. The value effect is obvious for micro and small portfolios, in which average return increases monotonically with B/M. H-L is the difference in average returns between high and low B/M portfolios. The highest value spreads are shown in micro and small stocks at 1.74% and 1.26% per month (significant at 5% and 10%, respectively). In size row of big stocks, the return drops in neutral category before increasing again. However, H-L spread is positive at 0.77%. The strongest value effect for smaller stocks is consistent with Fama and French (2015). Evidences of higher average excess return of small stock over big stocks, and value stocks (high B/M) over growth stocks (Low B/M) are consistent with Taha and Elgiziry (2016) for Egypt.

Panel B of Table 2.4 reports the average excess returns for Size-Prof portfolios, where the profitability as well as size effects can be checked. In general, profitability spread H-L is smaller than what is produced previously by the value spread. The profitability effect is shown in small and big stocks (rows), in which average return is higher for robust than weak profitability stocks, as reflected in H-L column at 0.62% and 0.22% per month, respectively. On the other hand, interestingly there is an opposite profitability effect for micro stocks (H-L= -0.85%), where micro weak profitability stocks have the highest average returns at 3.66% per month. Nevertheless, the spread for these portfolios is not high enough to pass the significance test, and the

Table 2.4 Test assets portfolios average excess returns

	Panel (A): Size-BM portfolios							
	Low	**Neutral**	**High**	H-L	**Low**	**Neutral**	**High**	H-L
		Mean				**std**		
Micro	2.35	2.54	4.09	1.74**	14.43	12.71	12.69	10.98
Small	1.98	2.23	3.24	1.26*	10.59	9.02	11.17	9.03
Big	1.78	1.62	2.54	0.77	8.66	8.45	11.45	8.13
M-B	0.58	0.92	1.55*		12.41	10.25	11.88	

	Panel (B): Size-Prof portfolios							
	Weak	**Neutral**	**Robust**	H-L	**Weak**	**Neutral**	**Robust**	H-L
		Mean				**std**		
Micro	3.66	2.52	2.81	-0.85	14.46	10.48	11.69	11.03
Small	2.01	2.80	2.63	0.62	10.26	9.64	9.62	9.25
Big	1.68	2.12	1.90	0.22	12.32	8.73	8.64	9.03
M-B	1.98**	0.41	0.91		11.82	9.58	10.40	

	Panel (C): Size-INV portfolios							
	Conserve	**Neutral**	**Aggressive**	H-L	**Conserve**	**Neutral**	**Aggressive**	H-L
		Mean				**std**		
Micro	3.85	2.46	3.33	-0.51	14.35	11.50	14.35	12.57
Small	2.22	2.74	1.89	-0.33	10.68	10.41	8.43	8.22
Big	1.70	1.81	2.13	0.43	10.10	9.14	8.98	7.32
M-B	2.15***	0.65	1.21		10.49	9.42	12.46	

	Panel (D): Size-Mom portfolios							
	Loser	**Neutral**	**Winner**	H-L	**Loser**	**Neutral**	**Winner**	H-L
		Mean				**std**		
Micro	3.36	3.92	5.01	1.66*	11.67	12.44	15.18	12.24
Small	2.44	2.16	2.57	0.13	10.27	9.19	12.13	9.06
Big	1.24	1.42	1.93	0.69	10.18	8.40	9.58	9.25
M-B	2.12***	2.51***	3.09***		8.72	9.23	13.60	

This table presents average monthly VW excess returns (and their standard deviations) for portfolios formed on size and B/M, ROE, investment and momentum. Sample period is from July 2003 to June 2017, except for momentum which starts from July 2004. Size-BM, and Size-PROF, Size-INV, Size-Mom portfolios are formed from independent sorts on size and B/M, profitability, investment and momentum. Size has three categories; micro, small and big. Other sorting variables (B/M, profitability, investment and momentum) have three groups from low (left) to high (right) values of the sort. Monthly value-weight excess returns are computed for each portfolio from July of year t to June of year t+1, except for momentum portfolios that re-balanced monthly. H-L is the difference between average returns of high and low sorting portfolios. M-B is the difference in average returns between micro and big stocks. *,** and *** refer to significance levels of 10%, 5% and 1%, respectively.

increase in average return from weak to robust profitability is not clearly monotonic as in the case of B/M. Higher profitability spread for small stocks is consistent with Fama and French (2015). Size effect is shown smoothly in weak and robust profitability stocks in which average return falls as size increases but M-B spread is positive in all three profit categories. The highest M-B spread is for weak profitability stocks at

1.97% per month. This is consistent with Panel A, in which the highest M-B spread is for high B/M stocks, as usually high B/M stocks correspond to weak profitable stocks, as discussed next in portfolios characteristics.

Regarding size-INV portfolios presented in Panel C of Table 2.4, the relation between investment and average return is supposed to be negative (known as asset growth effect), and thus higher average return for conservative (low investment) than aggressive (high investment) stocks. By considering H-L, the investment effect can be shown in micro and small stocks with negative spread at -0.51% and -0.33%, respectively. Again, the spread is not high enough to pass the significance test[24], and the decrease of average return from conserve to aggressive category is not monotonic as the case of B/M. Interestingly, there is an inverse investment effect for big stocks, where average return is higher for aggressive, then neutral and conserve investment categories, which raises a question about the behaviour of big stocks. A stronger investment effect for smaller stocks is consistent with Fama and French (2008, 2015). Size effect is clear in conserve column; that is average return decreases with an increase in size. However, M-B spread is positive for the three columns. The highest M-B spread is for conserve column at 2.15% (significant at 5%).

Panel D represents the relation between momentum and average returns. For each size row, average returns increase moving from losers to winners (of last year), especially for micro and big firms, which show the presence of momentum patterns in returns. H-L is positive and more stronger for micro stocks at 1.66% per month. The larger momentum spread for the smallest stocks is consistent with results for developed markets (Fama and French, 1992) and for emerging markets (Cakici et al., 2013). The size patterns in momentum returns are obvious across all columns, with high and significant values for M-B spread.

From the above, the study concludes that value and size effect are more important in the Egyptian stock market. Value effect is stronger for micro and small stocks, whereas size effect is significant for high B/M, low profitability, low investment stocks and all momentum categories. Profitability, investment and momentum patterns exist, especially for smaller stocks. Nevertheless, profitability and investment effects are less strong and monotonic compared to the value effect. The opposite profitability pattern in average return for micro stocks of size-prof portfolios and the opposite investment pattern for big stocks in size-investment portfolios are not consistent with Fama and French (2015) but consistent with some emerging markets, for example, Lin (2017) for the Chinese market.

[24]The significance of the spread will be more useful when developing hedging or trading strategies.

2.5.2 Portfolios characteristics

After discussing the anomalies patterns in average returns, it is interesting to explore portfolios characteristics that show the relation between anomaly variables (size, B/M, ROE and investment) that are used to construct test assets and factors portfolios. Furthermore, this can be beneficial to check how factors analysis (regression result) lines up with firms characteristics for next chapter.

Table 2.5 presents portfolios characteristics of test assets portfolios. Panel A shows the average number of firms for each portfolio and Panel B reports the time series averages of the annual equal-weight averages of the variables within each portfolio (averages of size, B/M, ROE and investment). Before discussing the relation between anomaly variables, it is interesting to check how the anomaly variable itself varies across the cell of the sort. This allows for further understanding of the behaviour of average return for that sort. It is discussed in the last section that the relation between average return and profitability (or investment) is not systematic across portfolios, which means that average return does not increase (or decrease) monotonically from low to high levels of the sort. However, the spread H-L in most of the cases is consistent with the expected profitability or investment effect. This can be partially explained by the non-uniform distribution of the variable across the cell of the sort with much action in the extreme. For example, in Size-INV portfolios it is clear that the distribution of the investment rate (INV) is not uniform with negative values in conserve category at around 0.06%, positive values around 0.07% in middle category and extreme values in the aggressive category at 44% on average. Moreover, one can not neglect that a small sample size with only three sorting categories may also contribute to this less monotonic behaviour.

The relation between anomaly variables can be tackled from two lenses. The first one is the well-known empirical observation, that firms with lower B/M ratios tend to be more profitable and invest more (Fama and French, 1995, 2008). The other one is the prediction of investment-based asset pricing models such as Berk et al. (1999) and Zhang (2005) models. The latter models suggest that firm valuation ratio evolves as a response to optimal corporate investment decisions and predict a relation between capital investment and firm characteristics, such as size and B/M. Specifically, growth firms invest more than value firms, and small firms invest more than big firms. This chapter partially explores whether these relation between B/M, profitability and investment are common for the Egyptian firms using portfolio sorts. Moreover, this discussion can provide some insight about factors correlations and their role in regression analysis for the next chapter.

First, B/M and profit: It is noticed from Size-BM and Size-prof portfolios that robust profitability correspond to low B/M. B/M ratios in robust column in Size-Prof portfolios are lower than those in weak profitability. Similarly, for Size-BM portfolios, ROEs are higher for low B/M column than high one (0.16, 0.22 and 0.27 vs 0.11, 0.09 and 0.11). Moreover, big growth (or robust) stocks are more profitable than micro and small stocks (ROE at 0.27 vs 0.16 and 0.22), but value big (or weak) firms are not profitable than micro stocks (with the same ROE at 0.11). This leads to ask: Does this symmetry in B/M and profit behaviour increase their factor correlations and do they provide the same information which might lead to the dominance of one factor than the other in factor analysis. This is tackled later in the analysis of Chapter 3.

Second, profit and investment: The relation between profitability and investment can not be generalized across size groups. It is true that for small and micro stocks, profitable firms invest more. In contrast, the behaviour of big firms is misleading. For example, in Size-INV portfolios, ROEs for micro and small stocks (0.15 and 0.17) in aggressive investment category are higher than conserve investment (at 0.13). The same can be noticed if one looks at INV rates in robust and weak profitability columns for Size-Prof portfolios. However, it seems that big firms are investing less despite high profitability, or some are investing more despite having the same level of profitability. Indeed, in Size-INV portfolios, for the same rate of profitability for big firms (ROE at 0.22), the investment rates are -0.06 and 0.47 for conserve and aggressive columns, respectively. This is confirmed by the opposite direction of investment rates for big firms in Size-Prof portfolios, in which weak profitability firms are investing more at 0.20 compared to robust firms at 0.16. This refers that lower profitability does not necessarily lead to lower investment. In-obvious investment behaviour of big firms matches the opposite investment patterns in average excess return. It is also consistent with Feyen (2010) on the performance of the Egyptian stock market over the period 2003-2007/2008. The author finds that profits are not always translated into investment, as net fixed asset growth is not higher than peer group in emerging markets, which imply underinvestment and the hoarding of earnings. Further analysis of the investment behaviour of the Egyptian firms is illustrated in Chapter 4.

Table 2.5 Portfolio characteristics

	Size-BM portfolios				Size-Prof portfolios				Size-INV portfolios		
	Low	**Neutral**	**High**		**Weak**	**Neutral**	**Robust**		**Conserve**	**Neutral**	**Aggressive**
Panel (A): Average number of firms											
Micro	11	23	30	**Micro**	28	19	8	**Micro**	28	22	15
Small	8	19	19	**Small**	16	15	10	**Small**	14	19	12
Big	20	18	8	**Big**	10	19	16	**Big**	13	19	15
Panel (B): Averages size, B/M, ROE and investment characteristics											
Size (market value)											
Micro	107	100	103	**Micro**	85	107	123	**Micro**	96	104	105
Small	549	553	553	**Small**	574	585	502	**Small**	562	523	588
Big	8445	4321	4890	**Big**	5205	5118	8240	**Big**	5492	5563	7865
B/M ratio											
Micro	0.34	0.80	2.21	**Micro**	1.83	1.11	0.95	**Micro**	1.29	1.62	1.57
Small	0.34	0.77	1.94	**Small**	1.55	1.14	0.68	**Small**	1.27	1.18	1.06
Big	0.32	0.72	1.48	**Big**	1.02	0.72	0.41	**Big**	0.69	0.72	0.65
ROE (+ve)											
Micro	0.16	0.13	0.11	**Micro**	0.05	0.15	0.35	**Micro**	0.13	0.13	0.15
Small	0.22	0.17	0.09	**Small**	0.05	0.15	0.31	**Small**	0.13	0.15	0.17
Big	0.27	0.16	0.11	**Big**	0.05	0.16	0.36	**Big**	0.22	0.20	0.22
INV (asset growth)											
Micro	0.08	0.08	0.06	**Micro**	0.09	0.10	0.14	**Micro**	-0.07	0.07	0.41
Small	0.17	0.13	0.10	**Small**	0.14	0.11	0.14	**Small**	-0.06	0.08	0.44
Big	0.14	0.21	0.14	**Big**	0.20	0.18	0.16	**Big**	-0.06	0.08	0.47

This table provides descriptive statistics of portfolio characteristics. Panel A reports the average number of firms in each portfolio through time. Panel B shows the time series averages of equally-weight averages of size, B/M, ROE and asset growth variables for portfolios formed on size and B/M, size and ROE, size and investment from July 2003 to June 2017. Size is measured as market value at the end of June, year t. B/M ratio is book equity for the fiscal year ending in calendar year t-1, divided by market equity at the end of December of t-1. The investment ratio is the change in total assets from the fiscal year ending in year t-2 to the fiscal year ending in t-1, divided by t-2 total assets. The ROE, is the positive earnings for the fiscal year ending in t-1, divided by book equity at the end of year t-1. B/M, ROE, asset growth variables are winsorized at 0.5 and 99.5 % each year.

Third, B/M and investment: The last thing is to check whether high B/M firms invest less. It is found that the relation is not reflected in both sorts; Size-INV and Size-BM portfolios. For Size-INV portfolios, it is true that B/M ratios are higher in low investment category (conserve) except for micro stocks. For Size-BM portfolios, the investment rates are higher for low B/M than high B/M category except for big stocks, where INV is the same at 0.14. Furthermore, growth (low B/M) big firms are not necessarily investing more, small growth firms have higher investment rate at 0.17 compared to big growth firms at 0.14. This shows the low investment rates for big growth firms despite their higher profitability (ROE at 0.27) in general and compared to small and micro firms. Therefore, big growth firms tend to be more profitable but invest less. This discussion might contribute to an expected lower correlation between investment (CMA) and value (HML) factors. Moreover, it provides preliminary evidence against the investment literature that suggests that the explanatory power of the B/M ratio arises from return predictability associated with optimal investment decisions (Anderson and Garcia-Feijóo, 2006; Berk et al., 1999).

To sum up, portfolios characteristics show that the non-uniform distribution of anomaly variables across the cell of the sort might partially explain the profitability and investment spread H-L in average returns and the weak monotonic change in average return across these sorts. For the relation between anomalies, the study finds that low B/M firms are more profitable. For micro and small firms, profitable firms invest more, but the investment behaviour of big firms is misleading. Profitable big firms do not necessarily invest more, or for the same level of profitability some big firms invest more than others. This might be related to the opposite investment pattern in average excess return for big firms in size-INV portfolios. Lastly, there is a contradictory evidence that high B/M firms invest less. Big firms contribute to this contradiction as big growth firms have high profitability but invest less, compared to value firms.

2.6 Cross-section regressions: Firm level analysis

For further investigation of the size, value, profitability, investment and momentum anomalies returns, the cross-section regressions on individual stocks are applied in the spirit of Fama and MacBeth (1973). These regressions employ the anomaly variables to explain the cross-section of average returns. The study uses regression analysis because the previous analysis on double-sorted portfolios does not prevent the effect of other anomalies to show up in returns, especially when it is shown that some characteristics are correlated, and also due to fact that the small sample size does not allow for multiple sorting. Cross section regressions allow for the estimation of the marginal effect of each anomaly variable. Compared to the sorts, cross section regressions still have shortcomings, such as sensitivity to outliers, equal-weight for each observation and misspecification that imposes a functional form on the relation between variables (Fama and French, 2008; Novy-Marx, 2013). Nevertheless, it is interesting to check these regressions.

The study employs the same definition of variables that are used previously in portfolios sorting, in the spirit of Fama and French (1992, 2008). Monthly excess returns from July of year t to June year t+1 are matched with anomaly variable observed in previous periods. Size is the natural log of market value at June t. B/M is the natural log of book equity for t-1 divided by market value in December t-1. Pos Y/B is the positive net income (ROE) in t-1 divided by book equity t-1. Neg Y is a dummy variable for negative income. gA is the change in total assets from the fiscal year ending in year t-2 to the fiscal year ending in t-1, divided by t-2 total assets. Mom (momentum) for month j is the average return from month j-12 to j-2. To avoid extreme observation, the study winsorizes the smallest and largest 0.5% of observation for B/M, Pos Y/B and gA each year. Finally, Newey and West standards errors at lag(3) are used to get heteroskedastic and autocorrelation consistent estimators. In addition to running regression using the whole sample, the study runs regressions separately for micro, small, big and all but micro stocks. This is to avoid the dominance of micro stocks that account for more than 40% of the sample. The study applies the same size breakpoints that are used for tests assets and rebalanced annually.

Table 2.6 reports the time-series averages of slope coefficients from monthly cross sectional (FM) regressions of individual stocks returns on firm-level characteristics and their t-statistics[25]. Result for the whole market (column 1) shows that B/M, positive profits (Pos Y/B), size and the dummy for negative profits (DNeg Y) have significant coefficients (0.851, 6.388, -0.373 and 1.438) at 5%, 1%, 10% and 5%, respectively. Accordingly, these anomalies play a role in predicting returns, especially the profitability. On the other hand, asset growth (gA) and momentum (Mom) coefficients are insignificant. Excluding micro stocks (All but micro, column 5) keeps the positive significant roles of B/M and profitability in explaining the cross section return, while confirming the insignificant roles of asset growth and momentum. Despite

[25]Market beta is not included in regressions following Fama and French (2008) to avoid the imprecision of beta estimates for individual stocks. They argue that little is lost in omitting them assuming that all betas equal to one. On a different note, if the study allows for the nature of thin trading and frequent zero returns in emerging market, and excludes stock-month observations if the stock has consecutive zero returns for more than 3 months, the results will be the same.

Table 2.6 Cross-section regressions

	(1) r Market	(2) r Micro	(3) r Small	(4) r Big	(5) r All but Micro
Size	-0.373*	-1.196***	1.833	-0.232	-0.148
	(0.201)	(0.394)	(1.737)	(0.235)	(0.185)
B/M	0.851**	0.651	1.651	0.491	0.780**
	(0.336)	(0.415)	(1.185)	(0.370)	(0.343)
Pos Y/B	6.388***	3.805	16.15	4.317***	6.435***
	(1.869)	(2.928)	(11.79)	(1.616)	(2.198)
DNeg Y	1.438**	1.908**	1.740	0.749	0.210
	(0.722)	(0.939)	(2.151)	(0.660)	(0.810)
gA	0.435	0.548	0.551	-0.287	-0.0210
	(0.508)	(2.211)	(1.078)	(0.656)	(0.497)
Mom	-0.0713	-0.0432	-0.114	0.0148	-0.0440
	(0.0540)	(0.0895)	(0.0789)	(0.0699)	(0.0606)
Constant	3.829**	7.744***	-10.11	2.945	2.148
	(1.612)	(2.205)	(10.85)	(1.806)	(1.530)
Observations	24030	9812	7129	7073	14218
R^2	0.106	0.188	0.212	0.192	0.134

This table reports average slopes and their t-statistics from monthly cross sectional regressions (FM) for individual stocks returns. Monthly returns from July of year t to June year t+1 are matched with anomaly variables observed in previous periods, as follows. Size is the natural log of market value at June t. B/M is the natural log book equity for t-1 divided by market value in December t-1. Pos Y/B is the positive net income (ROE) in t-1 divided by book equity t-1 and zero otherwise. DNeg Y is a dummy variable for negative income. gA is the change in total assets from the fiscal year ending in year t-2 to the fiscal year ending in t-1, divided by t-2 total assets. Mom (momentum) for month j is the average return from month j-12 to j-2. Newey-West corrected standard errors (lag=3).* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

the significant role of B/M for market and all-but-micro, it is not significant for for micro, small, big categories separately. This contradicts the significant value effect in portfolio sorting for micro and small stocks (Table 2.4). Nevertheless, the comparison might be less valid, given that portfolio sorting uses value-weight returns, while cross-section regressions weight each observation equally.

The profitability role is mainly driven by big stocks with positive significant coefficient (4.317) at 1% (column 4). This is in contrast to Fama and French (2008), where profitability is significant for only small stocks. The dummy variable for negative profit (DNeg Y) is significant at 5% for micro stocks, which contributes to overall market significance for this dummy. However, the positive sign for the dummy implies that negative profitability is not associated with lower average returns, and therefore the observed positive relation between profitability and average return does not hold across all profit categories. It seems that the power of the size in explaining returns is mainly driven by micro stocks, as size variable is significant (-1.196) at 5% for micro stocks (column 2), and the coefficient for size for all-but-micro stocks (column5) is insignificant but still has the negative expected sign. Small stocks add no information in this regressions, the intercept is always negative, the size has unexpected positive sign, and all variables are insignificant.

The investment (gA) slopes are always insignificant and have the expected negative sign for only big and all-but micro-stocks. This negative sign is predicted by either the valuation theory or investment CAPM. This result is in contrast to opposite investment pattern found in portfolios sorts (Table 2.4), in which big firms with aggressive investment have higher return than firms with conservative investment. The momentum variable unexpectedly has a negative sign, except for big stocks, which is against the continuation of past returns of Jegadeesh and Titman (1993). In addition, it is in contrast to momentum patterns in return found in portfolios sorted on size and momentum (Table 2.4), in which there is a positive relation between momentum and average return, across all size categories. The difference in some inference between the sort and the cross sectional regressions might be due to influential observation problems (Fama and French, 2008), or it might present a clearer picture of marginal effects than sorts. Therefore, a formal testing of factor models that include factors representing these anomalies is required.

To sum up, the cross sectional regressions using individual stocks show the important roles of B/M and profitability in predicting stocks' returns. On the other hand, they show a different return dynamics in the Egyptian market, where asset growth (investment) and momentum play no role in predicting returns.

2.7 Conclusion

The early contribution of this chapter is the construction of a unique dataset of the cross section of stocks for the Egyptian stock market and building portfolios that constitute the base for testing asset pricing models. This dataset is not available otherwise with this coverage, care in construction, and reliability. It overcomes the shortage of firm coverage of TDS by merging data from different sources. In addition, it improves the reliability of the data by excessive static and dynamics screening procedures and by revising the observations of the Worldscope corporate database, which help overcoming major shortfalls of TDS data, especially for a small emerging market.

key features of the Egyptian stocks are presented in this chapter. For example, there is a long tail of small stocks, which are more volatile and have higher returns. Egyptian stocks share the characteristics of other emerging markets such as high return and risk of investing in stocks. It provides benefits for international and regional portfolio diversification, which motivates further investigation of factor pricing for the Egyptian stocks. Portfolio characteristics reveal that the behaviour of big firms is questionable. Big profitable firms on average are not investing more than less profitable firms, and big growth firms invest less compared to value firms despite having higher profits. This observation might motivate further examination of investment and return dynamics in Egypt on the one hand and the investment behaviour of firms on the other in next chapters.

The chapter provides an investigation of anomalies patterns in returns; mainly the size, B/M, profitability, investment and momentum patterns. Two ways are employed to explore these anomalies patterns; portfolio sorts and cross sectional regression on individual stocks. Using portfolio sorts, it is found that anomalies patterns exist in average excess returns, especially value and size anomalies. Profitability and investment patterns are less strong and monotonic compared to the value effect. This can be partially explained by the non-uniform distribution of the variable across the sort, especially for the investment variable. Moreover, there is reverse investment effect for big stocks and reverse profitability effect for micro stocks, which are not consistent with Fama and French (2015). On the other hand, cross sectional regressions show the significant importance of mainly B/M ratio and profitability in predicting returns. Size is particularly significant in explaining micro stocks returns, whilst asset growth and momentum play no roles in predicting returns. The contradictory inferences from the sort and regression analysis, especially for investment, momentum and to some extent profitability, might refer to technical problems with regressions using individual firms, or present but weak patterns in returns using sorts. Therefore, the thesis attempts in the next chapter to test factor models using regression on portfolios to provide a clearer picture about the priced factors in returns.

Chapter 3

Testing Factor Models in Emerging Markets: Evidence from the Egyptian Stock Market

3.1 Introduction

Most existing studies of factor models focus on the US and some developed markets. However, less attention is given to emerging markets which have different economic and structural characteristics that might impact the importance of factors in explaining stock returns. Therefore, it is crucial to investigate whether factors importance differs in emerging markets than in developed markets. Exploring which factors are important is also essential for understanding market return dynamics, the underlying priced sources of risks, and for determining the appropriate asset pricing model for an emerging market, which has various practical implication such as projects valuation, investment performance evaluation and optimal portfolios choice.

The chapter focuses on Egypt as a small emerging market instead of emphasizing on China in most of emerging markets studies. This is to provide insights about emerging markets dynamics that might be generalized to other similar economies such as those in the MENA region and Africa. The different characteristics of the Egyptian market compared to developed markets (i.e. illiquidity, few listed companies, retail-based trading, concentrated ownership, less corporate governance enforcement, and economic and political uncertainties) can affect the importance of the priced risk factors. Egypt is also an interesting case because of its growing stock market, openness to foreigners and potential profits for international investors given the low correlation with developed markets, and due to the fact of being amongst the five best performers in years 2012, 2013 and 2014 according to MSCI emerging market index in dollars terms.

Exploring the priced risk factors for the Egyptian stocks and asking whether they differ in interesting ways from those that have been shown to be important in the US and elsewhere is a challenge given the plethora of factors that might be included in a factor model. Therefore, the chapter focuses on factors that are widely known as well as motivated by theories, which help limit the range of tested factor models. Motivated by the valuation theory, Fama and French (2015) add profitability and investment factors to the widely accepted three-factor model of Fama and French (1993). The importance of these two extra factors is also emphasized by the investment CAPM theory (Cochrane, 1991; Hou et al., 2015; Zhang, 2017). Moreover, it is interesting to add the momentum factor to the list of factors because it is well documented in the asset pricing literature since the introduction of Carhart (1997) model. Fama and French (2018) add this factor to the five-factor model to satisfy the popular demand because the momentum is a profitable strategy, particularly in the US market. Accordingly, this chapter aims to test whether the Fama-French asset pricing models; the three, five and six-factor models can explain the cross sectional stock returns in the Egyptian stock market during the period of July 2003 -June 2017. It explores whether the Fama and French five (2015) and six (2018) factor models offer a better description of an emerging market stock returns than the traditional three-factor model (1993).

There are less empirical investigation of the five-factor model for emerging markets, in contrast to the Fama-French three and Carhart four-factor models. The five-factor model outperforms the three-factor model in emerging European markets (Zaremba and Czapkiewicz, 2017), Chinese market (Guo et al., 2017; Lin, 2017), Eastern Europe and Latin America, except for Asia (Foye, 2018). Accordingly, there are still far less evidences to confirm the outperformance of the five-factor model in emerging markets. The current debate in the US literature is about the motivation behind the investment factor, and the cause of the redundant value factor that Fama and French (2015) reported after adding profitability and investment factors. While Fama and French (2015) motivate the investment factor by valuation theory, others argue that value factor is a different manifestation of the investment factor, backed by investment CAPM (Hou et al., 2015; Zhang, 2017). However, empirical evidences tell another story, especially in emerging markets, which is the redundancy of the investment factor (Foye, 2018; Guo et al., 2017; Lin, 2017). Another interesting study by Wahal (2019) shows insignificant role of the investment in pre-1963 period, which implies that factors importance can vary through time. Studies on asset pricing for Egypt are limited (Omran, 2007; Shaker and Elgiziry, 2014; Taha and Elgiziry, 2016), and they use small sample size in contrast to the sample used in this chapter. There is no paper that assessed the five and six factors model for the Egyptian stock market by the start of this analysis, to the best of our knowledge. Therefore, this chapter adds to the literature an investigation of these models contributing to the debate on the outperformance of the five-factor model and factors redundancy. The analysis becomes more important after the observed mixed results of anomalies pattern in returns in Chapter 2. Portfolio sorts show that profitability, investment and momentum patterns in return exist, however, profitability and investment patterns are less monotonic compared to the value effect. On the other hand, cross sectional regressions mainly emphasize the importance of B/M ratio and profitability in predicting returns.

The main contribution of the chapter is that the importance of factors in explaining average stock returns varies across countries. Indeed, it adds evidence on the redundancy of the investment factor in emerging markets in contrast to the value factor in the US market, and tries to interpret it using the literature on asset growth effect and investment theory. It provides an investigation of the recent Fama-French five and six-factor models for the Egyptian stocks. It produces a comprehensive analysis of the principal asset pricing models (CAPM, Fama and French three, five, six factor models) using a unique and larger dataset. This also helps enriching the empirical work on asset pricing for Egypt and the MENA region which have limited research on this area, and providing an out-of-sample test especially for the US results of the Fama-French five-factor model (2015).

In order to answer the main research question, time series regression approach of Black et al. (1972) is employed on four test assets; Size-B/M, Size-Profitability, Size-Investment and Size-Momentum portfolios. If a factor model explains portfolios expected returns, the intercepts of test assets portfolios excess returns on the model factors should be zero. To compare models performance, two approaches are used. The first is the Gibbons, Ross, and Shanken (GRS) tests on the intercepts from time series regressions. The second is factor spanning regressions that Fama and French (2018) find it useful to compare between nested models, as it can show the marginal contribution of a factor to the model's maximum Sharpe ratio. The latter approach was not used by previous studies for Egypt (Shaker and Elgiziry, 2014; Taha and Elgiziry, 2016).

Model performance tests show the good performance of the five-factor model in explaining average returns. GRS tests do not reject the five-factor model in most of the cases. Factor spanning regressions and multi-factor GRS tests reject the three and six-factor models in favour of the five-factor model, mainly due to the role of the profitability factor. Despite the good performance of the five-factor model, it is not fully satisfactory for two reasons. Some metric of dispersion and regressions details offer better support to the three-factor model for other test asset than Size-Prof portfolios. Average adjusted R^2 of the model is low, which calls for a better model that can fully describe the cross sectional variation of the Egyptian stocks returns. Results emphasize the important roles of market, value, size and profitability factors in the Egyptian market. This implies that the relative profitability and distress are the sources of common risk factors that explain the size and value effects as proposed by Fama and French (1992, 1995). Investment and momentum factors are redundant in the Egyptian market, which refers to different return dynamics than what is documented in the US market. The negligible role of the investment factor can be related to weak asset growth effect in emerging markets.

The rest of the chapter is organized as follows. The next section reviews the related literature and international evidences on factor models. Section 3 presents the empirical methodology. Section 4 reports descriptive statistics of factor returns. Section 5 discusses asset pricing tests for four testing asset environment. Models performance is examined in section 6, using GRS test and metrics of dispersion as well as factor spanning tests. Discussion on the less powerful performance of the five-factor model and factors redundancy are shown in Section 7. Section 8 provides some robustness checks. The last section concludes.

3.2 Related literature

3.2.1 Multifactor and Fama-French models

Explaining the cross section of assets returns is one of the major challenges for academics and practitioners. Basic theoretical asset pricing model that paved the way in the literature is the capital asset pricing model of Sharpe (1964) and Lintner (1965). The CAPM is a single factor model in which market portfolio (factor) is mean-variance efficient in the sense of Markowitz (1959). The CAPM provides an intuitive way to measure the risk of an asset and to draw the relation between its expected returns and risk. The Sharpe-Lintner CAPM is stated as follows:

$$E(R_i) = R_f + \beta_{im}[E(R_m) - R_f)], \quad i = 1, ..., N. \tag{3.1}$$

The expected return on any asset i is the risk free rate, R_f, plus a risk premium. This risk premium is the asset's market beta[1] β_{im} multiplied by the premium per unit of beta, which is expected market return minus the risk free rate $[E(R_m) - R_f)]$.

Multifactor asset pricing models claim that market beta cannot alone explain the cross section returns, such as arbitrage pricing theory (APT) of Ross (1976) and inter-temporal CAPM (ICAPM) of Merton (1973). These models provide some theoretical foundation for multifactor models. ICAPM adds to the market (wealth) portfolio in the CAPM other state variables that forecast changes in the distribution of future asset returns. It takes into account long investment horizons and time varying investment opportunity. Cochrane (2005a) shows that CAPM and ICAPM are special cases of consumption-based models, that both add some assumption for better substitution of consumption. Beyond consumption-based models, APT finds common movement of assets returns (or factors) through a statistical analysis of the covariance matrix of returns. Common movements are the priced factors while the residual idiosyncratic movement has zero risk.

In the empirical literature, many patterns have been identified in the behaviour of stock returns. These patterns are not explained by the CAPM, and thus called anomalies. The widespread of anomalies casts doubt on the adequacy of the CAPM. Examples of popular anomalies are size (Banz, 1980), leverage (Bhandari, 1988), book to market equity (Rosenberg et al., 1985), earnings to price (Ball, 1978; BASU, 1983), and the continuation of short (Jegadeesh and Titman, 1993), and long term past returns (Bondt and Richard Thaler, 1984). Consequently, the CAPM, as a single factor model, loses its popularity, and literature has moved from single factor into multiple factor models with several sources of risk.

The empirical failures of the CAPM and consumption-based capital asset pricing models[2] lead to factor models motivated by theory that suggests possible important variables or factors in describing average returns but without a fully specified model by the theory. There are two main approaches for determining factors (Ferson and Korajczyk, 1995). The first is a statistical or analytic factor approach motivated by APT. The second is a theoretical approach in which risk factors are either economic variables that ought to capture systematic risk of the economy (Chen et al., 1986), or factor mimicking portfolios on the firms' characteristics. Mimicking portfolios mimic

[1]Covariance of asset return with market portfolio return; $\beta_{im} = cov(R_i, R_m)/\sigma^2(R_m)$.

[2]The empirical failure of the consumption CAPM model is mainly due to what is know as the equity premium/risk-free rate puzzle. To match a high Sharpe ratio of stocks, the model requires huge risk aversion or consumption growth volatility. High risk aversion implies high risk free rate, negative discount factor or very volatile interest rates, which are not feasible empirically (See Campbell (2003) for a more detailed discussion). Factors models came by modeling the marginal utility in terms of other variables. They specify the discount factor as a linear function of some proxies.

state variable of special hedging concern to investors (Fama and French, 1993, 2015). Examples of motivated theories for recent studies are dividend discount model of Miller and Modigliani (1961) and production-based model of Cochrane (1991).

Inspired by empirical findings and multifactor theoretical framework, Fama and French (1993) introduce the three-factor model, as presented in equation (3.2). It is the most investigated one in the empirical literature in the last 20 years. This model adds two additional risk factors (factor mimicking portfolios) to market portfolio; the size (small minus big, SMB) and value (high minus low, HML) factors. SMB (HML) factor is the difference in returns between a portfolio of small (high book to market ratio) stocks and another of large (low book to market ratio) stocks. Fama and French (1995) argue that size and book to market ratio proxy for sensitivity to common risk factors in returns, which might be related to relative profitability.

$$E(R_i) = R_f + \beta_{im}[E(R_m) - R_f] + s_i E(SMB) + h_i E(HML) \quad i = 1, ..., N. \quad (3.2)$$

The SMB factor takes into account the size effect of Banz (1980) in which average return is higher for small stocks than their betas justify. It is consistent with Huberman and Kandel (1987)'s evidence on the covariance of returns of small stock that are not captured by market return. HML allows for the value effect in which average returns increase with book-to-market ratio. Fama and French (1992, 1995, 1997) suggest that the value premium is a compensation for systematic risks, rather than market portfolio risk, that is related to relative distress. Book to market ratio reflects market expectation about future performance. Compared to firms with strong prospects, firms with poor prospects have lower stock prices and high book to market ratio, and hence higher expected returns. This is consistent with Chan and Chen (1991) evidence of the covariance in returns that is related to relative distress. The idea of value investing can be dated back to Graham and Dodd (1934). Value investors buy stocks with low price relative to accounting based fundamentals, which can be dividends, earning or book equity. However, the focus is on book to market ratio, since the work of Fama and French (1993). While Graham and Dodd (1934) consider the deviation of market value from the accounting (intrinsic) values as mispricing, risk-based explanation of the value premium of Fama and French (1993) considers the market values (or prices) as efficient.

Interpretations of factor premiums are mainly debatable in the literature between two approaches. The risk-based explanation approach led by Fama and French considers it as compensation for other risk premium than market, in spirit of ICAMP and APT, as discussed above. Vassalou (2003) and Liew and Vassalou (2000) provide support to the risk-based explanation by arguing that size and value factors forecast output growth, and thus future changes in investment opportunity set. On the other hand, the behavioural approach supported by Lakonishok et al. (1994), amongst others, views these premiums as inefficiencies in the market in incorporating information into prices. For example, Lakonishok et al. (1994) argue that overreaction to poor past performance of value stocks and strong performance of growth stocks lead to pricing value stocks too low and growth stocks too high. Regardless of factors interpretations, both approaches agree on the same sign of the payoff, which is higher expected returns for the value stocks.

The Fama-French three-factor (FF3F) model succeeds in explaining many famous CAPM anomalies. Fama and French (1996) show that the model explains Earning/ price, cash flow/price, sales growth and the reversal of long term returns. Nevertheless, it fails to explain the momentum effect (short term continuation of last year returns) of Jegadeesh and Titman (1993). This leads Carhart (1997) to augment the FF3F model with a momentum factor, which becomes common in the empirical literature. Fama and French were not in favour of this four-factor model, because they believe that momentum effect is short lived, thereby not important in the estimates for the cost of equity capital (Fama and French, 2004). Furthermore, momentum effect is mostly explained by a behavioural approach rather than their risk-based explanation for factors. For example, momentum effect can be generated by the market tendency to exhibit lagged reaction to individual earnings reports (Haugen and Baker, 1996), or investors' overconfidence and self-attribution bias (Daniel et al., 1998). However, Fama and French (2018) add the momentum factor to their factor models under pressure to satisfy popular demand.

Variations in returns due to profitability and investment are left unexplained by the FF3F model. Responding to that, new multi-factors models have been emerged, containing investment and profitability factors (Fama and French, 2015; Hou et al., 2015), sought to explain these anomalies, but they differ in their theoretical motivation. The first is motivated by valuation theory, while the latter is motivated by investment CAPM. Fama and French (2006) argue that valuation theory refers to possible candidates for explaining the cross section returns, besides size and book-to-market value. They rearrange the dividend discount model of Miller and Modigliani (1961) in equation (3.3), to get equation (3.4) which emphasizes the joint control of the three variables (B/M, profitability and investment) that was missing in previous work.

$$m_t = \sum_{\tau=1}^{\infty} E(d_{t+\tau})/(1+r)^{\tau} \tag{3.3}$$

$$\frac{M_t}{B_t} = \frac{\sum_{\tau=1}^{\infty} E(Y_{t+\tau} - dB_{t+\tau})/(1+r)^{\tau}}{B_t} \tag{3.4}$$

where m_t is share price, $E(d_{t+\tau})$ is expected dividends, r is long run average expected return (internal rate of return), M_t is market value of firm's stock, $Y_{t+\tau}$ is equity earnings per share, and $dB_{t+\tau}$ is change in book equity per share. Equation (3.4) has three main implications, as follows: Controlling for profitability (expected earning) and investment (expected change in book equity), a high book-to-market ratio implies higher required returns (r). Controlling for M/B and expected investment, higher expected earning implies higher expected returns. Finally, controlling for M/B and expected profitability, higher expected investment or growth (due to reinvestment in earning) implies lower expected cash flow and lower expected returns. Unlike the previous literature that treats each variable as anomaly and separately studies the effect on return, Fama and French show that adding lagged profitability and asset growth in return regressions to size and book-to-market value raise the spread between actual and predicted returns in all size- B/M groups used.

Motivated by this valuation theory, Fama and French (2015) propose the five-factor model (FF5F) by adding profitability (robust minus weak, RMW) and investment (conservative minus aggressive, CMA) factors, as presented in equation (3.5). They argue that this model performs better than the three-factor model in capturing the variation of stock returns, where average returns is related positively with profitability and negatively with investment. These additions become feasible after the work of Novy-Marx (2013) and Aharoni et al. (2013), who provide good proxies for expected profitability and investment. The growing literature on the negative relation between investment and subsequent returns adds more motivation for the FF5F model (Cooper et al., 2008; Titman et al., 2004)

$$E(R_i) = R_f + \beta_{im}[E(R_m) - R_f] + s_i E(SMB) + h_i E(HML) + r_i E(RMW) + c_i E(CMA) \tag{3.5}$$

An interesting result is that the value factor become redundant in the new five-factor model. This redundancy raises more questions about the FF5F model. Most of the criticism was led by the investment-based asset pricing literature (Anderson and Garcia-Feijóo, 2006; Berk et al., 1999; Hou et al., 2015; Xing, 2008; Zhang, 2005, 2017) that suggests that CMA and HML convey the same information. For example, Hou et al. (2014), using the q-factor model motivated by the investment CAPM, argue that a value premium is a different manifestation of the investment factor, and without the redundant HML, the five-factor model collapses to a noisy version of the q-factor model. This is because the first principal of investment says that marginal costs of investment equal marginal q, which in turn closely related to market to book ratio. CMA is motivated by valuation theory, which shows the negative relation between expected investment and the internal rate of return. However, by reformulating the valuation equation, Zhang (2017) shows the relation between the one-period-ahead expected returns and expected investment is more likely to be positive. Hou et al. (2014) criticise Fama and French's use of past investment as a proxy for future investment. They believe that while past profitability forecasts future profitability, past investment does not necessarily forecast future investment. Their critics imply that the investment factor is derived from the book to market term in the valuation equation, which supports the intuition behind the investment CAPM.

The current debate is around models' motivation whether valuation theory or investment CAPM, in addition to emphasizing the role of investment itself for the US market. Nonetheless, international evidences show a different story, which is the redundancy of CMA factor, not the HML factor, especially for emerging markets. Wahal (2019) adds more fuel to the debate, when he finds no reliable relation between investment and returns in the US pre-1963 period, the year in which Fama and French start their analysis. The CMA was not, therefore, useful in asset pricing for that period. This provides a further motivation for the study to check whether the importance of factors are the same across markets, especially for an emerging market.

3.2.2 International evidences

Most of the investigations using the Fama-French models are done for developed markets, with fewer evidences from emerging markets. Different characteristics for emerging markets such as higher transaction costs, slower diffusion of information and low institutional participation can amplify or lessen the importance of these factors. Therefore, the study focuses on emerging markets evidences as well as those from Egypt.

Early pioneering studies have investigated return factors in emerging markets (Bekaert and Harvey, 1995; Fama and French, 1998; Griffin, 2002; Rouwenhorst, 1999). For example, using data from 20 emerging countries, Rouwenhorst (1999) reports similar return factors to those for developed markets such as size, value and momentum effect. Value effect is well documented in the international markets literature, whereas size and momentum effects are less pronounced, as results are mixed across countries or regions. Cakici et al. (2013) confirm the existence of value and momentum effects in 18 emerging markets grouped into three regions: Asia, Latin America and East Europe. Unlike developed markets literature where value premium is larger for small stocks, they find that the value effect is similar between big and small stocks. On the other hand, consistent with developed markets, momentum premium is larger for small stocks, with exception of Eastern Europe that reports no significant momentum premium. Using individual emerging markets for the period 1990-2013, Cakici et al. (2016) show that the value effect is strong in all countries except Brazil, and is robust to sub periods and the state of the economy, whereas the size effect is only significant for China. In contrast to the previous study, Cakici et al. (2016) find that momentum effect is weak in almost all countries in the study.

On similar work to Fama and French (2012) and Cakici et al. (2013), Hanauer and Linhart (2015) analyse size, value and momentum patterns in average stock returns for 21 emerging and 24 developed countries over the period 1996-2012. They document a strong and highly significant value effect, especially for emerging markets, a strong but less significant momentum effect, and weak statistical evidences for market and size premiums. The market risk premium is only significant for EM Latin America while the size premium is only significant for EM Asia and BRIC. In contrast to Cakici et al. (2013), they find evidences in favour of the local four-factor model.

Using data for North America, Europe, Japan and Asia Pacific, as an international evidence on the FF5F model, Fama and French (2017) conclude that the FF3F model captures well the strong positive relation between B/M and average returns for Japan while it left profitability and investment patterns in North America, Europe and Asia Pacific unexplained. The FF5F model captures most of value, profitability and investment patterns in average returns, except for Japan.

There are few empirical investigations using the FF5F model for emerging markets. Furthermore, there is less strong agreement about the outperformance of the FF5F model, and disagreement about the redundancy of HML factor. Zaremba and Czapkiewicz (2017) document the outperformance of the FF5F over the CAPM, FF3F and Carhart four-factor models for European emerging markets in explaining many anomaly patterns. For three emerging regions, Foye (2018), however, shows that the five-factor model does not outperform the three-factor model in Asia, but it (or the four-factor version without investment) does a better job for Eastern Europe and Latin America. For the Chinese market, Guo et al. (2017) demonstrate that the FF5F model outperforms the FF3F model, and report strong size, value and profitability patterns but weak investment patterns for returns. Lin (2017) confirms this result after taking into account the bias in mean returns induced by noise in prices. Harshita et al. (2015) use data from companies constituting the CNX500 index for the period 1999-2014 in India. They find that the FF5F model performs better, when the underlying portfolios are sorted on profitability and investment, while the FF3F performs better on all portfolios than CAPM. Their most parsimonious model is the four-factor model without investment. In south Africa market, Cox and Britten (2019) report that size-value and size-profitability three-factor models describe time-series stock returns better than the five-factor model.

Evidences on the FF5F model raise questions about the redundancy of factors. For the US market, Fama and French (2015) report that the value effect is redundant in the FF5F model. However, using international data for North America, Europe, Japan and Asia pacific, Fama and French (2017) show that the investment factor is redundant in Europe and Japan. For emerging markets, Guo et al. (2017) and Lin (2017) exhibit the redundancy of CMA factor for the Chinese market. Moreover, Foye (2018) find the HML is not redundant for three emerging market regions (Eastern Europe, Asia and Latin America). Their factor spanning test shows the redundancy of CMA and SMB factors in the three regions. This emphasizes that the importance of factors may vary across regions or countries.

One can argue that the redundancy of the CMA factor might be related to the role of investment itself as a predictor of returns, which also known as investment or asset growth effect. It refers to a documented negative relation between investment and subsequent returns; that is firms that increase investment should earn lower expected returns than low investment firms (Cooper and Priestley, 2011; Cooper et al., 2008; Titman et al., 2004). Two camps have proposed explanations for this effect; behavioural and risk-based (optimal investment) explanations. Behavioural explanations include; over-investment and empire building agency problems (Titman et al., 2004), mis-pricing and market timing in financing investment (Baker et al., 2003) and overreaction to past performance (Cooper et al., 2008; Lakonishok et al., 1994). Optimal investment explanations are based on; Q theory of investment (Li and Zhang, 2010; Xing, 2008), investment CAPM (Zhang, 2017) and real growth options that shows that investing exercise growth options and thus reduces overall firm's risk and expected returns (Berk et al., 1999). The former two theories depend on the idea that low cost of capital implies high net present value of new capital and high investment.

For international data, however, evidences point to a weak asset growth effect for emerging markets compared to developed markets. Watanabe et al. (2013) argue that the asset growth effect is stronger in markets that are more informationally efficient. Titman et al. (2013) find asset growth effect is related to financial market development such as an equity index market cap or stock value traded to GDP ratios. Both studies provide support for the optimal investment explanation, away from mis-pricing explanations. They relate it to Q-theory in which the financial development determines the willingness or the ability of managers to align their investment with changes in expected returns. Yao et al. (2011) confirm the weaker relation for nine Asian markets.

They relate the weak investment effect to the financial system; bank-based financial systems might weaken the investment effect, and financial constraints may lead to underinvestment and homogeneity in asset growth.

- **Egypt related literature**

Few studies have investigated asset pricing for the Egyptian stock market. Omran (2007) provides early evidences for the validity of applying the capital asset pricing model for the Egyptian stock market. Cheng et al. (2010) examine three CAPM for nine countries in the MENA region (including Egypt); static international CAPM, constant parameter intertemporal CAPM, and Markov-Switching intertemporal CAPM for the period 1997-2008. They report the Egyptian market to be CAPM efficient but the model turns to be CAPM inefficient for Egypt, when adding other factors and dummy variables in the spirit of Chen et al. (1986). Intertemporal CAPM holds for Egypt under GARCH-M specification. For the third model, Egypt is found to be highly segmented with higher persistence in segmented state. For investigating multi-factor models, Girard and Omran (2007) show that both firms' fundamentals (beta, market to book value, size and industry type) and country risk rating factors are significant in explaining the cross section of stock returns for five Arab countries, including Egypt for the period of 1997-2001. Nevertheless, they report a positive relation between return and fundamental risk (beta and market to book value), which implies that large and growth stocks are riskier than small and value stocks. Hearn et al. (2010) use the FF3F model in estimating the cost of equity in four African countries including Egypt. They document higher premiums using market, size and liquidity factors with a greater impact for size premium.

Shaker and Elgiziry (2014) test the applicability of the CAPM, FF3F, and Cahart four factor models in addition to a liquidity augmented factor model. They use monthly data of 55 stocks of EGX 100 for the period 2003-2007. They conclude that the best model is the FF3F model, the Cahart model is not applicable for the Egyptian market, and there is no strong support for liquidity augmented asset pricing. Taha and Elgiziry (2016) extended the last study to cover the period from July 2005-June 2013 using the same 55 firms, excluding financial firms. They assert that no momentum effect for Egypt, and they propose a five-factor model, which includes market factor, firm size, book-to-market, earning to price (E/P) and liquidity. They also show that B/M does not absorb the role of the E/P ratio which is in contrast to US evidences. From above, this chapter adds to the literature an investigation of the Fama-French five-factor model. In contrast to these previous studies, it uses a larger dataset for the cross section of equities with longer time series. It also tries to add more evidences on the debate around the redundancy (or the importance) of factors across countries.

In this review of the previous literature, it is found that the five-factor model provides a development of the original Fama-French model and depends more on theoretical foundations. Empirical investigations of the model for emerging markets are limited with less strong evidences on the outperformance of the model over the traditional three-factor model. The importance or redundancy of factors varies across regions and countries. Given the limited and mixed results in the literature, particularly for Egypt, it is interesting to investigate factor models for this market.

3.3 Empirical methodology

This chapter intends to test the CAPM, the Fama-French three, five and six-factor models for the Egyptian stocks. This is to determine the best model that explain the cross-section variation in average stock returns, and to provide an out-of-sample test of the US results in Fama and French (2015). In order to test these models, time series regression approach of Black et al. (1972) on double-sorted portfolios on anomaly variables is followed. The asset pricing formula when factors are returns can be expressed as:

$$E(R^{ei}) = \beta_i[E(f)], \tag{3.6}$$

It can be evaluated by estimating the regression equation

$$R^{ei} = \alpha_i + \beta_i f_t + \epsilon_t^i, \tag{3.7}$$

where R^{ei} is portfolio excess returns, f is risk factor, β_i is risk factor sensitivity, exposure or loading, α_i is intercept or pricing error. The study considers first the classical CAPM model:

$$R_{it} - R_{ft} = \alpha_i + b_i Mkt_t + \epsilon_{it} \tag{3.8}$$

The second model to be tested is the Fama-French three-factor model (FF3F):

$$R_{it} - R_{ft} = \alpha_i + b_i Mkt_t + s_i SMB_t + h_i HML_t + \epsilon_{it} \tag{3.9}$$

Lastly, the Fama-French five and six-factor models (FF5F and FF6F) are tested:

$$R_{it} - R_{ft} = \alpha_i + b_i Mkt_t + s_i SMB_t + h_i HML_t + r_i RMW_t + c_i CMA_t + \epsilon_{it} \tag{3.10}$$

$$R_{it} - R_{ft} = \alpha_i + b_i Mkt_t + s_i SMB_t + h_i HML_t + r_i RMW_t + c_i CMA_t + w_i WML_t + \epsilon_{it} \tag{3.11}$$

where R_{it} is the return on portfolio i , R_{ft} is the risk-free rate, Mkt_t is the return on the value-weight market portfolio minus the risk-free rate. Factors on RHS are differences between returns on diversified portfolios of small and big stocks; SMB_t, high and low B/M stocks; HML_t, robust and weak profitability stocks; RMW_t, stocks of conservative (low) and aggressive (high) investment; CMA_t, and past winner and loser stocks (or lagged momentum); WML_t. Construction of factors and test assets portfolios are discussed earlier in Section 2.4.

In time series regressions, the implication of the model is that all regression intercepts ($\alpha_i's$) should equal zero. The average risk premium for the factor is the average value of the explanatory variables, which implies a zero pricing error assumption of the factor. Besides intercepts, factor loadings (b_i, s_i, h_i, r_i, c_i and w_i) and R^2 values are direct evidence of whether different risk factors capture common variation in stock returns.

To test model performance and to compare between models, two approaches are followed. First, the left-hand-side (LHS) approach compares competing models based on the intercept left unexplained by the model. The GRS statistic or F-statistic of Gibbons et al. (1989) is used to test the hypothesis that regression intercepts for all portfolios are equal to zero. This test is exact in a finite sample, but it has a limitation which is a strong assumption of normally distributed errors. Another limitation of this approach is that inferences can vary across sets of LHS portfolios (Barillas and Shanken, 2017). The GRS test is:

$$\tfrac{T-N-K}{N} \; (1 + E_t(f)\; \hat{\Omega}^{-1}\; E_t(f)\;)^{-1}\; \hat{\alpha}'\; \hat{\Sigma}^{-1}\; \hat{\alpha} \quad \sim \quad F_{N,\; T-N-K} \qquad (3.12)$$

where α and f refer to intercept and factor. N is number of assets, K number of factors, $\hat{\Omega} = \frac{1}{T}\sum_{t=1}^{T}[f_t - E_t(f)]\;[f_t - E_t(f)]'$, and $\hat{\Sigma} = \frac{1}{T}\sum_{t=1}^{T}\hat{\epsilon}\hat{\epsilon}'$

Second, the right-hand-side (RHS) approach uses factor spanning regressions to judge whether a factor adds to the model's explanation of average returns. Each factor is regressed on the model's other factors. If the intercept is close to zero, the LHS factor will be redundant; hence it adds noting to the model explanation of average returns. In other words, returns for the LHS factor are explained by the linear combination of the RHS factors.

This approach is useful when models compared are nested models, in which the question is whether to add extra factor to improve the explanation of average returns provided by a model. Following Barillas and Shanken (2017), Fama and French (2018) illustrate that tests on the intercepts from factor spanning regressions are equivalent to judging models on the max Sharpe ratio produced by their factors;

$Sh^2(f)$. Barillas and Shanken (2017) assume that competing model should be judged on the maximum-squared Sharpe ratio for the intercepts, $Sh^2(a_i)$, from time series regression of LHS portfolios on a model's factors. The best model is the one with the smallest $Sh^2(a_i)$ defined as $Sh^2(a_i) = \alpha_i' \Sigma_i^{-1} \alpha_i$. GRS (1989) show that the latter is equal to the difference between the maximum Sharpe ratio constructed from both factors (f_i) and Π_i that includes the factors of all model's i competitors and LHS excess returns, and the max for f_i alone as follows; $Sh^2(a_i) = Sh^2(\Pi) - Sh^2(f_i)$. Therefore, the best model that minimize $Sh^2(a_i)$ is the model that has the highest max Sharpe ratio produced by its factors, $Sh^2(f_i)$. The intercept in the spanning regression of each factor on the model's other factors provides a way to measure the marginal contribution of a factor to a model. The marginal contribution is the increase in the max Sharpe ratio for a model's factor when factor i is added to the model. It is $\frac{\alpha_i^2}{\sigma_i^2} = Sh^2(f,i) - Sh^2(f)$, where α_i is the intercept from spanning regression and σ_i is the standard deviation of the regression residuals. Therefore, the marginal contribution of a factor to model's max Sharpe ratio is small if the intercept (α_i) in the spanning regression is close to zero (factor expected returns is explained by other factors), or/and σ_i is large (factor's variation is not explained by other factors).

3.4 Summary statistics for factor returns

Summary statistics of monthly percent value-weight returns for factors are presented in Table 3.1. From Panel (A), the highest factors premiums (means) are for the market factor (Mkt) followed by value factor (HML), then momentum (WML) and size (SMB) factors, whereas investment factor (CMA) has a negligible premium. The Mkt premium is the highest at 1.98% per month, and is highly significant (t=3.2). The significant market premiums is consistent with Fama and French (2017) except for Japan. However, it is in contrast to weak statistical evidences of market premiums for some emerging markets (Cakici et al., 2016; Hanauer and Linhart, 2015), GCC[3] markets (Alhashel, 2019), and the MENA region (Abadi and Silva, 2019), which emphasizes the important role of the market factor in the Egyptian market.

The high value premium at 1.46% (t= 3.3) is consistent with evidences for high value premiums in emerging markets (Cakici et al., 2013)[4], and specifically with significant but lower premium in the region around 0.65 (Abadi and Silva, 2019; Alhashel, 2019). Value premium is stronger for small stocks; that is HMLs equals

[3] Gulf Cooperation Council

[4] The value premium for all emerging markets is 1.15% in Cakici et al. (2013)'s study, in contrast to lower premiums in international evidences (Fama and French, 2016), where the HML premiums is 0.20% (0.32) for North America (Europe).

2.08 (t= 3.15), while HMLb equals 0.85 (t=1.44), as shown in panel (B). Although HML_{s-B} is only 1.38 standard error from zero, it is significant at 10% for the alternative hypothesis that difference between small and big is greater than zero. This matches earlier observation for strong value effect in average excess returns for micro and small stocks in Size-BM portfolios in Table 2.4. High value premium amongst small stocks is consistent with Fama and French (2012) and Cakici et al. (2013, 2016).

The size factor (SMB) has high premium at 0.6% but insignificant (t=1.48). This is consistent with weak statistical significant for size in emerging markets (Cakici et al., 2016) and GCC markets (Alhashel, 2019). It seems that the size factor gains most of its power from portfolios sorted on size and investment, where SMB-inv premium is the highest at 0.77 (t=1.80). The high value and size premium for Egypt, compared to international data, draw an important observation for the asset pricing results to come. Similar to the size factor, the momentum factor has relatively high premium at 0.74 but insignificant (t=1.27). Both are much weaker than the value factor. There is no evidence of stronger momentum effect amongst small stocks, as WML_{s-B} is equal to -0.03. This may contradict earlier observation of strong momentum effect for micro stocks for Size-Momentum portfolios in Table 2.4.

Contrary to previous factors, RMW and CMA have low premiums. The RMW premium equals to 0.28% (t= 0.23). The insignificance of RMW factor is in contrast to international evidences (Fama and French, 2016; Foye, 2018; Zaremba and Czapkiewicz, 2017), but consistent with evidences from Asia, China and the MENA region (Abadi and Silva, 2019; Foye, 2018; Lin, 2017). This can relate the performance of the Egyptian market to countries in MENA region and Asian emerging markets other than other international markets. There is no evidence for higher profitability premium for small stocks. Although RMW_{s-B} is positive at 0.25%, it is far from significant. This matches earlier observation of the opposite profitability effect for micro stocks in average excess returns for portfolios sorted on size and profitability in Table 2.4.

Finally, the CMA premium is negligible at 0.06%. The negative CMA premium for big stocks (CMAb) mirrors the opposite investment pattern in average returns for size-INV portfolios in Table 2.4. There is some, albeit weak, evidences that the CMA factor is driven by small stocks; CMA_{s-B} is significant at 10% for the test that the difference is greater than zero. Interestingly, the small and insignificant premium for the CMA factor is consistent with evidences from emerging markets and the MENA region (Abadi and Silva, 2019; Foye, 2018; Guo et al., 2017; Lin, 2017; Zaremba and Czapkiewicz, 2017). This can be related to evidences of weak asset growth effect in emerging markets, as will be discussed.

Factors correlation

Correlations between factors are reported in Panel (C) of Table 3.1. Market factor has a negative correlation with SMB, which indicates that big firms tend to have higher betas, in contrast to Fama and French (2015). The RMW is negatively correlated with all factors, in which the highest correlation coefficients are with Mkt and HML at -0.33 and -0.35, respectively. This means that highly profitable (robust) firms tend to be big, have low B/M, lower beta and aggressive in investment. The negative correlation between RMW and HML is an interesting observation for the asset pricing tests to come.

The correlation between CMA and HML is very low at 0.08, as expected from the characteristics of portfolios in Section 2.5.2. This contradicts the highest correlation coefficient between both at 0.70 in Fama and French (2015), which sheds light on the redundancy of their HML factor in the five-factor model. This weak correlation, besides the positive correlation between SMB and CMA, are also against the predictions of investment-based asset pricing models such as of Zhang (2017), that consider the value factor a different manifestation of the investment factor. Lastly, the momentum and value factors are positively correlated at 0.20 [5]. This positive correlation is consistent with Hanauer and Linhart (2015) for EM EMEA[6] and BRIC countries, which confirmed in Abadi and Silva (2019) for the MENA region. However, it is inconsistent with other evidences for emerging markets (Cakici et al., 2013, 2016) and for developed markets (Asness et al., 2013). This emphasizes the different return dynamics across countries.

To sum up, summary statistics for factor returns show the significant importance of the Mkt factor as in the case of the developed markets, and of the value factor especially for emerging markets. The second factors in importance are the size and momentum factors, however, statistically insignificant. The insignificant profitability factor may relate the Egyptian market performance to the MENA and Asian markets than other emerging markets. There are some, albeit weak, evidences that CMA and HML factors are stronger for small than big stocks. Interestingly, the CMA premium is negligible. The highest factor correlation is between HML and RMW, while the lowest correlation is between HML and CMA. This shapes the characteristics of the market and regression results to come.

[5] This implies that momentum returns might not be puzzling and can be explained by the FF3F model, especially the HML. This is mostly true when winner portfolios have higher HML's slopes than loser portfolios (Cochrane, 2005b). Actually, this is the case in the regression analysis. Moreover, HML is the significant factor in explaining the WML returns in factors spanning regressions.

[6] Europe, Middle East and Africa.

Table 3.1 Summary statistics for factor returns

Panel (A): Means and standard deviation of factor returns

	Mkt	**SMB**	**HML**	**RMW**	**CMA**	**WML**
Mean	1.979	0.610	1.466	0.282	0.060	0.742
std	7.988	5.321	5.712	6.865	5.677	7.25
t-stat	3.202	1.483	3.316	0.531	0.137	1.27

Panel (B): Components of factor returns

	SMB_bm	**SMB_inv**	**SMB_prof**
Mean	0.47	0.77	0.60
std	5.84	5.49	5.50
t-stat	1.03	1.80	1.41

	HMLb	**HMLs**	**HMLs-b**	**RMWb**	**RMWs**	**RMWs-b**	**CMAb**	**CMAs**	**CMAs-b**	**WMLb**	**WMLs**	**WMLs-b**
Mean	0.85	2.08	1.23*	0.16	0.41	0.25	-0.43	0.55	0.98*	0.76	0.73	-0.03
std	7.63	8.53	11.48	8.60	8.87	10.79	7.06	7.74	9.50	9.17	8.76	10.56
t-stat	1.44	3.15	1.38	0.23	0.59	0.30	-0.79	0.92	1.33	1.03	1.03	-0.04

Panel (C): Correlation matrix for factor returns

	Mkt	**SMB**	**HML**	**RMW**	**CMA**	**WML**
MKT	1.00					
SMB	-0.17	1.00				
HML	0.14	-0.14	1.00			
RMW	-0.33	-0.08	-0.35	1.00		
CMA	0.15	0.19	0.08	-0.19	1.00	
WML	0.09	0.06	0.20	-0.10	0.13	1.00

This table reports summary statistics of factor returns for the period from July 2003 to June 2017 (expect for momentum factor from July 2004). Panel (A) presents means, standard deviation and t-statistics of factor returns. Means represent time series averages of value-weight monthly returns of each factor. MKT is the excess market portfolio above the risk free rate. SMB, HML, RMW, CMA and WML are the size, value, profitability, investment and momentum factors. Panel (B) reports summary statistics for the detailed components in constructing factors. SMB_bm, SMB_Prof, and SMB_inv are size factors for each of the three test assets. HMLb is the value premium for big firms, while HMLs is the value premium for small firms. The same is for RMWb, CMAb, RMWs, CMAs, WMLb and WMLs. HMLs-b is the difference between HMLs and HMLb. The same is for RMWs-b, CMAs-b, and WMLs-b. * sign refers to 10% level of significance for the alternative hypothesis that the difference is greater than zero. Lastly, panel (C) presents pairwise correlation for factor returns.

3.5 Asset pricing tests: Time series regression details

In time series regressions, if an asset pricing model explains expected returns, all regressions intercepts ($\alpha_i's$) should equal zero. For each test asset, robust OLS regressions[7] are estimated to test the CAPM, the Fama-French three, five and six-factor models. The study investigates alphas and anomaly patterns in alphas. In addition, it examines the significance of factor loadings and adjusted R-squared to check whether different risk factors provide a good description of returns (variation in returns).

The main regression results that will be discussed in details are the following. Market beta cannot alone explain the cross section variation in returns. Given the high value and size factors premiums, the three-factor model plays an important role in explaining return leaving little room for the five-factor model to improve upon. Nevertheless, portfolios sorted on size and profit challenge the FF3F model and support the five-factor model. The role of RMW factor is vital which provides the five-factor model a power in explaining average returns, whilst the role of the CMA factor is negligible. The momentum factor has a marginal role in describing the variation of returns. Finally, Size-INV portfolios are of a least challenge for asset pricing models, while Size-Mom are the most challenging.

3.5.1 Size-BM portfolios

Size-BM portfolios are firstly used to test each factor model. A strong relation between returns and size or/and value is documented in Table 2.4, as well as the high size and value premiums in Table 3.1. In this section, it is shown how Size-BM portfolios offer support to the FF3F model, however, leaving some value and size patterns in alphas. Micro-high B/M stocks are problematic for the model. The five and six-factor models cannot explain micro and small high BM stocks returns.

The CAPM

For Size-BM portfolios, the CAPM estimated intercepts (alphas) are different from zero as shown in Table 3.2. Alphas are significantly different from zero for micro and small high B/M (1.91 and 1.18) at 5% and for big low B/M (-0.30) at 10% significance levels. Alphas show the influence of size and B/M effects. It increase from low to high B/M portfolios and decrease from micro to big portfolios. Intercepts of micro

[7] Robust regressions are chosen since residuals suffer from heteroscedasticity. Serial correlation is not a problem in residuals especially after allowing for heteroscedasticity.

stocks exceed those of big stocks by 0.65% to 1.59% per month, which show the size effect. Value effect is shown in every row, where H-L ranges from 0.63% to 1.56% per month. This indicates that market beta leaves cross sectional variation in average stock returns that is related to size and B/M.

The CAPM betas are close to one and significant for all portfolios, however, the size pattern is not clear in betas. Although micro stocks' betas are higher than small stocks' betas, big portfolios tend to be riskier than micro stocks in low and high B/M columns. However, these high betas for big stocks are not compensated by high returns. This negative relation between return and beta matches negative correlation between Mkt and SMB factors, and is consistent with previous evidence by Omran (2007) and Girard and Omran (2007) for Egypt and Ajlouni and Khasawneh (2017) for Jordan, which imply the limitation of the CAPM in these markets. The fit of the CAPM is the highest for big portfolios and increases from high to low portfolios, reaching a maximum of 94% for big-low BM stocks. These results confirm that market beta alone cannot explain the cross sectional variation in returns that is related to size and B/M, which call for factors that control for these effects.

For easier presentation of the results, the CAPM prediction is presented in Panel (A) of Figure 3.1, where expected returns versus predicted returns (beta*market premium) are displayed. The model prediction is not very good, as plots are not concentrated around the 45 degree line, especially the MH and SH (micro and small high B/M) portfolios. Therefore, the study estimates next the FF3F model to verify whether size and value factors add to the explanation of the cross sectional variation of return that is related to size and B/M.

The three-factor model (FF3F)

Adding the size and value factors to the market factor helps in reducing the magnitude of the estimated intercepts compared to the CAPM, as shown in Table 3.3. Most interestingly, all intercepts become insignificant. The strength of the patterns of the size and value effects in intercept has decreased. Subtracting away neutral portfolios, the value effect is only shown in micro stocks. Meanwhile, size effect remains to a lesser extent in high B/M column, where the M-B is 0.94% per month. This means that micro-high B/M stocks earn higher average returns than what is explained by the model. Therefore, micro value stocks are of challenge to the FF3F model, in contrast to the case of extreme growth stocks in Fama and French (1993). This provides an early evidence for the difficulty in pricing micro stocks in Egypt, which may suffer from illiquidity and high cost of trading. Difficulty in explaining micro stocks by the FF3F model is also emphasized by Ajlouni and Khasawneh (2017) for Jordan.

For factors loadings, the market betas for the three-factor model are positive and significant as in the case of the CAPM. The slopes of the SMB are related to size, where it increase monotonically from negative for big stocks to positive values for micro stocks. Similarly, the slopes of the HML are related to B/M, where it increase monotonically from negative values for low B/M stocks to high positive values for high B/M stocks. This is consistent with Fama and French (1993) results and factors' intuition that small and value stocks have higher returns than big and growth stocks, respectively. The estimated coefficients (S) for the SMB factor are significant in all portfolios, except for big neutral B/M portfolio. Meanwhile, the estimated coefficients (h) for the HML factor are highly significant for all high-B/M portfolios, and significant for micro and big low B/M portfolios at 10% and 5%, respectively. The neutral portfolios are insignificant where slopes pass from negative to positive. These results support the existence of size and value effects. Therefore, the FF3F model plays a good job in explaining the cross section of average stock returns for portfolio formed on size and B/M. Results match previous evidences for Egypt (Taha and Elgiziry, 2016), GCC markets (Alhashel, 2019), and other individual countries such as Jordan and South Africa (Ajlouni and Khasawneh, 2017; Boamah, 2015), however, with the limitation that the model cannot fully describe the variation in returns.

The influence of the SMB and HML factors is also confirmed by the regressions adjusted R-squared (R^2). The average R^2 increases from 58% in the CAPM to 77% in the FF3F model. The increased fit of the model can be reflected in the FF3F plot (Figure 3.1, Panel A), where portfolios returns are more concentrated around the 45-degree line. Despite the increase in regressions R^2, only big-low B/M portfolio has R^2 that exceed 90%, which might call for additional factors that can improve the description of the variation of stock returns.

The five-factor model (FF5F)

Despite the good performance of the FF3F model, it is interesting to test the validity of the FF5F model for the Egyptian equities. On the one hand, profitability and investment are possible candidates for explaining the cross section returns based on the valuation theory (Fama and French, 2006, 2015) or investment-based asset pricing (Hou et al., 2015; Zhang, 2017). On the other, the study finds some profitability and investment patterns in average excess returns in Table 2.4, however, these patterns are without multiple control for different firm characteristics. Therefore, time series regressions analysis using portfolios can provide clear evidences about their roles, especially with small and insignificant risk premium for both factors.

The FF5F model does not provide good news for alphas, as shown in Table 3.4. It deteriorates alphas for micro (-0.85, t=-2.78) and small (-1.39, t= -3.09) high B/M portfolios, compared to the FF3F model, as it become larger and significant. This is mainly because the positive slopes of the RMW and CMA factors for small-high B/M portfolio raise the model prediction of its returns. Meanwhile, negative RMW loadings for micro high B/M portfolio lower the model prediction of its returns. The size effect is shown across alpha's columns, in addition to value effect in micro stocks.

The Mkt, SMB and HML loadings are significant with the right expected signs across portfolios, as in the case of the three-factor model. The RMW slopes are negative in 7 out of 9 portfolios, and significant in 6 out of 9 portfolios at 5% except one portfolio at 10% significance level. Negative slopes of RMW, except for small-high B/M and big low B/M portfolios, may imply the less profitability of stocks sorted on size and BM. One can argue that the reason for these negative slopes is that sorting on size and B/M leads to portfolios polluted by low profitability. Indeed, from Table 2.5, Size-Prof sorting can provide an approximate measure of high and low ROE averages for firms. For example, weak ROE is around 0.05, while robust profitability range from 0.32 to 0.41. For size-B/M sorting, ROE for size-B/M portfolios ranges from 0.09 to 0.17 and the highest ROE are at 0.22 and 0.27 for small and big low B/M. Accordingly, most of size-BM portfolios have negative slopes on RMW because of their relatively low ROE. However, the positive slope of small-high B/M and negative slope for small-low B/M is confusing. For example, small high B/M are acting as profitable firms despite having the lowest ROE.

Investment factor (CMA) plays no or marginal role in explaining returns. Its slopes are positive in 7 out of 9 portfolios, but they are all insignificant at 5% significance level. Removing the CMA from the regressions does not have a major effect on s, h, r slopes, which confirms the notion that the CMA factor adds no information to the model. This result is consistent with cross section regressions in section 2.6, where asset growth (investment) plays no role in predicting individual stock returns.

The fit of the model, as presented in the FF5F plot (Figure 3.1, Panel A), shows a relatively good performance of the model on size-B/M portfolios except for micro and small high B/M. The less successful performance of the FF5F for explaining size-B/M portfolios can be consistent with Fama and French (2016)'s finding that the FF5F has problems in describing average returns of size-BM portfolio for North America and Europe. Therefore, it is important to test this model using other test assets.

The six-factor model (FF6F)

The momentum factor is not motivated by the two main umbrella theories for factor models; the valuation theory and the investment/production-based models. However, it is well documented in the asset pricing empirical literature, especially since the introduction of Carhart (1997) model. Fama and French (2018) add the momentum factor to the five-factor model under pressure to satisfy popular demand. Therefore, it is interesting to test the six-factor model for the Egyptian equities, given the inconclusive evidences about the momentum effect in emerging markets, and to verify earlier evidences from Egypt that used small sample and found no momentum effect (Shaker and Elgiziry, 2014; Taha and Elgiziry, 2016).

Adding the momentum factor to the five-factor model keeps the significant alphas for micro and small high B/M portfolios (1.06, t=2.39 and -0.79, t=-2.75), as shown in Table 3.5 and the FF6F plot (Panel A, Figure 3.1). Indeed, the performance of the six-factor model is quite similar to the five-factor model in terms of the significance of alphas, size and value patterns in alphas, and the five-factor slopes. However, the momentum factor adds more to the description of returns than the CMA factor does. Factor loadings of momentum are significant in 3 out of 9 portfolios. It is especially significant for big stocks in low and neutral B/M portfolios (0.10, t=4.27 and -0.13, t= -2.87), and for micro high B/M (0.21, t= 3.33) portfolios. The lower number of significant Size-BM portfolios for the momentum factor is consistent with Abadi and Silva (2019). The average R^2 increases to 80% from 78% and 77% for the five and three-factor models, respectively.

3.5.2 Size-Prof portfolios

It is found from portfolios summary statistics and factor returns that positive relation between profit and returns exists except for micro stocks. Likewise, the profitability factor premium is relatively small and insignificant. In this section, the study shows that weak profitable stocks, especially big stocks, are challenging the three-factor model. The FF5F model plays a good job in explaining those portfolios, eliminating the profitability effect in alphas returns. Nonetheless, micro and small weak profitable stocks may leave little challenges to this model. The momentum and investment factors are not adding much to the description of returns for Size-Prof portfolios.

The CAPM

The intercepts highlight the CAPM failure, with positive significant values for micro weak (1.48), and small robust (1.16) and neutral (1.05) profitability at 10%, 10%, 5% levels, and negative intercept for big weak profitability (-0.81) at 10% level. The size effect is also shown in alphas with positive M-B premiums, while the profitability effect is only shown in small stocks, with an opposite profitability effect in micro stocks. Similar to size-BM portfolios, the significant estimates of betas show the riskiness of big stocks compared to micro and small stocks. The model fit is the highest for big portfolios and increases from weak to robust profitability reaching a maximum of 87%, which is lower than the highest R^2 for size-B/M portfolios at 94%. The model failure is easily presented in the CAPM plot in Figure 3.1, Panel B, where returns of BN, BH and SL are only predicted by the model while the returns of other six portfolios are not.

The FF3F model

The introduction of the three-factor model plays a good role in decreasing intercepts' magnitude. However, this model fails to explain the returns of small and big weak profitability portfolios (Table 3.3), with negative alphas at -0.85 (t= -2.78) and -1.39 (t=-3.09). Negative alphas means that the model is predicting higher returns for these portfolios, mainly because of the positive slope of the HML, and they may deserve, though, low premium due to their weak profitability. Weak profitable stocks, especially big stocks, are the biggest problem for the FF3F model, which is consistent with Lin (2017) for the Chinese market. Profitability effect is shown in alphas for small and to lesser extent big portfolios, which requires controlling for a profitability factor. The existence of the SMB factor does not fully eliminate the size effect as it is still shown in alphas in the three columns.

Regarding factors slopes, the market factor continues to have high significant slopes. The SMB loadings are highly significant in 6 out of 9 portfolios. Micro and small portfolios have positive loadings on the SMB, while big stocks have negative loadings as expected, except for big-weak portfolio (0.13) which causes a problem to the FF3F model but insignificant. The HML loadings are significant in 5 portfolios (4 at 5% or higher and one at 10% levels). Its loading are positive and significant for weak column, and almost negative in robust profitability column. This matches portfolios characteristics in Table 2.5, where high (low) B/M stocks corresponds to weak (robust) profitability stocks. The FF3F model plays a good role in pricing micro and small stocks where R^2 have increased for them but a slight increase for big stocks. On average, R^2 has increased to 69% from 56% for the CAPM. The prediction of the model is presented in the FF3F plot (figure 3.1, panel B), with the failure to predict SL and BL (small and big low profitability) stocks.

Table 3.2 CAPM regression results

	Size-BM portfolios						Size-Prof portfolios						Size-INV portfolios						Size-Mom portfolios					
	Low	**N**	**High**	**Low**	**N**	**High**	**Weak**	**N**	**Robust**	**Weak**	**N**	**Robust**	**Cons-**	**N**	**Aggr-**	**Cons-**	**N**	**Aggr-**	**Loser**	**N**	**Win-**	**Loser**	**N**	**Win-**
		α			t(α)			α			t(α)			α			t(α)			α			t(α)	
Micro	0.35	0.48	1.91	0.40	0.71	2.85	1.48	1.01	0.95	1.70	1.62	1.38	1.44	0.64	1.06	1.95	0.93	1.39	1.45	1.93	3.21	2.47	3.01	3.10
small	0.13	0.54	1.18	0.23	1.29	2.07	-0.01	1.05	1.16	-0.02	2.28	1.95	0.27	0.69	0.49	0.46	1.56	1.04	0.68	0.48	0.56	1.36	1.17	0.97
Big	-0.30	-0.29	0.32	-1.81	-1.22	0.67	-0.81	0.12	-0.10	-1.82	0.49	-0.41	-0.38	-0.24	0.06	-0.91	-0.97	0.25	-0.58	-0.34	0.07	-1.37	-1.42	0.18
		b			**t(b)**			**b**			**t(b)**			**b**			**t(b)**			**b**			**t(b)**	
Micro	1.01	1.04	1.10	7.63	7.73	10.72	1.10	0.77	0.94	7.98	8.27	10.32	1.22	0.92	1.15	9.42	9.93	6.89	1.05	1.10	0.99	10.05	9.95	6.85
small	0.94	0.85	1.04	11.42	13.21	13.33	1.02	0.88	0.74	14.06	13.31	7.87	0.99	1.04	0.71	12.48	15.06	12.71	0.97	0.93	1.10	12.75	16.81	10.05
Big	1.05	0.97	1.12	34.89	21.45	12.58	1.26	1.01	1.01	10.71	21.91	22.78	1.05	1.04	1.04	13.30	18.18	26.17	1.00	0.97	1.02	11.36	25.09	14.43
		R^2			**Root MSE**			R^2			**Root MSE**			R^2			**Root MSE**			R^2			**Root MSE**	
Micro	0.31	0.42	0.48	11.99	9.66	9.18	0.37	0.34	0.41	11.50	8.54	8.98	0.46	0.41	0.41	10.57	8.86	11.06	0.53	0.51	0.28	7.99	8.72	12.90
small	0.49	0.57	0.55	7.53	5.93	7.47	0.63	0.53	0.38	6.24	6.61	7.59	0.54	0.63	0.45	7.22	6.32	6.26	0.58	0.67	0.54	6.63	5.25	8.19
Big	0.94	0.83	0.61	2.10	3.45	7.14	0.66	0.85	0.87	7.14	3.38	3.15	0.69	0.82	0.86	5.62	3.85	3.33	0.64	0.88	0.75	6.12	2.97	4.78

This table reports regression results for the following regression $R_{it} - R_{ft} = \alpha_i + b_i Mkt_t + \epsilon_{it}$, where alpha is the intercept and b is the slope of excess market return. R^2 is the adjusted R-squared. In the second row, N refers to neutral or middle categories for sorting variables. Cons- stands for conservative (low) investment, while Aggr- refers for aggressive (high) investment. Lastly, Win- stands for winner.

Table 3.3 FF3F regression results

	Size-BM portfolios						Size-prof portfolios					
	Low	**N**	**High**	**Low**	**N**	**High**	**Weak**	**N**	**Robust**	**Weak**	**N**	**Robust**
		α			t(α)			α			t(α)	
Micro	-0.01	-0.13	0.55	-0.02	-0.27	1.32	0.07	0.49	0.62	0.14	0.91	0.98
small	-0.27	0.06	-0.40	-0.65	0.18	-1.49	-0.85	0.33	0.73	-2.78	1.00	1.59
Big	-0.03	-0.29	-0.39	-0.21	-1.05	-1.02	-1.39	0.20	0.19	-3.09	0.74	0.78
		b			**t(b)**			**b**			**t(b)**	
Micro	1.10	1.09	1.11	10.28	10.16	13.47	1.13	0.79	0.98	9.99	8.22	12.61
small	0.98	0.88	1.00	14.29	18.31	20.52	1.03	0.90	0.77	16.35	17.43	8.57
Big	1.06	0.96	1.05	34.87	22.16	16.40	1.22	1.01	1.02	10.83	22.38	24.93
		s			**s(t)**			**s**			**s(t)**	
Micro	1.26	1.09	1.20	7.89	8.32	13.06	1.43	0.71	0.71	10.33	5.23	5.26
small	0.82	0.73	0.85	8.97	8.30	12.16	0.77	0.76	0.61	10.02	8.08	6.05
Big	-0.09	-0.08	-0.24	-3.15	-1.18	-2.42	0.13	-0.06	-0.16	1.20	-1.09	-3.16
		h			**h(t)**			**h**			**h(t)**	
Micro	-0.28	0.00	0.54	-1.87	-0.01	4.26	0.47	0.10	-0.06	2.30	0.71	-0.41
small	-0.05	0.06	0.86	-0.42	0.61	7.91	0.32	0.23	0.06	2.84	1.93	0.36
Big	-0.18	0.03	0.67	-6.46	0.50	5.01	0.40	-0.04	-0.15	2.99	-0.70	-3.22
		R^2			**Root MSE**			R^2			**Root MSE**	
Micro	0.60	0.67	0.77	9.09	7.30	6.04	0.68	0.48	0.54	8.17	7.57	7.97
small	0.70	0.78	0.85	5.78	4.22	4.38	0.81	0.73	0.50	4.42	5.03	6.77
Big	0.95	0.83	0.75	1.86	3.43	5.72	0.69	0.85	0.88	6.83	3.38	2.96

	Size-INV portfolios						Size-Mom portfolios					
	Cons-	**N**	**Aggr-**	**Cons-**	**N**	**Aggr-**	**Loser**	**N**	**Win-**	**Loser**	**N**	**Win-**
		α			t(α)			α			t(α)	
Micro	0.19	-0.38	0.25	0.38	-0.77	0.40	0.80	1.03	1.87	1.64	2.18	2.25
small	-0.49	-0.11	-0.13	-1.32	-0.39	-0.39	0.06	-0.28	-0.83	0.13	-1.05	-2.16
Big	-0.57	-0.39	0.26	-1.27	-1.48	1.09	-0.57	-0.31	-0.06	-1.22	-1.22	-0.14
		b			**t(b)**			**b**			**t(b)**	
Micro	1.25	0.94	1.18	12.14	10.78	7.67	1.07	1.12	1.01	10.58	12.60	7.96
small	1.00	1.04	0.72	14.30	21.14	12.36	0.98	0.93	1.10	12.66	19.63	14.00
Big	1.05	1.02	1.04	13.64	19.22	26.54	1.01	0.97	1.02	11.18	25.34	14.73
		s			**s(t)**			**s**			**s(t)**	
Micro	1.36	1.04	0.98	13.87	8.88	6.13	0.76	1.01	1.26	8.03	10.89	7.93
small	0.74	0.70	0.68	8.09	8.21	6.99	0.62	0.63	0.99	5.88	8.81	11.73
Big	0.11	-0.05	-0.23	1.45	-0.73	-4.64	0.03	-0.05	0.03	0.27	-1.07	0.37
		h			**h(t)**			**h**			**h(t)**	
Micro	0.38	0.34	0.20	2.84	2.47	1.46	0.10	0.19	0.43	0.83	1.32	1.74
small	0.27	0.31	0.19	1.47	2.37	1.82	0.17	0.30	0.67	1.37	3.11	4.52
Big	0.09	0.14	-0.05	1.02	1.55	-0.89	-0.04	0.01	0.10	-0.33	0.11	1.25
		R^2			**Root MSE**			R^2			**Root MSE**	
Micro	0.74	0.67	0.55	7.28	6.64	9.60	0.67	0.71	0.49	6.76	6.64	10.82
small	0.70	0.78	0.65	5.89	4.86	4.97	0.70	0.82	0.78	5.67	3.85	5.68
Big	0.69	0.83	0.88	5.61	3.76	3.08	0.63	0.87	0.75	6.15	2.97	4.78

This table presents the regression results for $R_{it} - R_{ft} = \alpha_i + b_i Mkt_t + s_i SMB_t + h_i HML_t + \epsilon_{it}$, where α is the intercept. b, s, h are the factor loading for excess market returns, SMB and HML factors, respectively. R^2 is the adjusted R-squared. Cons- stands for conservative (low) investment, while Aggr- refers for aggressive (high) investment. Lastly, Win- stands for winner.

Table 3.4 FF5F regression results

	Size-BM portfolios					
	Low	**N**	**High**	**Low**	**N**	**High**
	α			t(α)		
Micro	0.19	0.32	0.98	0.28	0.63	2.29
small	-0.02	0.04	-0.88	-0.05	0.12	-2.85
Big	-0.08	-0.14	0.01	-0.52	-0.49	0.03
	s			**s(t)**		
Micro	1.24	1.07	1.15	7.78	10.19	11.53
small	0.83	0.82	0.91	8.66	9.05	11.11
Big	-0.10	-0.09	-0.28	-3.23	-1.30	-2.52
	h			**h(t)**		
Micro	-0.54	-0.31	0.22	-3.10	-2.48	1.65
small	-0.26	-0.08	0.85	-2.66	-1.00	7.63
Big	-0.14	0.00	0.60	-4.16	0.05	4.82
	r			**r(t)**		
Micro	-0.22	-0.38	-0.35	-1.36	-3.24	-2.81
small	-0.24	-0.12	0.28	-2.71	-1.46	3.21
Big	0.06	-0.10	-0.26	1.53	-1.68	-3.14
	c			**c(t)**		
Micro	0.12	0.25	0.17	0.71	1.49	1.37
small	0.08	-0.07	0.13	0.83	-0.86	1.67
Big	0.03	0.00	-0.04	0.75	-0.10	-0.36
	R^2			**Root MSE**		
Micro	0.59	0.73	0.79	9.23	6.61	5.76
small	0.73	0.81	0.85	5.54	3.93	4.28
Big	0.96	0.84	0.76	1.80	3.41	5.56

	Size-prof portfolios					
	Weak	**N**	**Robust**	**Weak**	**N**	**Robust**
	α			t(α)		
Micro	0.91	0.66	0.70	1.68	1.27	1.16
small	-0.51	0.20	-0.19	-1.69	0.60	-0.42
Big	0.07	0.14	-0.05	0.21	0.50	-0.22
	s			**s(t)**		
Micro	1.39	0.75	0.78	12.90	5.75	5.88
small	0.77	0.88	0.85	9.80	8.00	8.72
Big	-0.23	-0.04	-0.15	-3.11	-0.71	-2.66
	h			**h(t)**		
Micro	-0.002	-0.08	-0.21	-0.02	-0.55	-1.90
small	0.10	0.12	0.18	1.18	1.07	1.32
Big	0.03	-0.01	-0.06	0.29	-0.24	-1.13
	r			**r(t)**		
Micro	-0.72	-0.21	-0.16	-5.48	-1.38	-1.32
small	-0.31	-0.05	0.51	-3.01	-0.68	2.88
Big	-0.82	0.03	0.19	-7.01	0.56	3.53
	c			**c(t)**		
Micro	0.01	0.07	0.08	0.07	0.52	0.78
small	0.06	-0.05	0.20	0.73	-0.55	1.60
Big	0.23	-0.03	-0.01	2.30	-0.45	-0.14
	R^2			**Root MSE**		
Micro	0.77	0.51	0.56	6.92	7.32	7.74
small	0.86	0.75	0.66	3.90	4.82	5.62
Big	0.87	0.85	0.90	4.45	3.40	2.70

	Size-INV portfolios					
	Cons-	**N**	**Aggr-**	**Cons-**	**N**	**Aggr-**
	α			t(α)		
Micro	0.63	0.07	0.57	1.26	0.15	0.94
small	-0.65	-0.28	-0.29	-1.73	-0.96	-0.90
Big	0.12	-0.23	0.09	0.32	-0.77	0.42
	s			**s(t)**		
Micro	1.22	1.06	1.07	11.09	10.59	5.53
small	0.74	0.83	0.84	9.14	8.53	8.79
Big	-0.17	-0.07	-0.18	-2.43	-0.98	-3.64
	h			**h(t)**		
Micro	0.053	0.04	-0.07	0.30	0.39	-0.69
small	0.19	0.22	0.09	1.43	1.70	1.02
Big	-0.07	0.10	0.02	-0.84	1.26	0.53
	r			**r(t)**		
Micro	-0.25	-0.46	-0.42	-1.48	-3.62	-2.46
small	0.16	-0.03	-0.10	1.23	-0.35	-1.02
Big	-0.22	-0.11	0.07	-1.87	-1.30	1.65
	c			**c(t)**		
Micro	0.53	-0.10	-0.17	2.95	-0.97	-1.37
small	0.59	-0.08	-0.30	5.00	-0.76	-2.73
Big	0.63	-0.01	-0.28	6.95	-0.26	-9.73
	R^2			**Root MSE**		
Micro	0.77	0.73	0.60	6.83	6.01	9.09
small	0.81	0.80	0.72	4.68	4.61	4.47
Big	0.83	0.83	0.92	4.21	3.73	2.58

	Size-Mom portfolios					
	Loser	**N**	**Win-**	**Loser**	**N**	
	α			t(α)		
Micro	0.94	1.20	2.47	2.03	2.29	2.73
small	0.20	-0.15	-0.78	0.46	-0.50	-1.76
Big	-0.62	-0.48	0.06	-1.24	-1.80	0.13
	s			**s(t)**		
Micro	0.86	0.98	1.16	7.87	9.88	7.02
small	0.69	0.63	1.01	6.15	9.58	9.58
Big	0.07	-0.01	-0.03	0.63	-0.24	-0.29
	h			**h(t)**		
Micro	-0.13	-0.10	-0.04	-1.29	-0.70	-0.17
small	-0.03	0.11	0.42	-0.26	1.13	2.59
Big	-0.03	0.06	0.07	-0.34	1.32	1.12
	r			**r(t)**		
Micro	-0.27	-0.16	-0.42	-2.67	-0.96	-1.94
small	-0.23	-0.13	-0.14	-2.01	-1.38	-0.88
Big	0.00	0.09	-0.03	0.00	2.84	-0.29
	c			**c(t)**		
Micro	-0.17	0.23	0.37	-1.51	1.63	1.87
small	-0.09	0.09	-0.03	-0.84	1.06	-0.25
Big	-0.03	-0.05	0.03	-0.42	-1.08	0.29
	R^2			**Root MSE**		
Micro	0.70	0.73	0.53	6.40	6.51	10.40
small	0.72	0.83	0.77	5.39	3.77	5.86
Big	0.63	0.88	0.75	6.19	2.92	4.81

This table presents the results of the following regression: $R_{it} - R_{ft} = \alpha_i + b_i Mkt_t + s_i SMB_t + h_i HML_t + r_i RMW_t + c_i CMA_t + \epsilon_{it}$, where α is the intercept. The market excess returns loadings (b) are excluded for the ease of presentation. s, h, r and c represent factors loadings for SMB, HML, RMW and CMA factors respectively. R^2 is the adjusted R-squared. Cons- stands for conservative (low) investment, Aggr- refers for aggressive (high) investment, and Win- stands for winner.

Table 3.5 FF6F regression results

	Size-BM portfolios						Size-prof portfolios						Size-INV portfolios						Size-Mom portfolios					
	Low	**N**	**High**	**Low**	**N**	**High**	**Weak**	**N**	**Robust**	**Weak**	**N**	**Robust**	**Cons-**	**N**	**Aggr-**	**Cons-**	**N**	**Aggr-**	**Loser**	**N**	**Win-**	**Loser**	**N**	**Win-**
		α			t(α)			α			t(α)			α			t(α)			α			t(α)	
Micro	0.15	0.32	1.06	0.21	0.61	2.39	0.90	0.72	0.62	1.66	1.30	0.97	0.58	0.01	0.61	1.18	0.02	0.97	1.02	1.20	2.45	2.26	2.28	2.73
small	-0.06	-0.05	-0.79	-0.14	-0.15	-2.75	-0.59	0.10	-0.16	-1.91	0.30	-0.36	-0.74	-0.25	-0.20	-1.92	-0.86	-0.61	0.29	-0.13	-0.87	0.77	-0.42	-2.40
Big	-0.07	-0.16	-0.07	-0.44	-0.58	-0.17	0.13	0.09	-0.09	0.36	0.33	-0.37	0.21	-0.23	-0.04	0.55	-0.79	-0.21	-0.49	-0.48	-0.03	-1.55	-1.79	-0.09
		s			**s(t)**			**s**			**s(t)**			**s**			**s(t)**			**s**			**s(t)**	
Micro	1.25	1.09	1.12	7.50	10.64	11.48	1.46	0.77	0.82	13.15	5.72	5.89	1.21	1.07	1.13	12.20	10.13	5.23	0.90	0.98	1.15	8.69	9.92	6.77
small	0.81	0.86	0.87	8.28	9.29	11.42	0.80	0.89	0.81	10.31	8.03	8.25	0.75	0.85	0.83	9.53	8.86	8.55	0.74	0.64	0.96	7.89	9.70	11.13
Big	-0.11	-0.10	-0.25	-3.69	-1.49	-2.03	-0.27	-0.07	-0.12	-3.55	-1.31	-1.99	-0.17	-0.05	-0.16	-2.27	-0.74	-3.41	0.14	-0.01	-0.08	1.68	-0.28	-1.05
		h			**h(t)**			**h**			**h(t)**			**h**			**h(t)**			**h**			**h(t)**	
Micro	-0.62	-0.21	0.11	-2.87	-1.50	0.77	0.027	-0.04	-0.13	0.23	-0.24	-1.11	-0.122	0.06	-0.09	-0.71	0.51	-0.65	-0.025	-0.10	-0.07	-0.26	-0.69	-0.31
small	-0.25	-0.04	0.70	-2.16	-0.46	6.86	0.13	0.18	0.23	1.32	1.39	1.40	0.28	0.30	0.12	1.97	2.14	1.11	0.09	0.15	0.30	1.03	1.44	1.96
Big	-0.19	0.06	0.65	-4.61	1.11	4.27	0.02	0.02	-0.11	0.12	0.32	-2.04	-0.14	0.22	-0.03	-1.65	2.88	-0.62	0.14	0.06	-0.04	1.68	1.26	-0.62
		r			**r(t)**			**r**			**r(t)**			**r**			**r(t)**			**r**			**r(t)**	
Micro	-0.25	-0.37	-0.37	-1.48	-2.97	-3.17	-0.77	-0.23	-0.14	-6.25	-1.52	-1.12	-0.28	-0.46	-0.46	-1.69	-3.46	-2.57	-0.27	-0.16	-0.42	-3.59	-0.96	-1.88
small	-0.26	-0.12	0.26	-2.77	-1.30	2.65	-0.29	-0.05	0.54	-2.87	-0.59	3.04	0.19	-0.02	-0.10	1.50	-0.25	-0.94	-0.22	-0.13	-0.15	-2.70	-1.46	-1.00
Big	0.05	-0.06	-0.28	1.46	-1.49	-3.36	-0.82	0.07	0.16	-7.01	1.25	3.12	-0.25	-0.09	0.05	-2.28	-1.10	1.27	0.01	0.09	-0.04	0.13	2.80	-0.54
		c			**c(t)**			**c**			**c(t)**			**c**			**c(t)**			**c**			**c(t)**	
Micro	0.14	0.23	0.17	0.80	1.31	1.34	-0.06	0.10	0.04	-0.52	0.71	0.42	0.55	-0.10	-0.20	3.17	-0.93	-1.69	-0.13	0.23	0.36	-1.36	1.60	1.80
small	0.09	-0.08	0.17	0.87	-1.08	2.26	0.05	-0.07	0.18	0.52	-0.73	1.47	0.59	-0.12	-0.28	5.44	-1.21	-2.42	-0.04	0.10	-0.08	-0.48	1.27	-0.78
Big	0.02	0.01	-0.05	0.46	0.21	-0.42	0.23	-0.02	-0.01	2.39	-0.31	-0.23	0.62	-0.03	-0.30	7.29	-0.56	-8.83	0.04	-0.06	-0.01	0.49	-1.13	-0.20
		w			**w(t)**			**w**			**w(t)**			**w**			**w(t)**			**w**			**w(t)**	
Micro	0.01	-0.02	0.21	0.03	-0.18	3.33	0.13	-0.18	-0.05	1.38	-1.76	-0.54	0.13	-0.02	0.01	1.56	-0.22	0.04	-0.39	0.00	0.11	-4.01	0.05	0.72
small	0.06	-0.06	0.02	0.86	-1.17	0.35	-0.08	0.04	0.11	-1.35	0.70	1.15	-0.11	0.10	-0.10	-2.06	1.84	-1.35	-0.45	-0.13	0.46	-6.84	-2.73	6.17
Big	0.10	-0.13	-0.05	4.27	-2.87	-0.59	0.09	0.00	0.01	1.41	0.03	0.26	0.12	-0.10	0.09	1.56	-1.62	2.71	-0.65	0.02	0.43	-8.91	0.41	6.85
		R^2			**Root MSE**			R^2			**Root MSE**			R^2			**Root MSE**			R^2			**Root MSE**	
Micro	0.60	0.75	0.81	9.48	6.58	5.60	0.79	0.53	0.57	6.76	7.40	7.92	0.80	0.73	0.61	6.44	6.12	9.25	0.76	0.72	0.53	5.77	6.53	10.40
small	0.75	0.82	0.86	5.44	3.96	3.91	0.86	0.76	0.67	3.85	4.86	5.68	0.82	0.82	0.72	4.64	4.48	4.48	0.82	0.84	0.84	4.36	3.67	4.88
Big	0.96	0.86	0.76	1.67	3.13	5.60	0.87	0.87	0.91	4.48	3.19	2.61	0.83	0.86	0.93	4.15	3.57	2.42	0.84	0.88	0.85	4.07	2.92	3.69

This table reports the results of the following regression: $R_{it} - R_{ft} = \alpha_i + b_i Mkt_t + s_i SMB_t + h_i HML_t + r_i RMW_t + c_i CMA_t + w_i WML_t + \epsilon_{it}$, where α is the intercept. The market excess returns loadings (b) are excluded for the ease of presentation. s, h, r, c, and w represent factors loadings for SMB, HML, RMW, CMA and WML factors respectively. R^2 is the adjusted R-squared. Cons- stands for conservative (low) investment, Aggr- refers for aggressive (high) investment, and Win- stands for winner.

Fig. 3.1 Models prediction

Panel: A	Panel: B	Panel: C	Panel: D
Size-B/M portfolios	**Size-PROF portfolios**	**Size-INV portfolios**	**Size-Mom portfolios**

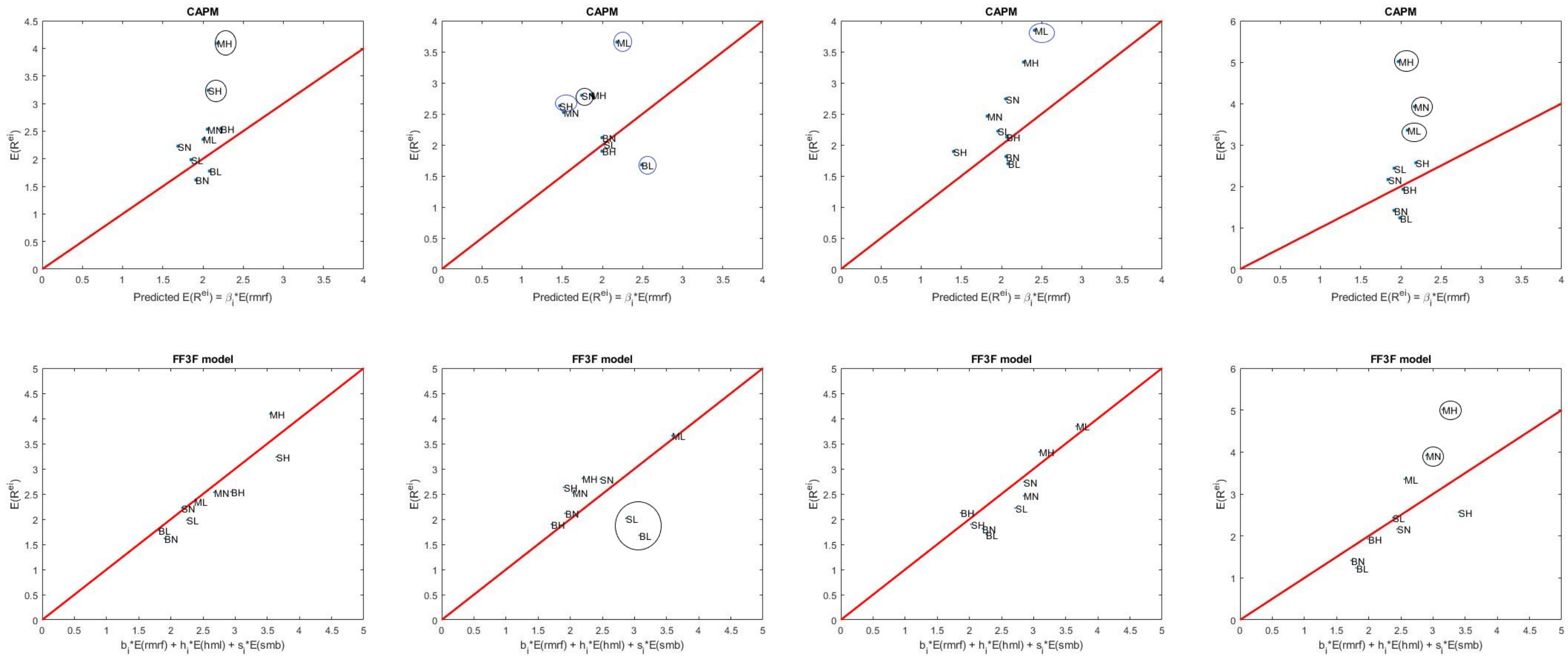
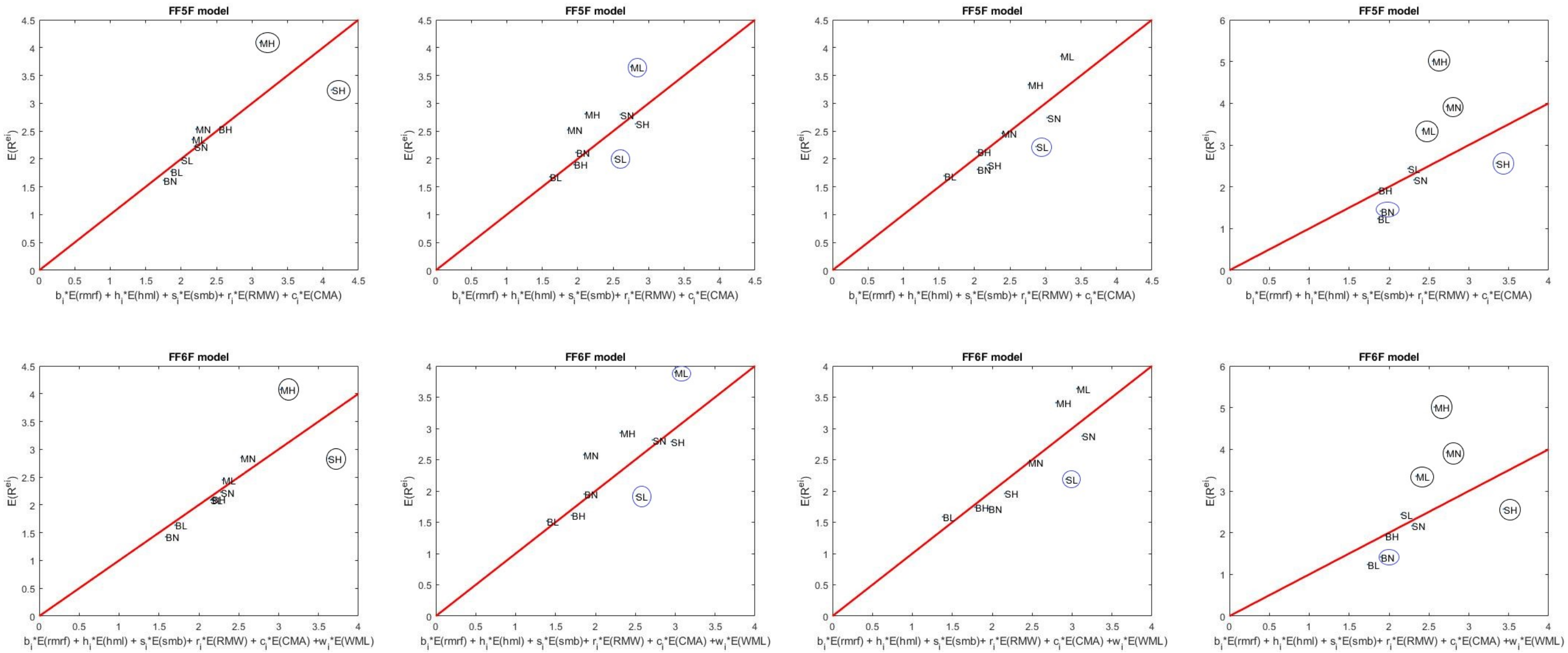


Fig. 3.1 Models prediction (continued)

Size-B/M portfolios | **Size-PROF portfolios** | **Size-INV portfolios** | **Size-Mom portfolios**



This figure presents models prediction (expected returns versus predicted returns) for nine portfolios in each of four tests assets Size-BM (Panel A), Size-Prof (Panel B), Size-INV (Panel C), and Size-Mom (Panel D). Models are the CAPM, FF3F, FF5F and FF6F. The top block is for the CAPM, the second is for the FF3F model, while the bottom block is for the FF6F model. Black (Blue) circles show significant alphas at 5% (10%). For abbreviations; M= Micro, S= small, B= big, H= high, N= neutral, L= Low. For example, ML refers to Micro-low B/M, micro-low profitability, micro-low investment or micro-loser portfolio in either of the four testing assets.

The FF5F model

The five-factor model achieves success in adjusting alphas towards zero, however, at the cost of increasing micro portfolios alphas. No alphas are significant at 5%, only micro and small weak profitability are barely significant at 10%, as presented in Table 3.4. The significant alphas in weak profitability portfolios is in contrast to Fama and French (2015), where their highest intercepts are in highest profitability microcap. In contrast, it is consistent with evidences for the Chinese market (Guo et al., 2017; Lin, 2017), in which the biggest problem for five-factor model is microcaps stocks in the lowest profitability quintiles. The profitability effect in alphas has been absorbed by the introduction of the RMW factor. However, size effect is not completely eliminated in alphas, given the high returns for micro portfolios, which may require a special risk factor to handle micro stocks. Intercepts' improvement can be traced to the negative RMW slopes for small and big weak ROE that help in lowering the five-factor prediction of their average returns.

The existence of the RMW factor for size-prof portfolios erodes the power of the HML factor. It seems reasonable since the correlation between HML and RMW factors is the highest at -0.35 and portfolio characteristics show that profitable firms are most probably growth firms (low B/M). One can argue that HML and RMW might be driven by similar economic forces and thus improvement of one is at the expense of the other. The RMW loadings are significant in 5 out of 9 portfolios, with negative loading on weak portfolios and positive loadings for robust portfolios, except micro robust. The HML is only significant for micro-robust portfolio at 10%. This makes sense since the profitability effect in average returns does not exist for micro stocks (Table 2.4), therefore, the HML comes to explain the low returns of micro robust portfolio that the RMW fails to explain.

The negligible role of the investment factor sheds light on its redundancy and an unclear relation between return and investment in an emerging market case. The CMA loadings are not significant for all portfolios except big-weak portfolio (0.23, t=2.30), which means a higher returns of this portfolio because of its conservative investment. This imply an ambiguous positive relation between investment and returns, which contradicts the expected sign of Tobin's Q-theory or the valuation theory. It also contradicts portfolio characteristics of this portfolio (Table 2.5), in which big-weak firms invest more in the Egyptian stock market, while profitable firms are reluctant to invest. Nevertheless, the uni-variate characteristics do not necessarily line up with slopes of multivariate regression, which display the marginal effect holding other factors exposure constant. The good performance of the five-factor model is confirmed by the increase in average adjusted R^2 from 69% in the three-factor model to 75%.

The FF5F model prediction (Figure 3.1, panel B) shows the good performance of the model except in explaining micro and small low profitability.

The FF6F model

The performance of the six-factor model is quite similar to the five-factor model. For example, it leaves only micro and small weak profitability alphas (0.91 and -0.51) barely significant at 10%, as shown in Table 3.5 or the FF6F plot (Panel B, Figure 3.1). The RMW factor kills the power of the HML factor. The momentum factor plays a negligible role in describing the return of Size-Prof portfolios, since factor loadings are not significant except for micro neutral portfolio (-0.18) at 10%.

3.5.3 Size-INV portfolios

Negative relation between investment and average returns, except for big stocks, is found in portfolios returns (Table 2.4). Likewise, the CMA premium is very small and insignificant. In this section, it is shown that both the three and five-factor models can successfully capture the investment patterns in alphas returns but alphas provide more support to the three-factor model.

The CAPM

The highest alpha from CAPM regressions on Size-INV portfolios is for micro conserve at 1.44 but only significant at 10%, as shown in Table 3.2. The size effect is shown in alphas, while investment effect slightly appears in micro stocks, where alpha for conserve category (1.44) is higher than aggressive category (1.06). The prediction of the model is not good considering the CAPM plot (Figure 3.1, Panel C), where micro stocks are the main problem for the model.

The FF3F model

The three-factor model provides a better description of portfolios return, as all alphas' become small and insignificant. This improvement can be clearly seen in the FF3F plot (Figure 3.1, Panel C). There are no investment patterns in the FF3F model's alphas, which reflect a pointless need for an investment factor. The SMB loadings are highly significant in 7 out of 9 portfolios. The HML loadings are significant in 4 portfolios (3 portfolio at 5% and 1 portfolio at 10%). The FF3F model improves the description of returns, as average R^2 increases to 72% from 59% for the CAPM.

The FF5F model

In Table 3.4, the intercepts for the five-factor model are still small and insignificant compared to the three-factor model, except for small-conserve portfolio at -0.65 (barely significant at 10%). The introduction of the RMW and CMA factors eliminate the power of the HML, where its loadings become only significant at 10% for only small neutral portfolio (0.22). RMW loadings are significant in 4 out of 9 portfolios (two at 5% or higher). The CMA has positive loadings on conserve and negative loadings on aggressive investment as expected. Since intercepts in the three-factor model does not show investment effect, the CMA significant loadings come at the cost of the power of HML and RMW factors, and this is most expected when portfolios on the LHS are sorted on size and investment.

The FF6F model

The six-factor model leaves the small conserve portfolio alpha at -0.74 (significant at 10%) in Table 3.5, which is similar to the performance of the five-factor model. The momentum factor plays a role in describing the return of some Size-INV portfolios, as loadings are significant for 3 portfolios. However, the increase in average R^2 from the five-factor model is minimal (from 78% to 79%).

One can argue that portfolios sorted on size and investment are the least challenging to pricing models. Investment patterns in models' alphas are weak, which means those models can capture the investment pattern in alphas returns. For example, investment patterns are only shown for micro stocks in the CAPM and the FF5F models, meanwhile, they are eliminated in the FF3F model. This provides an early evidence of weak investment effect in the Egyptian stock market.

3.5.4 Size-Mom portfolios

From summary statistics, it is found that the momentum factor is relatively large but insignificant while the momentum patterns in average excess return exist mostly in micro stocks. In this section, the study discusses how factor models are not successful in explaining the returns of micro stocks for Size-Mom portfolios, even after controlling for the momentum factor in the six-factor model.

The CAPM

For portfolios sorted on size and momentum, the CAPM could not explain the average returns of all micro stocks with significant alphas at 1.45% (t=2.47), 1.93% (t=3.01) and 3.2%(t= 3.10), as reported in Table 3.2. Size effect is apparent in all columns, while momentum effect is shown for big firms and for micro stocks where winner-micro alpha at 3.21% is higher than micro-loser alpha at 1.45%.

The FF3F model

The FF3F reduces the magnitude of alphas, but it does not succeed in pricing micro stocks, as their alphas are still significant, as reported in Table 3.3. The SMB loadings are significant and positive for all micro and small stocks, while insignificant for big stocks with only one portfolio has a negative sign. This means that the size factor does not explain the returns of big stocks of portfolios sorted on size and momentum. The value factor is only significant in 3 portfolios. The average R^2 has increased from 60% to 71%, which provides a better description of return, albeit not the best.

The FF5F model

The FF5F performs slightly worse than the FF3F model in explaining the returns of portfolios sorted on size and momentum. Micro stocks alphas are significant in addition to two barely significant portfolios; small-winner (-0.87, t=-1.76) and big-neutral (-0.48, t=1.80) momentum. Size patterns in alphas exist, as well as momentum patterns in micro and big stocks. It seems that the RMW is the dominant factor in describing the variation of returns compared to HML and CMA factors with significant loadings for 4 portfolios.

The FF6F model

Despite adding a momentum factor, the six-factor model does not help in pricing the high returns of micro stocks and the other two portfolios of small-winner and big-neutral. The WML is significant for 7 portfolios at 5%, and has negative loadings for loser column and positive loadings for winner column as expected.

3.6 Models performance

To test models performance, the study follows two approaches as discussed in the methodology section (3.3). It uses the GRS test and other metrics of dispersion which focus on regression intercepts for the left-hand-side approach and factor spanning regressions for the righ-hand-side approach.

3.6.1 GRS statistic and metrics of dispersion

If an asset pricing model explains the expected returns, the time series regression intercepts of LHS portfolios' excess returns on the model's factors should be indistinguishable from zero. The GRS statistic of Gibbons et al. (1989) is used to test the hypothesis that regressions intercepts for all portfolios are equal to zero. Competing models can all be statistically rejected or accepted by the GRS test, and since the study is interested in the relative performance of competing models, it employs other metrics besides the GRS tests following Fama and French (2015). Metrics that rely on the intercepts are the mean absolute intercepts $|A|$, and $A(a_i^2)/A(r_i^2)$ and $As^2(a_i)/A(a_i^2)$ ratios. The latter two ratios estimate the unexplained proportion of the cross-section of expected return by competing models, following Fama and French (2016). $A(a_i^2)/A(r_i^2)$ is the ratio of unexplained dispersion of the LHS average return relative to the total dispersion of LHS average return. $As^2(a_i)/A(a_i^2)$ estimates the proportion of unexplained dispersion in average return attributable to sampling error (noise) rather than the true alpha. Therefore, a better performance of a model requires a lower value of the former and/or a higher value of the latter. $A(a_i^2)$ is the average squared intercept. $A(r_i^2)$ is average squared value of r_i, which is the difference between the average return on LHS portfolio i's and the average return on the market portfolio. $As^2(a_i)$ is the average estimated squared standard error of the intercept. Moreover, the study exploits the regression adjusted R^2 to compare between models, which indicates how well different factors capture common variation in returns. The study considers factor models; the CAPM and the Fama and French three, five, and six-factor models. It adds the four-factor model (FF4F), which is the Fama and french five-factor model excluding the CMA factor. This is to verify the role of CMA factor that is found to be marginal in regression results. Testing environment are four sets of portfolios; Size-BM, Size-Prof, Size-INV and Size-Mom portfolios.

Overview of models performance results

The GRS statistic and metrics of dispersion are presented in Table 3.6. It is found that most of the CAPM, three, five and six-factor models pass the GRS test at 10% level, however with some exceptions. The FF3F model only passes the GRS test at 5% significance level for Size-Prof and Size-Mom portfolios. Meanwhile, the null hypothesis is rejected for the five and six-factor models for portfolios sorted on size and momentum, as p-value of the GRS test is around 0.01. This shows the bad performance for these models in explaining the return of Size-Mom portfolios. The non-rejection of the FF3F model on Size-BM portfolios is consistent with Taha and Elgiziry (2016) for Egypt, however, inconsistent with their rejection of the CAPM.

The less rejection of the asset pricing models in the Egyptian market, compared to the US market in which all models are rejected, can be related to some reasons as follows. Anomalies patterns in return are not strong enough, as in the case of the US market, to challenge factor models. On the other hand, better performance of factor

Table 3.6 Models performance: GRS tests and other metrics

	GRS	P(GRS)	AR^2	$\|A\|$	$\frac{A(a_i^2)}{A(r_i^2)}$	$\frac{As^2(a_i)}{A(a_i^2)}$	GRS	P(GRS)	AR^2	$\|A\|$	$\frac{A(a_i^2)}{A(r_i^2)}$	$\frac{As^2(a_i)}{A(a_i^2)}$
	Size-BM portfolios						**Size-Prof portfolios**					
CAPM	1.63	0.11	0.58	0.61	0.85	0.47	1.36	0.21	0.56	0.74	1.44	0.37
FF3F	0.61	0.79	0.77	0.24	0.11	1.90	1.81	0.07	0.69	0.54	0.80	0.43
FF4F	1.07	0.39	0.78	0.29	0.26	0.82	0.74	0.67	0.75	0.38	0.42	0.74
FF5F	1.05	0.40	0.78	0.30	0.27	0.80	0.71	0.70	0.75	0.38	0.42	0.74
FF6F	1.01	0.44	0.80	0.30	0.27	0.84	0.68	0.73	0.76	0.38	0.43	0.79
	Size-INV portfolios						**Size-Mom portfolios**					
CAPM	0.82	0.60	0.59	0.59	0.72	0.58	1.87	0.06	0.60	1.03	1.08	0.17
FF3F	0.77	0.65	0.72	0.31	0.17	1.43	1.83	0.07	0.71	0.65	0.39	0.32
FF4F	0.68	0.73	0.74	0.33	0.24	1.09	2.22	0.02	0.72	0.75	0.54	0.25
FF5F	0.67	0.74	0.78	0.33	0.22	1.07	2.40	0.01	0.73	0.77	0.59	0.24
FF6F	0.64	0.76	0.79	0.32	0.23	1.04	2.45	0.01	0.79	0.45	0.60	0.20

This Table presents the GRS test and other metrics of dispersion to test model performance using the LHS approach. FF3F is the Fama and French (1993)'s three-factor model using SMB_Bm. FF5F and FF6F refer to the Fama and French (2015)'s five and the Fama and French (2018)'s six-factor models. FF4F is the Fama and French five-factor model excluding the CMA factor. AR^2 is the average of the regression adjusted R-squared. $|A|$ is the average absolute value of the model intercepts. $A(a_i^2)$ is the average squared intercept, $A(r_i^2)$ is average squared value of r_i, which is the difference between the average return on LHS portfolio i and the average return on market portfolio. $As^2(a_i)$ is the average estimated squared standard error of the intercept.

models for the Egyptian market might be due to irrational pricing accompanied with imperfect markets in emerging markets[8]. This is because asset pricing models still do not differentiate between risk-based and behavioural explanations. Therefore, these models draw partial albeit not a full story of the dynamics of the stock returns in Egypt.

Since most of the models do well using the GRS statistic, it is important to judge the relative importance of competing models by using other metrics (mentioned above). The average absolute intercepts $|A|$ shows that the CAPM has the worst performance (highest values of $|A|$) in all set of portfolios. The FF3F model has the lowest values for Size-BM and Size-INV portfolios at 0.24 and 0.31. Higher factor models either FF4F, FF5F or FF6F produce the lowest $|A|$ for Size-Prof portfolios at 0.38, while the FF6F produces the lowest value for Size-Mom at 0.45. The average adjusted R^2 (AR^2) is increasing from the CAPM towards the six-factor models (FF6F), which shows the improvement in the description of returns by using multiple factors. For example, AR^2 has increased from 58% to 80% for Size-BM portfolios.

The $A(a_i^2)/A(r_i^2)$ ratio indicates the dispersion of average return that the model fails to explain. Again, the CAPM is the worst performer, where the metric ranges between 0.72 for Size-INV portfolios and 1.44 for size-Prof portfolios. The value of one means that the dispersion of the model' intercepts is similar to the dispersion of

[8] For example, El-Ansary and Atuea (2012) argue that the Egyptian stock market is informationally inefficient as information arrives to the market chronologically and there is much noise and speculative trading.

average return. This metric shows that the higher factor models, compared to the FF3F model, improve the explanation of the dispersion of return for only Size-Prof portfolios. The unexplained dispersion left for these portfolios is 42%, compared 80% in the FF3F model. The FF3F model is the best performer for Size-BM, Size-INV and Size-Mom portfolios. Although the best performer model for Size-BM and Size-INV portfolio is the FF3F according to this metric, the five-factor model still plays an excellent role in explaining the dispersion of these portfolios returns, as they fail only to explain 27% and 22% of their dispersion. For comparison purposes, the unexplained dispersion for the five-factor model for North America is 64% and 35% for Size-BM and size-INV portfolios, respectively (Fama and French, 2016). The better performance of the FF3F model, except for Size-Prof portfolios, is in contrast to Fama and French (2015, 2016) where the five or four-factor model improve intercepts and other metric in most of the test assets, even for a slight improvement as in the case of Japan.

Another important metric is the $As^2(a_i)/A(a_i^2)$, which shows whether the deviation of estimated intercept is due to the dispersion of the true intercept or the sampling error (and thus the unexplained dispersion is mostly a noise). $As^2(a_i)/A(a_i^2)$ metric matches the results of $A(a_i^2)/A(r_i^2)$. The highest value (the best) for this metric corresponds to the FF3F model for Size-BM, Size-INV and Size-Mom portfolios. Its value exceed one for Size-BM and Size-INV portfolios (1.90 and 1.43), which means that dispersion of average return is mostly a sampling error. On the other hand, higher factor models either FF4F, FF5F or FF6F are the best performing models for Size-Prof portfolios. The good performance of the five-factor model for Size-Prof portfolios is consistent with Fama and French (2015) who show problems in the application of the three-factor model on portfolios with strong tilts towards profitability. Despite the superior performance of the FF3F model, this metric is still high enough for higher factor models. It is above one for Size-INV portfolios and above 0.80 for Size-BM portfolios. This confirms again the good performance of the five and/or six-factor models in explaining the average return of these portfolios.

According to these metrics, there are very small differences between the performance of the four, five and six-factor models especially for Size-BM, Size-Prof and Size-INV portfolios, which show the marginal contribution of investment and momentum factors in explaining average returns. Meanwhile, these higher factor models are not improving the explanation of average return for Size-Mom portfolios. Although the FF6F produces the lowest $|A|$, it does not perform well according to other metrics of dispersion such as $A(a_i^2)/A(r_i^2)$ and $As^2(a_i)/A(a_i^2)$, which shows that pricing these portfolios is challenging.

To sum up, multiple factor models play a good role in explaining the average return for most of the test assets as indicated by metrics of dispersion and GRS test. Nonetheless, higher factor models (FF4F, FF5F and FF6F) mainly outperform the three-factor model on portfolios sorted on size and profit. Results confirm regression details of the marginal role of CMA and WML factors. Finally, Size-Mom portfolios are the most challenging portfolios for factor models.

3.6.2 Factor spanning regressions

The previous LHS approach has a limitation that inferences can vary across sets of LHS portfolios. Barillas and Shanken (2017) argue that while comparing the performance of models using different test assets provides useful information, it cannot identify the best model. They add that test assets add no information more than what is learned from the extent to which each model could price the (traded) factors in other models. Therefore, it is useful to employ factor spanning regressions (RHS approach) which draw inference about models performance using only factors. Factor spanning tests can also mitigate concerns regarding inadequate diversification of test assets, which is a possible case given the small sample size. Fama and French (2018) use these regressions to compare among competing nested models, where the question is whether to add extra factor to improve the explanation of average returns provided by a model. Since all tested factor models are nested models, the study applies factor spanning regressions to choose the best model as well as to check for factors redundancy.

Panel (A) of Table 3.7 reports factor spanning results for the six-factor model, where each factor is regressed on other factors. The intercept for the market factor (Mkt) is the highest at 2.29 and is significant (t=3.85). Since this intercept represents average return unexplained by exposure to SMB, HML, RWM, CMA and WML factors, the Mkt cannot be redundant. Similarly, positive and significant intercepts for HML, SMB and RMW at 1.38 (t=3.62), 1.27 (t=3.20) and 1.43 (t=3.65) suggest that these factors are important in explaining average return and are not redundant.

The redundant factors here are the investment (CMA) and momentum (WML) factors with small and insignificant intercepts at -0.41 (t=-0.99) and 0.20 (t=0.34). This means that other factors absorb the positive return of the CMA (WML) factor, particularly the SMB (HML) factor. In other words, adding the CMA factor, for example, does not improve the mean-variance efficient frontier tangency portfolio produced by combining Rf, Mkt, SMB, HML, RMW, WML and CMA. The negligible roles of CMA and WML factors are consistent with previous regression results, model performance and factor statistics (especially, the CMA's small and insignificant premium at 0.06% per month).

Table 3.7 Spanning regressions

Panel (A): six-factor model spanning regressions

LHS	Coefficent							t(Coefficent)									
	α	Mkt	SMB	HML	RMW	CMA	WML	α	Mkt	SMB	HML	RMW	CMA	WML	R^2	s(e)	$\alpha^2/s^2(e)$
Mkt	2.29		-0.33	-0.15	-0.41	0.19	0.08	3.85		-2.51	-0.86	-3.50	1.44	0.69	0.17	7.5	0.09
SMB	1.27	-0.15		-0.18	-0.11	0.21	0.06	3.20	-2.66		-1.88	-1.65	2.80	0.77	0.12	5.0	0.06
HML	1.38	-0.06	-0.18		-0.28	0.07	0.13	3.62	-0.83	-2.10		-2.48	0.47	2.54	0.18	5.0	0.08
RMW	1.43	-0.27	-0.16	-0.42		-0.09	0.01	3.65	-2.54	-2.09	-2.39		-0.56	0.09	0.24	6.2	0.05
CMA	-0.41	0.10	0.26	0.08	-0.08		0.06	-0.99	1.34	2.57	0.48	-0.53		0.82	0.11	5.6	0.01
WML	0.20	0.08	0.11	0.26	0.01	0.10		0.34	0.71	0.76	2.44	0.09	0.81		0.06	7.1	0.00

Panel (B): Spanning regressions for nested models

LHS	Coefficent						t(Coefficent)							
	α	Mkt	SMB	HML	RMW	CMA	α	Mkt	SMB	HML			R^2	s(e)
SMB	0.84	-0.12					2.22	-2.20					0.03	5.25
HML	1.27	0.10					3.07	1.40					0.02	5.68
RMW	1.54	-0.27	-0.23	-0.39			4.15	-2.65	-2.53	-2.58			0.23	6.07
CMA	-0.47	0.13	0.25	0.08			-1.26	1.89	2.87	0.68			0.08	5.49
WML	0.20	0.08	0.11	0.26	0.01	0.10	0.34	0.71	0.76	2.44	0.09	0.81	0.06	7.14

Panel (C): Multi-factor test

Model	LHS	GRS	P(GRS)
CAPM	SMB & HML	6.658	0.002
Three-factor model (FF3F)	RMW & CMA	4.906	0.009

This table reports factor spanning regressions. Panel (A) presents factor spanning regression for the Fama and French's six-factor model. It shows coefficients and t-statistics of regressing each factor of the model on other factors. α is the regression intercept, R^2 is the adjusted R^2, and $\alpha^2/s^2(e)$ is the squared intercept over the variance of the regression residuals, which shows a factor's marginal contribution to a model's max squared Sharpe ratio, $Sh^2(f)$. Panel (B) shows spanning regression for nested models (CAPM and the Fama and French three, five and six-factor models). The first two rows test whether the market factor span the size (SMB) and value (HML) factors. The following two rows test whether the Mkt, SMB and HML span the profitability (RMW) and investment (CMA) factors. The last row of the panel tests whether the five factors span the momentum factor (WML). Panel (C) presents the GRS statistics and their p-values for the test that additional factors are jointly improving the maximum Sharpe ratio of the base model, either the CAPM or the three-factor model.

In the last column of Panel (A), $\alpha^2/s^2(e)$ shows the marginal contribution of each factor to the maximum squared Sharpe ratio produced by the model factors, $Sh^2(f)$. The Mkt and HML factors have the largest contribution at 0.09 and 0.08, while SMB and RMW factors contribute less by 0.06 and 0.05. The marginal contributions are for CMA and WML factors at 0.01 and 0.001. The CMA and WML factors redundancy is in contrast to Fama and French (2015, 2018), where HML is the redundant factor and the least contributor to model's maximum Sharpe ratio. However, CMA redundancy is consistent with evidences for Asia, Eastern Europe and Latin America regions (Foye, 2018), the Chinese market (Guo et al., 2017; Lin, 2017), and for Japan and Europe (Fama and French, 2016). Evidences for weaker investment factor are also highlighted, however without implementing factor spanning regression, for individual countries such as Saudi Arabia[9] and South Africa (Cox and Britten, 2019; Salameh, 2020) and for the MENA region (Abadi and Silva, 2019). Meanwhile, the redundancy of the WML factor is consistent with earlier evidences of the nonexistence of the momentum effect for Egypt (Shaker and Elgiziry, 2014; Taha and Elgiziry, 2016), the MENA region (Abadi and Silva, 2019), and with some evidences of weak momentum patterns in returns for emerging markets (Cakici et al., 2016; Zaremba and Czapkiewicz, 2017)[10]. This confirms the weak importance of momentum and investment factors in emerging markets compared to what is documented in the US and other developed markets.

Spanning regression are also useful to choose among nested models (Panel B & C). Specifically, the FF3F versus CAPM, FF5F versus FF3F, and FF6F versus FF5F. The GRS test on the intercept from spanning regressions of the SMB and HML on the Mkt (Panel C) rejects the hypothesis that intercepts are jointly zero with p-value at 0.002. This means that the CAPM loses to the FF3F model. This is confirmed by individual regression of each factor on the Mkt (Panel B). The intercept in the regression for SMB is 0.84 % per month (t=2.22) and for HML is 1.27 (t=3.07), which implies that these returns cannot be explained by the exposure to the market factor alone. Similarly, the GRS test from spanning regressions of the RMW and CMA on the three-factor model rejects the FF3F model in favour of the FF5F model with p-value at 0.009 (Panel C). The intercept in the profitability regression in Panel B is strong at 1.54 (t=4.15), while the intercept in the regression for investment is less impressive at -0.47 (t=-1.26). This shows that the power of the FF5F model comes

[9]However, Salameh (2020) reports evidence for weak profitability factor beside investment factor which is different from the role of the profitability factor in the Egyptian market.

[10]Further investigation is needed to explain weak momentum returns. Culture differences such as low individualism is one possible explanation (Chui et al., 2010). The other is that momentum returns are weak in market transitions than when market continues to be in the same state (Cheema and Nartea, 2017; Hanauer, 2014). The latter is possible especially when EGX was hit hard in 2008, 2011 and 2015 by external shocks and the political uprising.

from the RMW factor. Finally, the FF6F model loses to the FF5F model as indicated in the last row in Panel (B), where the momentum factor (WML) adds noting to the model explanation of average return with its insignificant alpha at 0.20 (t=0.34).

To conclude, using only factors returns, factor spanning regressions show the outperformance of the five-factor model compared to the FF3F and FF6F models. This superiority comes mainly from the profitability factor. The redundant factors are CMA and WML. Findings here generalize the importance of the profitability factor, and thus the superiority of the FF5F model. Meanwhile, in the LHS approach, the superiority of the FF5F was specific to portfolios sorted on size and profitability. The study finds no conflict since it is shown that the five-factor model is still performing well in explaining most of test assets using GRS test and other metrics of dispersion.

3.7 On the performance of the five-factor model and redundancy of factors

The five-factor model is performing the best among nested models according to factor spanning regressions and multi-factor GRS tests. It plays a good role in explaining average returns according to the GRS test and metrics of dispersion. Nevertheless, some metric of dispersion, for the LHS approach, offer superior performance to the three-factor model for other test assets than Size-Prof portfolios, as confirmed in regression details. This less powerful role of the five-factor model in the Egyptian data can be explained by various reasons. First, the negligible role of the investment factor has weaken the power of the FF5F model. Second, the highest correlation between RMW and HML factors (at -0.35) plays another role. The introduction of the RMW factor reduces the power of the HML factor in explaining returns (as indicated in HML loadings), however, it does not lead to a redundant HML factor. One can argue that HML and RMW factors might be driven by similar economic forces. Indeed, part of the information contained in valuation is related to earnings (profitability). B/M ratio reflects market expectation about future performance, which include a firm's ability to generate profits. Therefore, RMW might capture the earnings effect in valuation[11]. Actually, Ebaid (2011) shows that earning-based measures especially net income have the highest value relevance in the Egyptian market[12]. However, the

[11]This argument is consistent with the economic interpretation of the value effect by Fama and French (1995), who suggest that relative profitability is the common source of risk that explain the value effect. Since controlling for the RMW factor does not lead to the redundancy of the HML, the B/M ratio might also capture the relative distress risk of Chan and Chen (1991).

[12]An accounting measure is value relevant, if it reflects information that is relevant to investors in valuation, and is measured in a reliable way to be reflected in stock prices.

high correlation between HML and RMW might also be related to data limitation, where ROE is used as a proxy for profitability instead of Fama-French's operating profitability. Third, the five-factor model usually succeed in pricing big stocks at the cost of micro stocks. In other words, the FF3F (FF5F) performs best for micro (big) portfolios. Since pricing micro stocks is mostly a challenge for the tested factor models, the FF3F model sometime appears as the most successful model in explaining return due to its role in pricing micro stocks. Fourth, anomalies patterns in return are not strong enough, as in the case of the US market, to challenge factor models, and thus there is no giant improvement for the five-factor model. Lastly, despite the good performance of the five-factor model, it does not provide a full description of the cross sectional variation of the Egyptian equities. This is apparent from the low average adjusted R^2 for the model, which ranges between 73% and 78% across testing environments.

The redundancy of the investment factor draws an interesting story for the Egyptian market. It is proven, by different ways, that the CMA factor has a negligible role in the FF5F model or in explaining average returns. Factor spanning tests show that the investment factor is redundant. Detailed asset pricing regressions confirm this result. This redundancy is supported by models performance metrics, with slight differences between the FF5F model and the FF4F model that drops CMA. In addition, cross sectional regressions on individual stocks (Section 2.6) show that asset growth (investment) plays no role in predicting returns. In these regressions, the negative relation between asset growth and expected return, as predicted by theories such as Tobin's Q or investment CAPM, are shown only for big and all but micro stocks but insignificant. Lastly, the CMA premium is the lowest among factors around zero (0.06)[13]. The redundancy of the investment factor is consistent with recent evidences from the MENA region (Abadi and Silva, 2019; Salameh, 2020), however, this chapter takes further step and provides an explanation for this phenomenon in Egypt that can be generalized to countries in the region and other emerging markets.

One can argue that the redundancy of the CMA factor for Egypt can be explained by weak asset growth (investment) effect in emerging markets. Return patterns in the double-sorted portfolios on size and investment in (Table 2.4) show that the spread between high and low investment is not significant. Furthermore, there is an opposite investment effect for big stocks, in which average returns is higher for high than low investment portfolios. As big firms dominate the market, an overall weak asset growth effect is expected. Weak asset growth effect in Egypt is also consistent with some evidences of Titman et al. (2013) and Watanabe et al. (2013) where they include

[13]It is even negative and insignificant in non-financial sample.

Egypt in their international studies. Watanabe et al. (2013), using equal-weight measures, find that the SPREAD and SLOPE[14] for Egypt for the period 1994-2010 have the right sign predicted by theory but insignificant, in local currency. However, for value-weighted measure; the SPREAD has unexpected sign, which means that top investment have higher return than bottom investment, while SLOPE has the right sign but both insignificant again. Titman et al. (2013) document a significant investment effect for Egypt for the period 2004-2010, using the difference between top and bottom quintile investment portfolios (TAG5- TAG1) and equally-weight size adjusted monthly returns. However, when using value-weighted size adjusted returns instead, the investment effect becomes insignificant. The chapter tries to simply replicate previous studies using its sample and constructs quintile portfolios sorted on investment then gets the value- weight monthly return for these portfolios. A positive relation between return and investment is found (Table B.1). The spread between high and low investment (H-L) is positive but insignificant, which confirms previous results of weak asset growth effects in Egypt.

Egypt is characterized by low equity market development compared to the developed markets, with inadequate corporate governance and protection of minority rights, immature bond market, large number of listed state owned firms, and a semi bank-oriented financial system. These characteristic in addition to the observed decrease in the ratio of market capitalization to GDP (as a proxy for the importance of equity market) after the 2008 financial crisis (see appendix A.1), can provide evidences for why asset growth effect is weak in Egypt. In less financially developed markets, managers are less willing to align their investment decisions with the cost of equity, and they are more pressured to purse social objectives driving away from shareholders' value maximizing behaviour (Titman et al., 2013; Watanabe et al., 2013; Zhang, 2017). Moreover, a positive relation between investment and stock returns might appear in less developed capital markets because investors might consider the ability of the firm to finance an increase in investment as good news (Titman et al., 2013, 2004).

3.8 Robustness checks

To ensure the robustness of the results, the study tests factor models using a subsample and different structures of the sample. Specifically, it examines whether the main results change if financial stocks are excluded and alternative breakpoints in

[14]The SPREAD is the average annual return difference between the bottom and top assets growth portfolios, while SLOPE is time series averages of coefficients, which are obtained by regressing buy and hold stock return from July of year t to June of year t+1 on assets growth measured over year t-1.

constructing factors and test assets are used. Extra checks are conducted to make sure that penny stocks or thin trading are not driving the results.

Non-financials sample

In the main analysis of the chapter, the whole sample is used without excluding financial firms. However, Fama and French (1993) exclude financial firms, arguing that the structure of financial firms might have more leverage which can be interpreted as financial distress. Accordingly, the study redoes the analysis excluding financial firms to verify the results. Due to the smaller sample size of non-financial stocks and shorter time series coverage, the study uses different breakpoints for portfolios construction and excludes the first year (2003) of the sample. More details on portfolios construction of non-financials sample are discussed in Section A.3.

The non-financial sample supports the main conclusion of the overall sample. First, factor spanning tests confirms the redundancy of investment (CMA) and momentum (WML) factors with insignificant alphas (-0.24 and -0.001) in Table B.3 in the appendix. Second, the FF3F model performs better for other test assets than Size-Prof portfolios, as confirmed by GRS tests and metrics of dispersion in Table B.4. For example, $|A|$ and $A(a_i^2)/A(r_i^2)$ metrics ($As^2(a_i)/A(a_i^2)$) are the lowest (highest) for the FF3F model for Size-BM, Size-Prof and Size-Mom portfolios. Meanwhile, these metrics support the FF5F model (or the FF4F model that excludes the CMA factor) for Size-Prof portfolios. Third, multi-GRS tests favour the FF3F against the CAPM and the FF5F model against the FF3F, however, at 5% significance level, as indicated in Panel B of Table B.3.

Nevertheless, factor statistics and regression details show some differences. The premium for the HML factor is lower for the non-financial sample at 0.87% per month compared to 1.46% in whole sample (or 1.13% after excluding year 2003 to be compared with non-financial sample's period), as shown in Table B.2. This implies that using the whole sample may exaggerate the value premium, however, it does not contradict the main results. The premium of RMW factor is higher in the non-financial sample at 0.69% per month compared to 0.28% (or 0.314% after excluding year 2003) but still insignificant. The investment and momentum premiums convert to negative in this sample at -0.046 and -0.014 but insignificant. This confirms the different dynamics for the relation between investment (or momentum) and expected returns in the Egyptian market as an emerging market, compared to the developed markets.

For regression details, the averages of adjusted R^2 are generally lower and average absolute intercepts $|A|$ are relatively higher, which are shown easily in Table B.4 in columns 3, 4, 9 & 10, compared to the whole sample in Table 3.6. The FF3F model leaves one intercept (-0.52) marginally significant at 10% level for big-high B/M in size-BM portfolios (Table B.5). This is consistent with lower HML premium, which does not eliminate the significance of all alphas compared to the whole sample. The unsuccessful role of the FF3F model for pricing portfolio sorted on profitability is confirmed with three significant alphas (-0.79, -1.09) for small and weak profitability (as in the whole sample) and a significant alpha for small robust portfolio (1.09). For the FF5F model, the RMW is more powerful with more significant loadings and less significant intercept for Size-Prof portfolios; only one marginally significant alpha (0.89) at 10% is left for micro weak portfolio. The RMW leaves slightly more power to the HML factor. This is mainly because of the lower correlation between RMW and HML factors at -0.29 instead of -0.35 in whole sample. Portfolios sorted on size and investment are less challenging for factor models, as both models can explain its average returns (except for small-conserve portfolio for the FF5F model). Finally, micro stocks of Size-Mom portfolios are challenging for both factor models, where they leave significant alphas for most of them.

Portfolios construction alternatives

Unlike ready-made portfolios in the Kenneth R. French-Data Library for mainly the US market, the results might be sensitive to the choice of breakpoints in constructing factors and test asset portfolios. Therefore, it is interesting to check the robustness of results using different breakpoints options. Three options are defined inspired by studies for the UK and Australian markets that have large tail of small stocks, as well as some emerging markets. Option 1; use the biggest 50 firms as big portfolio and the remaining as small, and use the 30th-70th percentiles of big 50 firms as B/M, profitability, investment and momentum breakpoints, in the spirit of Chiah et al. (2016). Option 2; rank and use the first n number of firms that makes up to 90% of market cap as big portfolio and the rest as the small portfolio, and use the 30th-70th percentiles of big 50 firms as before, in the spirit of Brailsford et al. (2012). Option 3; assign the first n number of firms that build 90% of market cap to big portfolio and the rest is for small portfolio, and use the 30th-70th percentiles of this big portfolio as B/M, profitability, investment and momentum breakpoints, in the spirit of Cakici et al. (2016) and Fama and French (2016).

It is very optimal to expect exactly the same findings from portfolios constructed using different breakpoints. Nevertheless, some common results can be found and even some differences can support one of the main arguments, which is the less powerful role of the FF5F in explaining the cross section returns of the Egyptian equities. Option 1 presents the closet results to baseline sample, which implies that using either the breakpoints of big 50 or big 100 does not change the main conclusion. For example, in factor spanning tests (Table B.8), option 1 confirms the powerful role of Mkt, SMB, HML and RMW factors in explaining the cross section returns, as well as the redundancy of CMA and WML factors. However, option 2 (and 3) emphasize more the importance of Mkt and SMB (and RMW), with a marginal significant role of the HML (at 10%), while they confirm the redundancy of CMA and WML factors. This can be related to the most striking difference between the three options which is the HML premium. It varies from a premium of 1.08% significant at 5% level to insignificant premium at 0.67% for option 3, as presented in Table B.9. However, removing the momentum factor from factor spanning regression returns the powerful roles (significant alphas) of all factors in factors spanning regressions except the CMA. This may happen because the existence of the momentum factor reduces the observations in regressions; mainly the first year that is lost in momentum factor's calculation. It seems that value investing is more important in early years of the sample.

Using the multi-factors GRS tests (Table B.8), the CAPM loses to the FF3F model in the three options. However, the FF3F loses to the FF5F at 5% for option 1 and marginally (at 10%) for option 2 and 3. This implies that using different sorts of portfolios can shed light on the less powerful role of the FF5F model. It can explain the average returns of portfolios, but it is not the best performer for some test assets. Keeping aside the FF6F model, which loses to the FF5F model due to the redundancy of the momentum factor, the study focuses on the comparison between the CAPM, FF3F and FF5F models. For the three options, the three models pass the GRS tests, except for the CAPM in size-BM and size-Mom, as shown in Table B.7. The CAPM is the worst performer according to metrics of dispersion. The FF3F (FF5F) model performs better for Size-BM and Size-Mom (Size-Prof) portfolios. Results disagree about the best model that explain Size-INV portfolios average returns. Option 1 provides a support to the FF3F model in pricing those portfolios, while option 2 favours the FF5F model, and indistinguishable results between two models for option 3. This is actually not surprising given the weak investment patterns in return, which make it the least challenging kind of portfolios for asset pricing.

Zero returns filtering

Another robust check is related to characteristics of emerging markets which is thin trading and thus frequent zero returns. In order to check whether the existence of subsequent zero returns changes the main conclusion, the study imposes a filter to exclude stocks that have zero return for a whole year (12 months) from portfolios' construction. Filtering zero return favours the FF5F model in explaining returns of size-prof and size-INV portfolios, and the FF3F model for size-BM portfolios. It seems meaningful here to have a better performance for FF5F in explaining size-INV portfolios return, given the increase of the CMA premium from 0.06% in the baseline sample to 0.25%, albeit insignificant. Regarding factors premiums, filtering also reduces the HML premium to 1.13% (Table B.9), from 1.47% in the baseline sample. Filtering zero returns looks as a promising data restriction for further research.

Penny stocks exclusion

In data screening procedures with TDS data, Ince and Porter (2006) drop observation whose monthly unadjusted prices lower than $1[15]. This is to avoid errors in return calculations when prices are low, since TDS rounds prices to the nearest penny. They add that this screening can help also in removing anomalous observations when prices dramatically increase from low price levels. The study was reluctant to exclude 939 observation from sample, related to more than 30 firms, with no sign of outliers in returns. However, to make sure that results are not affected by the existence of penny stocks, penny stocks are excluded from the sample which are defined as stocks with unadjusted prices lower than one Egyptian pound. Precluding penny stocks does not change the main conclusion. It does not largely affect factor premiums and their significance except negligible change for CMA factor which become negative at -0.02 (Table B.9).

To sum up, employing either the whole sample or non-financial subsample leads to similar main conclusions, which promotes using the whole larger sample, and hence improving the fits of the models. Sensitivity of using different breakpoints for portfolio construction does not contradict the main conclusion. They differ on how powerful is the FF5F model in explaining returns, and in the best model that price size-INV portfolios. However, this is not a big problem provided that these portfolios are the least challenging for asset pricing. Existence of penny stocks does not disturb the results. Finally, filtering zero returns can be a promising restriction in future research.

3.9 Concluding remarks on asset pricing for the Egyptian stocks

This chapter examines whether four principal asset pricing models - the CAPM, the Fama and French three-factor (1993), five-factor (2015) and six-factor (2018) models-

[15]However, they found that 0.1 threshold works as the same as $1.

can explain the cross section of stock returns in the Egyptian market. The results for the asset pricing regressions and model performance using both left and right hand side approaches, confirm the limitations of the CAPM in explaining the cross section returns. Model performance tests show the good performance of the five-factor model in explaining average returns. The GRS test do not reject the five-factor model in most of the cases or its reduced version which is the four factor model excluding the CMA factor. Factor spanning and multi-factor GRS tests reject the three and six-factor models in favour of the five-factor model. This is due to the role of the profitability factor which produces returns that could not be explained by the linear combination of other factors. Nonetheless, some metric of dispersion and regressions details offer better support to the three-factor model for other test asset than Size-Prof portfolios. Using only non-financial stocks or other alternative portfolios constructions of the whole sample do not contradict the main results.

Performance of each model in regression details can be summarized as follows. The CAPM is the worst performing model with some significant alphas for test assets portfolios and inferior results for metrics of dispersion. It seems that Size-INV portfolios are less of a challenge to the CAPM, where only the micro-conserve investment portfolio is significant at 10% level. The three-factor model (FF3F) reduces the magnitude of alphas and weakens anomalies patterns in alphas returns. The FF3F model is performing best in explaining Size-BM and Size-INV portfolios by eliminating significant alphas. Micro-high BM stocks are problematic for the FF3F model, that leave the value effect presents in micro stocks alphas. Profitability patterns are a big challenge for this model, and thus it performs poorly for portfolios sorted on size and profitability. Portfolios formed on size and investment are less of a challenge to the FF3F model, than portfolios sorted on size and profitability. The good performance of the FF3F model for Egyptian equities is consistent with high SMB and HML factors premiums, compared to international data. It is also consistent with evidences for the well-documented value effect in returns for emerging markets. However, the model fit is low, that is average adjusted R^2 ranges from 69% to 77%, compared to 93% in the US. This means that the three-factor model does not fully describe the cross sectional variation in portfolios returns.

The five-factor model (FF5F) plays a good role in explaining the cross section returns, especially for portfolios sorted on size and profit. The FF5F model successes in reducing the magnitude of alphas compared to the FF3F model for Size-Prof portfolios while eliminating profitability patterns. The five-factor model prices big stocks better than micro stocks. Accordingly, micro and small stocks in the lowest profitability category leave some challenge to the five-factor model, in contrast to

Fama and French (2015) where the biggest problem for this model is microcaps in highest profitability quintiles. The FF5F model could not also explain micro and small high B/M portfolios for Size-BM portfolios. Nevertheless, it leaves only 27% of total dispersion of the LHS average returns of Size-BM portfolios unexplained, compared to 42% for Size-Prof portfolios. Both the three and five-factor models can capture investment patterns in alphas.

The five-factor model mainly gains its power to explain average returns from the profitability factor. Factor spanning regressions confirm the redundancy of the investment (CMA) factor, which is consistent with weak asset growth effect in emerging markets. This can be explained by the less willingness of managers in emerging markets to align their investment decisions with the cost of capital, due to other objectives than value maximization. Moreover, this result does not support the investment CAPM model that explicitly say that firm characteristics are driving expected stock returns.

The performance of the six-factor model is quite similar to the five-factor model which refers to the marginal role of the momentum factor. For Size-Mom portfolios, all factor models considered could not explain the return of micro stocks for these portfolios, which is reflected in the rejection of models for Size-Mom portfolios using GRS tests. The redundancy of the momentum factor supports earlier evidences of weak momentum effect in returns for some emerging markets and for the Egyptian market.

Pricing micro stocks remains a challenge for the Egyptian stock market. Factor models could not price micro stocks for Size-Mom portfolios. Micro and small weak profitability stocks are not fully explained by the FF5F model in Size-prof portfolios. The HML factor does not fully absorb the value effect in alphas for micro stocks in Size-BM portfolios while the SMB factor does not fully eliminate the size patterns in micro stocks' alphas in either the FF3F or FF5F model. Micro stocks are usually characterized by illiquidity problems and high cost of trading, which may push them out of the tradable universe of stocks. This may call for a more parsimonious model that can fully explain micro stocks. Searching for a better model for future research is also important given that the five-factor model provides a good but incomplete description of the cross sectional variation in portfolios returns due to low average R^2. The non-satisfactory performance of the five-factor model measured by R^2 is also common in Saudi Arabia, Turkey, South Africa, and Indonesia and Singapore among others in contrast to the US market (Cox and Britten, 2019; Ekaputra and Sutrisno, 2020; Karaomer and Acaravci, 2017; Salameh, 2020), which refers to the different nature of emerging markets and the necessity for developing a model that can fully describe returns variation of these markets.

Findings suggest that size and value investing are more promising in the Egyptian stock market, and that the role of profitability is important. This suggests that the priced sources of risk in the Egyptian market are mainly related to relative profitability and distress that explain size and value effects. On the other hand, asset growth and momentum factors are not priced, which is different than what is documented in the US market and some developed markets. Accordingly, international investors should be caution about using the latter as investing strategies. A limitation of this study is that it uses the return on equity as a measure of profitability instead of the operating profitability in Fama and French (2015). Finally, the comprehensive study of the principal asset pricing models in this chapter should help the finance and investment community to overstep the use of the CAPM to more advanced pricing techniques such as the Fama-French four-factor model (after excluding the investment factor) in various asset pricing applications such as performance evaluation, portfolios choice, and cost of capital calculations. However, caution is required in applying this model as it does not fully describe the cross section variation of stock return. This study opens the door for further investigation of asset pricing for the Egyptian market aiming to find the best model that prices the risks of the Egyptian equities.

Chapter 4

State Ownership and Investment Efficiency: Evidence from the Egyptian Publicly Listed Firms

4.1 Introduction

While excessive literature during 1908s and 1990s has shown that privatization leads to improvement in performance and efficiency (Megginson et al., 2005), the debate regarding state vs. private ownership has revived in recent years. This is motivated not only by the persistent presence of state ownership around the world, as governments in emerging and OECD countries retain control despite privatization waves (Bortolotti and Faccio, 2009; Boubakri et al., 2011), but also by the trend towards state capitalism and increased governments bailout observed after the 2008 financial crisis (Megginson, 2017). This, in turn, leads us to ask whether the sources of inefficiency of state ownership have disappeared, state ownership benefits outweigh or/and public sector reforms have paid off. Therefore, it is interesting to explore state ownership effect on firm behaviour, particularly the investment behaviour.

A firm investment is determined by growth opportunities according to Tobin's q theory of investment. However, firm investment can be less responsive to growth opportunities due to agency costs and asymmetric information frictions leading to sub-optimal investments and thus less efficient investments (Stein, 2003). In this regard, the sensitivity of investment to q implies the extent to which firm can invest optimally, and thus proxies for investment efficiency (Chen et al., 2017; McLean et al., 2012). State ownership can be accompanied by both frictions and thus affects investment efficiency. While few recent studies find negative state effect using this proxy, they did not explore the exact channels of effect[1]. Therefore, it is interesting to explore the state ownership effect on investment efficiency, the channels of influence, and whether these channels are the same across countries. Moreover, this chapter is interested in equity state ownership in listed firms, in contrast to using only privatization data (Chen et al., 2017) or comparing between pure private and state owned firms (O'Toole et al., 2016). This is to explore the effect of state participation in ownership, and to see if firms still suffer from poor governance and non-value maximizing behaviour of purely state owned firms or still benefit from explicit or implicit government guarantee after being listed on the exchange or partially privatized. Understanding firm investment behaviour and its relation with state ownership are important as they influence the efficient allocation of resources and thus the productive capacity and growth of the economy. They also provide insights for policymakers for further reforms of the public rector, corporate governance and investment environment.

The focus on investment-state relation for the Egyptian market is motivated by many reasons. First, firms investment behaviour is puzzling. key portfolio characteristics observed in Chapter 2 show that big firms are investing less despite being highly profitable. Moreover, weak asset growth effect observed in Chapter 3 is argued to be explained by the less willingness of managers to align their investment decisions with the cost of equity, as predicted by investment CAPM and Tobin's q theory. Therefore, disentangling the state effect helps in better understanding of firms investment behaviour, especially when state firms are usually old and big. Second, state ownership is of economic significant in the Egyptian market, as public sector accounts for 30% of GDP (IMF, 2017). State ownership is one of the main characteristics of the Egyptian stock market that distinguish it from developed market, where the state controls more than 20% (50%) of a firm shares in 39% (27%) of the sample observations for 120 publicly listed firms. This large existence is mainly due to massive listing of state owned firms triggered by privatization process in late 1990s and the reluctance of the state to leave control after privatizations (Ben Naceur et al., 2007; Omran, 2009). Finally, Egypt provides a proper environment for exploring the investment behaviour given the high presence of agency costs and asymmetric information. On the one hand, Egypt has a long history of state intervention as well as playing a role in achieving social objectives (Loewe, 2013). On the other, it is characterized, as with other emerging and civil law countries, by inadequate corporate governance, weak protection of minority rights and financial market imperfections.

[1]Chen et al. (2017, 2011), O'Toole et al. (2016) and Jaslowitzer et al. (2018) except for the latter who explore channels of effect for European firms.

Accordingly, this chapter aims to investigate the effect of state equity ownership on investment efficiency for the Egyptian publicly listed firms for the period 2006-2017. It also intends to explore the channels of state's influence on investment (in)efficiency.

Related literature indicates that state ownership is associated with agency costs and asymmetric information distortion channels. This, in turn, affects investment level and its responsiveness to growth opportunities and cash flow. Agency costs can lead to sub-optimal investments: overinvestment or underinvestment. Empire building preferences (Jensen, 1986) support overinvestment, while managers private costs, quiet life or conservative behaviour lead to underinvestment (Aggarwal and Samwick, 2006; Bertrand and Mullainathan, 2003; John and Knyazeva, 2006). State ownership can be accompanied with these principal-agent costs, however the direction of influence either over or underinvesting is inconclusive. Add to this, the non-economic objectives of the state and other principal-principal agency problems that lead the state as a controlling shareholder to influence investment decisions in either directions according to its political/social agenda[2]. For asymmetric information, Borisova et al. (2015) and Beuselinck et al. (2017) argue that state ownership is associated with a high cost of external finance, which affects negatively investment. However, soft budget constraints (SBC) theory (Kornai et al., 2003) suggests that state owned firms face lower financial constraints. This is explained by different types of support that state firms can enjoy such as implicit or explicit government guarantee, tax concessions, and preferential access to credit from state owned banks (Borisova et al., 2015; Chen et al., 2018; Schaffer, 1998). These SBC can lead firms either to overinvest taking excessive risk (Kornai et al., 2003), or to underinvest if a firm is a rent seeker or risk averse (Boubakri et al., 2013; John et al., 2008). Therefore, it is still controversial how state ownership affects firms investment behaviour and financial constraints.

Most studies about state ownership for Egypt were around privatization periods comparing firms investment levels before and after privatization with little attention to investment efficiency (Ben Naceur et al., 2007; Omran, 2009, 2004). While Rashed et al. (2018) investigate the relation between ownership structure and investment efficiency, authors neither examine the state's role nor use the proposed economic measure of efficiency. Moreover, the Egyptian banking sector has a history of concentrating its lending to the government (OECD, 2013; Raballand et al., 2015). Few contradictory studies have discussed the cost of capital or financial constraints associated with state ownership (Dang et al., 2018; Khlif et al., 2015). Therefore, it is still unclear whether listed state firms are facing lower or increased financial constraints, and whether state

[2] D'Souza and Nash (2017); Jiang et al. (2010); La Porta et al. (2002); Shleifer (1998); Shleifer and Vishny (1994); Vickers and Yarrow (1991); Young et al. (2008).

firms rely on bank credit to reduce financial constraints as a common way in the literature for softening the budget constraints.

This chapter contributes to the literature by investigating the state equity ownership effect on investment efficiency using Egyptian publicly listed firms data and showing that it is affected by ownership type. It provides evidence that state ownership negatively affects firm's investment sensitivity to both Q and cash flow due to the accompanied frictions of state ownership, and that both sensitivities draw a picture about the investment behaviour and channels of investment inefficiency. By exploring investment inefficiency channels, this chapter emphasizes the conservative investment behaviour of state firms because of high agency costs due to private costs and risk aversion as well as rent seeking behaviour, in contrast to the popular view in the literature of state firms' overinvestment and risk-taking behaviour benefiting from SBC. It contributes to the debate on state influence on firms financial constraints, and state firms access to bank credit. It highlights the importance of principal-principal type of agency costs on investment behaviour in developing markets.

To answer the research questions, an investment model is employed following (Jaslowitzer et al., 2018; Stein, 2003), which takes into consideration agency costs and financial frictions that deviate investment decisions from the first best. The study, however, departs from these papers by using a more general framework following the standard q-theory of investment (Hubbard, 1998; Wickens, 2008). This model is compatible with the empirical investment-q equation (Baker et al., 2003; Fazzari et al., 1988; McLean et al., 2012), where the investment sensitivity to growth opportunities is used as a proxy for investment efficiency (Chen et al., 2017, 2011; McLean et al., 2012), and sensitivity to cash flow (CF) is used as a proxy for financial constraints (Fazzari et al., 1988). By interacting a state variable with q and CF in this equation and using firm fixed effects regressions, the study can investigate the state effect on investment sensitivities to both q and CF. The latter sensitivity is effective in exploring the channels of investment inefficiency, as higher sensitivity can refer to either high financial constraints or empire building agency costs. With state's reluctance to leave control in strategic sectors and given the expected higher presence of agency costs and asymmetric information in those sectors, investment inefficiency for state ownership should be more severe in strategic sectors. Therefore, the sample is accordingly divided to strategic and non-strategic sectors to test this hypothesis.

The study key results show that state ownership is associated with lower investment levels. State ownership curtails firm's investment responsiveness to growth opportunities, and thus reduces investment efficiency. State ownership decreases firm financial constraints, as indicated by the negative effect on investment-CF sensitivity, which can be explained by SBC that state firms enjoy. However, by exploring the debt channel for softening budget constraints, it is shown that state firms are not relying heavily on this channel. Investment efficiency is found to be lower in the strategic compared to non-strategic sectors, while SBC are visible in strategic sectors. Finally, results of lower investment efficiency associated with state ownership are robust to the use of an alternative definition of state ownership and methods of estimation that tackle concerns around investment-q models such as measurement error in q and endogeneity problems. The study also excludes other interpretations of investment sensitivities that might drive the results such as price informativeness and asset tangibility. Findings suggest that policy maker should enhance corporate governance and encourage risk-taking behaviour as well as improving shareholders minority rights to avoid any expropriation of firms value by state controlled principals. It also provide lessons for future privatizations in the sense that privatizing firms while retaining controlling stake-holding is not an effective way to introduce sustainable improvements in performance. It sheds a light on the importance of ownership type in applying Tobin's Q theory in the Egyptian market, which paves the way for future investigation of how investment theories work in emerging markets.

The chapter is structured as follows. The next section provides a historical background about the state's role in investment. Section 3 reviews the literature emphasizing on the privatization, residual state ownership and investment strands of literature as well as the related literature for Egypt. Section 4 presents the development of the investment model. Sections 5 and 6 discuss the hypothesis testing and empirical specification. Descriptive statistics and empirical results are reported in sections 7 and 8, respectively. Section 9 provides some robustness checks, whereas the last section is for discussion and conclusion.

4.2 Historical background about the role of the state in investment

Egypt has a long history of strong state intervention, with the state playing the role of the country's largest investor. After the 1952 Egyptian revolution (also known as the 1952 coup d'état), a mass nationalization of manufacturing, services and financial enterprises took place during President Nasser era. The state invested heavily in import substituting industries (such as chemicals, metals, paper, steel, fertilizer and textiles) and some high technology consumer good (like auto mobiles, TV and pharmaceuticals), while heavily regulating private sector industrial activity. State guidance of economic development continued during the open-door policies of Sadat's regime (1970-1981). Government used to differentiate taxes and interest rate by product, sector and location to direct the investment of the private sector. Nonetheless, the government was still the largest investor with 75% share of total investment while public administration absorbing much of the unemployment (Loewe, 2013).

In early Mubarak presidential phase, price regulations, customs and financial sector policies continued to favour the public sector at the expense of the private sector during the eighties. Nevertheless, tax holidays, creation of free zones, abandoning of central planning and the devaluation of the currency had benefited the private sector. As a result, the share of the private sector in total investment increased to 41% for the period 1983-1990 from 16% over the period 1960-1982. In addition to mentioned favourable policies, the public sector was evaluated by the size of production and provision of various social schemes, rather than profitability, efficiency and competitiveness measures, which led to inefficient and deteriorating public enterprises. (Awadalla, 2003; Loewe, 2013; Sahnoun et al., 2014)

Private investment enjoyed more favourable conditions during the economic and structural adjustment reform program adopted in 1991, which was introduced among other reform packages by the World Bank and IMF. Public enterprise reform and privatization were on the top of reform agenda. The corporatization and commercialization of public enterprises were brought about by the enactment of law no.203 for 1991, which increases the management autonomy of public enterprises and exclude them from state budget (Carana, 2002). A private investment boom was triggered by steps to liberalize the financial sector and commodity prices, tax holidays and reduced trade and capital transfer barriers. The private investment share of total investment rose to 51% for the period 2001-2006. Though, state owned enterprises continued to monopolize the energy sector, while playing an active role in heavy industries among others. (Sahnoun et al., 2014)

Egypt had witnessed a shift in policies towards the private sector under the 'businessmen' cabinet of Ahmed Nazif for the period 2004-2011, that ended with the political uprising. The new government strongly resumed the privatization process where 87 state owned enterprises were privatized in one year, including ones in strategic sectors which were restricted before. Tax reductions were introduced with the new income-tax law in 2005. Further steps towards financial liberalization and elimination of custom tariffs and foreign investment obstacles were taken (Loewe, 2013). Most of these policies were beneficial for the politically well-connected businessmen which is referred in the literature as a period of 'crony capitalism' (Chekir and Diwan, 2013; Roll, 2010), with even a negative effect on government owned enterprises. Some sectors were protected against market entrants such as the energy sector, landlines telecommunication, railway and postal services, with very limited licenses in steel, aluminium and fertilizers industries. The politically connected firms have benefited from these limited licenses in the steel and cement industries. For example, Ezz steel company dominated 65% of steel production in 2010 as its owner Ahmed Ezz was a close friend to Mubarak's son and one of the most influential members in the parliament (Loewe, 2013). Despite this, during Mubarak final years in power, the public sector continued to absorb 27% of the Egyptian labour workforce in 2010, which was lower by 10% compared to 2000 (Beissinger et al., 2015).

After the 2011 revolution, some cases have been filed to cancel the privatization of some firms, where some Egyptian courts have ruled to annul the privatization of some firms, while most of the cases are under appeal (U.S. Department of State, 2014)[3]. It is obviously clear that the state still play a major role in the economy. The public sector has been mainly involved in strategic sectors such as extractive industries, manufacturing and the financial sector, which accounts for 30% of GDP, in addition to cotton-ginning sector due to its role in fostering employment. Public sector and connected private firms have been benefiting disproportionately from government' subsidies such as subsidized inputs (energy) or tax exemptions, which lead to their heavy existence in energy intense sectors (IMF, 2017; OECD, 2013). Despite privatizing many state owned firms, the state maintains a high share of 44% in privatized firms (Ben Naceur et al., 2007) and is reluctant to give up majority control in some sectors. For example, in the Pharmaceuticals industry, the state has no intention to decrease its ownership share below 60%[4]. Egypt has adopted an economic reform program supported by the IMF in 2016. Accordingly, authorities are taking steps to regulate the role of the state in the economy and improve governance, notably by creating independent regulators. With the aim to reduce the role of the state, state owned enterprises IPOs program was initiated in 2016 to prepare for privatizations. Moreover, in March 2018, Egypt named 23 state companies for possible privatisation[5]. However, no actual major actions have been taken so far.

[3]President Sisi signed a law in 2014 limiting appeal rights on state-conducted contracts to protect previous government privatization deals.

[4]From an interview with undisclosed executive working in the ministry of public sector enterprises.

[5]https://www.reuters.com/article/egypt-ipos/update-2-egypt-names-23-state-companies-to-float-shares-in-privatisation-scheme-idUSL8N1R021A

4.3 Literature review

This section discusses first the evolution of state ownership and its rational, the consequences of privatization, the residual state ownership, and the development of state capitalism. Afterwards, it reviews sources of state ownership inefficiencies and highlights the literature on investment efficiency. The last part of this section presents the related literature about Egypt.

4.3.1 The evolution of state ownership and privatization

The theoretical rational for state ownership based on efficiency ground is that government intervention provides economic benefits by resolving market failures. Government can promote efficiency if the product involved is a public good, generates externalities or involves a natural monopoly. This argument is built after a fundamental theorem of welfare economics that favours the private ownership of the mean of production under a strong assumptions of competitive environment, no externalities or public good. Another justification for public ownership is to ensure that commercial enterprises will pursue socially desirable objectives, besides minimizing costs. Therefore, many countries have responded to market failure by state ownership. Privatization in turn was a response to the failing of state ownership, so many governments in the 1980s and 1990s undertook large scale reforms and privatization programs in the public sector (Megginson et al., 2005; Netter and Megginson, 2001).

The privatization literature provides previous assessment of the differences in performance between state owned firms, mixed, and private firms, and it provides evidences for the superior performance of the latter. The literature on the effect of privatization reveals significant performance and governance improvements following the divestiture of SOEs, although with different factors to determine the extent of improvement[6]. However, improvements after privatization are less pronounced or even disappear when the government continues to own the majority of shares, and reluctant to relinquish control (Bortolotti and Faccio, 2009; Boubakri and Cosset, 1998; Boubakri et al., 2011, 2013).

Despite waves of privatization in both developing and developed countries, Boubakri et al. (2011) and Bortolotti and Faccio (2009) report that the state is reluctant to relinquish control in newly-privatized firms[7]. The two studies also show that political

[6]Surveyed literature on privatization can be found in Netter and Megginson (2001), Shirley and Walsh (2000), Gupta et al. (2001) and Megginson et al. (2005), amongst others, and in Megginson (2017) for an updated survey after 2004.

[7]The state maintain on average 33.5% stake in privatized firms while keeping more than 50% of shares in 46% of Boubakri et al. (2011)'s sample for 27 emerging markets. In OECD countries,

system adopted and the legal origins of the country are important determinants of residual state ownership in newly privatized firms. For example, in civil law countries governments tend to retain large ownership positions, whereas in common law countries governments retain control by using golden shares. Furthermore, Chernykh (2008) find in Russian publicly traded companies in 2000-02, state or anonymous private still exercises control through extensive use of pyramids. For developing countries, Boubakri et al. (2008) illustrate that 46% of firms remained under government control after privatization are concentrated in strategic sectors.

Other recent studies have discussed the consequences of the residual government ownership. Borisova et al. (2012) find that, after the financial crisis in 2008, the increase in state equity ownership is associated with lower governance quality in Europe. Ben-nasr et al. (2012) show that the cost of equity is increasing in the government ownership, reflecting the greater agency and information asymmetry problems faced by newly privatized firms (NPFs) associated with residual government ownership. Borisova et al. (2015) and Beuselinck et al. (2017) report that state ownership has a negative effect on the cost of debt for publicly traded firms, but during a crisis the cost of debt is lower due to implicit guarantee implied by state ownership. It is also found that firm investment is less sensitive to Tobin's Q for NPFs with more government ownership, while foreign institutional ownership promotes optimal investment decisions, especially if government relinquishes control (Chen et al., 2017). On the other hand, Boubakri et al. (2018) show that government controlled firms have higher market valuation and this benefit of control can be extended to firms where government is the second largest shareholder; therefore state ownership can be value enhancing. Chen et al. (2018) demonstrate that state ownership is positively associated with the provision of trade credit, which is considered as alternative source of fund when access to credit is limited.

Recently, the discussions have even inclined towards state capitalism. The turn happens with the rise of China as an economic power, the role of national oil companies with increasing oil prices, and governments interventions after the 2008 financial crisis (Megginson, 2017). Consequently, the literature has shifted to examine the influence of government ownership on different corporate policies away from privatization literature.

This subsection discusses the evolution of state ownership through privatization, state reluctance to leave control, and the consequences of residual government/state ownership up to the fact that the state still playing a role in business in the economies

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Bortolotti and Faccio (2009) exhibit that government maintain control of almost two-thirds of privatized firms either through direct ownership, leveraging devices or golden shares.

worldwide. Therefore, it is important to investigate the existing economic reality of the state as a current holder of business assets.

4.3.2 State ownership and efficiency

The literature provides different reasons why state ownership might be less efficient than private ownership. This section presents the sources of state inefficiencies that are organized into three main categories; state firm objective function, agency costs and soft budget constraints.

- **State ownership and non-economic objective functions**

Governments have *political objectives*, and thus can use their control of state owned firms as a way of channelling political benefits to supporters such as providing employment, producing goods desired by certain politicians, locating their production in politically attractive regions, charging prices below marginal costs, or even providing subsidies for a group of interest (La Porta et al., 2002; Shleifer, 1998; Shleifer and Vishny, 1994). Instead of just benefiting some political supporters at the cost of other groups, government can purse *social objectives* such as employment creation, target egalitarian wage distribution, or ensuring the decent production of strategic products (Bai and Xu, 2005; Fogel et al., 2008). Government can further impose *developmental objectives* that are usually accompanied with industrial policies to promote certain industries or to enhance economic development in impoverished regions (D'Souza and Nash, 2017; Lazzarini and Musacchio, 2018; Vickers and Yarrow, 1991). These non-economic objectives divert state firms behavior from being efficient.

The political consideration of state owned firms was the principal motive behind privatization waves worldwide (Shleifer, 1998). Despite that privatization has reduced the political interference in the allocation of firm resources, it does not completely eliminate it as long as the state retains a stake in the firm (Perotti, 1995). Boubakri et al. (2017) find that privatization pace is affected by the state's desire to extract political benefits from SOE's, and advocate for full privatization to maximize post privatization performance improvement. To emphasize the cost of state ownership even after full privatization, D'Souza et al. (2017) provide evidence of the persistent impact of state ownership in Eastern European and Central Asian countries even when the state is no longer the owner. By showing the outperformance of de novo firms compared to privatized ones, they argue that the profit motive of privatized firms is acquired, but not organic as the case for de novo firms.

- **State ownership and agency costs**

State firms can be less efficient than private ones for other reasons related to agency problems, even if a benevolent government with no political objectives is assumed. The literature has mainly focused on principal-agent and principal-principal problems that lead to inefficient behaviour of state owned firms.

Principal-agents problems tackle the relation between owners (principals) and managers (agents) (Jensen and Meckling, 1976). Managers in state owned firms have weak incentives either to innovate or reduce costs, as they are considered 'public employees' who bear the costs of firm's decisions but cannot personally reap the benefits of good performance (Hart et al., 1997). The principal-agents problems in state owned firms can occur also because of multiple principals problem (Lazzarini and Musacchio, 2018), which happens when mangers serve multiple constituencies (principals) with different objectives affecting their incentives to purse efficiency. At the same time, none of these principals bear the full cost of monitoring which lead to weak monitoring of managers (Dixit, 1997). Weak monitoring gives managers the discretion to undertake non-value maximizing activities (Laffont and Tirole, 1993; Vickers and Yarrow, 1991) such as empire building. These already weak incentives will be more tenuous if state firms (or their managers) are protected from competition or enjoy a monopoly position with little market pressures to improve efficiency (Boubakri et al., 2008; Chen et al., 2017; Megginson et al., 2005). The non-economic objectives of the government may hinder developing an efficient incentives contracts. Politicians are less likely to provide good incentives plans for managers, because it will reduce managers' incentives to achieve government non-economic objectives (Bai and Xu, 2005; Shleifer and Vishny, 1994). Although agency problems here emphasize managerial discretion, they include also a political dimension since politicians govern in a way or another managers' behaviour (especially if bureaucrats).

State ownership involves other form of agency costs which is principal-principal (PP) problems, especially in mixed or publicly listed firms. It mainly discuss the conflict between controlling and minority shareholders (similarly, state principals and private principals). PP conflicts are more dominant in emerging markets which are characterized by concentrated ownership combined with weak governance and poor protection of minority rights (Morck et al., 2005). These conflicts lead to expropriation of firm value from minority to majority (or controlling) shareholders[8]. This expropriation can take many forms such as selling products at below market prices to organization affiliated/connected to controlling shareholder, pursing political/social

[8]This phenomenon is mainly refereed in literature as tunnelling (Johnson et al, 2000) or private benefits of control. D'Souza and Nash (2017) studied the private benefit of state ownership as an analogue to private benefits of control. They define it as the political, social or personal advantages that the controlling politician may be able to extract from the SOE.

agenda at the expense of firm performance (D'Souza and Nash, 2017; Young et al., 2008), or providing inter-corporate loans to other affiliated companies (Jiang et al., 2010). Moreover, with poor investor's protection, dominate owners may direct firms to have conservative investment policies (John et al., 2008), and thus diverting firms behaviour away from an efficient one.

- **State ownership and soft budget constraints**

Soft budget constraints (SBC) can be a source of inefficiency (Berglof and Roland, 1998; Kornai et al., 2003; Megginson and Netter, 2001; Schaffer, 1998). Soft budget constraint theory can be dated back to Kornai in 1979 who first observed the SBC syndrome in Hungarian socialist economy where state owned firms were not allowed to fail and were bailed out. Large state owned firms are too big and politically too important to fail; hence governments continue subsidizing them. Accordingly, they are protected from some sorts of effective discipline that private firms are subject to (Megginson et al., 2005). SBC can weaken the managerial effort to maximize profits, reduce costs and innovate, but it may also boost the propensity to invest by reducing the risk to investor who anticipate support in case of poor results (Kornai et al., 2003).

A firm facing SBC can enjoy different kind of external support such as implicit or explicit government guarantee, tax concessions, preferential access to credit from state owned banks, or other indirect methods of support such as regulations or barriers to competition (Kornai et al., 2003). Privatization was seen as one way to harden the budget constraints, however, as argued by Vickers and Yarrow (1991) privatization does not imply a binding commitment by the government not to subsidize losses, but with less ease than before. Some empirical studies have shown evidences of SBC existence even after privatization. For example, Frydman et al. (2000) compare performance of privatized firms controlled by the government or by an outsider in transition economies, and argue that former firms are not disciplined because tax authorities and state banks provide extra support to soften the budget constraints.

Although the literature has focused on SBC as a source of inefficiency, it can provide a helping hand[9]. State firms can enjoy access to preferential financing, government guarantee of loans, or to capitalize on government ties to suppliers, customers or regulators (Nash, 2017). Studies from different countries have showed evidences of preferential access to credit from state owned banks to firms with state ownership (Frydman et al., 2000; Sapienza, 2004; Schaffer, 1998) and/or to firms with political connection (Faccio et al., 2006; Khwaja and Mian, 2005) that can be extended to an implicit guarantee of bailout during financial distress. In this context, SBC can reduce the financial constraints a firm is facing.

[9]It is known as the helping hand hypothesis for state ownership.

In this subsection, sources of the inefficient behaviour of state owned firms or state firms in which the state retains a stake after privatization have been presented. Non-economic objectives of state ownership impede the maximization of a firm value. It is more common in emerging countries to have agency costs in the form of conflicts between state and private principals, which divert firm resources (or objectives) away from an efficient behaviour. SBC are double edged; it can be a source of inefficiency or a helping hand to reduce firm financial constraints.

4.3.3 Investment efficiency

In a frictionless setting for a standard neoclassical investment model, a firm invests up to the level that marginal benefit of capital equals marginal cost (Modigliani and Miller, 1958; Tobin, 1969). In other words, a firm's investment is solely determined by growth opportunities; that is the expected future profitability of capital as measured by Tobin's Q. Nevertheless, in real world, firm's investment may become less responsive to growth opportunities because of some frictions. Theoretical models and empirical studies focus on two frictions; information asymmetry and agency problems. These frictions cause firm investment to deviate from the optimal level, leading to sub-optimal investment levels and thus less efficient investment (Stein, 2003). In this regard, the sensitivity of investment to q implies the extent to which a firm can invest optimally, and thus proxies for investment efficiency.

Agency costs affect investment decisions leading to two forms of sub-optimal investments: overinvestment or underinvestment. The free cash flow theory (Jensen, 1986) supports the overinvestment hypothesis due to empire building preference as managers engage in excessive acquisition, investment or diversification to build an empire for their private benefits. Moreover, under the framework of principal-principal agency costs type, controlling shareholders are likely to make self-interested and entrenched decisions expropriating resources from minority and spend firms' cash flow on unprofitable investment, resulting in overinvestment (Guariglia and Yang, 2016). Due to these empire building preferences, managers overuse the internal resources of the firm (cash flow); hence investment can be positively sensitive to cash flow (Jensen, 1986; Stein, 2003; Stulz, 1990).

The other form of sub-optimal investments which is underinvestment can be due to managers private costs, quiet life or conservative behaviour. Managers may underinvest (forego some positive net present value projects), as they face private costs of undertaking investment projects. This is because they are more inclined to shirk (to work less), and investment requires time and oversight responsibilities (Aggarwal and Samwick, 2006). John and Knyazeva (2006) argue that conservatism or risk aversion and thus lower investment levels can be manifested in the decisions of poorly governed managers because they are less likely to screen fluctuations in investment opportunities, which are privately costly, and are reluctant to take the risk of new investment. This is because new investments or acquisitions generate greater market scrutiny, amongst others. In the quiet life hypothesis formulated by Bertrand and Mullainathan (2003), managers prefer the current level of investment, and are less likely to initiate new investments or liquidate an old one, leaving a little effect on overall firm size. This suggests another distortion in investment levels which can be related to underinvestment in the sense that investment is lower than what is optimal and less sensitive to growth opportunities.

On the other hand, asymmetric information between borrower (firm) and lender (bank or stock market) can affect investment decisions, by generating significant cost disadvantages of external finance. Models of costly equity and debt financing generally predict underinvestment because of adverse selection or moral hazard problems (Myers and Majluf, 1984; Stiglitz and Weiss, 1983, 1981). A firm may invest less giving up good investment opportunities if it has scarce internal finance and is financially constrained to get external finance. The literature initiated by Fazzari et al. (1988) uses the investment-cash flow sensitivity to characterize financial constraints in Tobin's Q model. Their intuition depends on the difference in costs between internal and external finance due to asymmetric information, and the hierarchy in investment and financing decisions, where firms prefer internal cheap resources then debt and equity. Although other studies have questioned the validity of using the magnitude of investment-cash flow sensitivity as a measure of financial constraints (Cleary, 1999; Hennessy and Whited, 2007; Kaplan and Zingales, 1997), this topic is still debated in the literature.

Recent studies employ the sensitivity of investment expenditure to Tobin's Q as a proxy for investment efficiency (Badertscher et al., 2013; Chen et al., 2017, 2011; Jaslowitzer et al., 2018; McLean et al., 2012). Accordingly, the estimated coefficient of Tobin's q captures the investment response to investment opportunities (summarized by q) and therefore investment efficiency[10]. Higher investment-price (Q) sensitivity is associated with more efficient investments; hence better allocation of resources[11]. Agency costs and asymmetric information cause investment to deviate from its optimal level implied by q and therefore weaken the investment-q sensitivity. This argument is supported by other studies that directly explore the effect of agency cost (Asker et al., 2015; Jiang et al., 2011) and asymmetric information (Baker et al., 2003; Chen et al.,

[10]Efficiency here refers to the level of efficiency in investment.

[11]This measure can be consistent with Wurgler (2000)'s measure of investment efficiency which is the elasticity of industry investment to value added growth as a proxy for growth opportunities.

2007; McLean et al., 2012) on the investment sensitivity to growth opportunities or prices. The idea of investment efficiency here is related to the extent to which a firm can invest at the optimal level that responses to growth opportunities. This strand of literature classifies the inefficiency as sub-optimality in the investment behaviour. This is different from other accounting-based studies that quantify inefficient investments as deviations from expected investment (residuals) using a model that predicts investment as a function of growth opportunities (Biddle et al., 2009; Richardson, 2006).

State ownership curtails firms' investment responsiveness to growth opportunities and thus investment efficiency (Chen et al., 2017, 2011; Jaslowitzer et al., 2018; O'Toole et al., 2016). While Chen et al. (2011) consider government intervention as another friction besides agency costs and asymmetric information, the others highlight that state ownership is accompanied by both frictions leading to investment inefficiency. This chapter follows the latter camp in investigating the effects of state ownership on investment efficiency, aiming to explore the overall influence of the state as a current holder of business assets amongst Egyptian firms. Therefore, it will not only use privatized firms data like Chen et al. (2017) or compare the performance between SOEs and private firms as Chen et al. (2011) and O'Toole et al. (2016), it will employ data of listed firms whether they are SOEs, privatized or private firms similar to Jaslowitzer et al. (2018). Furthermore, the study examines the channels of investment efficiency by taking into account previous frictions as will be discussed in details in the investment model.

In this subsection, two main frictions were discussed; agency costs and information asymmetry that deviate firm investment from the optimal level, and reduce firm investment sensitivity to growth opportunities and thus investment efficiency.

4.3.4 Egypt related literature

The literature tackling the different performance between state and private firms or across ownership types in Egypt mainly started with privatization process in 1990s. Firm level studies that examine the impact of privatization on the operating performance of privatized firms are mainly; Omran (2004), Omran (2009), El-Mahdy and Metwally (2008), Carana (2002) and Ben Naceur et al. (2007). Omran (2004) shows a significant increase in profitability, operating efficiency, capital expenditure and payout ratio after privatization, while a decrease in employment and leverage, and insignificant decrease in output. Performance improvement is confirmed by Ben Naceur et al. (2007), but with a significant decrease in leverage for only those firms that the state maintains majority ownership.

The extent of improvement after privatization that took place depends on the form of privatization. Partial privatization through public offering (IPOs) was not effective as full privatization through anchor privatization, in which the firm is sold to strategic and/or foreign investors. State owned firms sold to an anchor investor outperform those sold by public offering (Carana, 2002; El-Mahdy and Metwally, 2008; Omran, 2004). Ben Naceur et al. (2007) emphasis that profitability changes are positively related to foreign ownership while negatively related to state control for four MENA countries including Egypt. IPO privatization limits the extent of real privatization because of the fragmentation of ownership, which has an adverse effect on corporate governance and enterprise restructuring, as government holding companies and/or public sector financial institutions remained the major single equity holder without change in management (Awadalla, 2003; Carana, 2002). This can amplify the agency problems, particularly the principal-principal conflicts.

During post privatization period, Omran (2009) finds that the state gave up control over time to the private sector but keep control of more than 36% of 52 privatized firms during 1995-2005 period, particularly over strategic sectors and/or firms with a monopoly position (e.g. pharmaceutical and aluminium industries)[12].

Abdelgouad et al. (2015) investigate the correlation between ownership structure and firm performance in the Egyptian manufacturing sector, employing World Bank enterprise survey data. They demonstrate that firms with public ownership have lower net profit rate and capacity utilization compared to the private sector, while there is no significant productivity difference. Although that study discusses public ownership, it does not explore investment efficiency nor it uses data for listed firms. Rashed et al. (2018) examine the relation between ownership structure (managerial, institutional, block holder and outside director ownership) and investment efficiency measured by positive or negative residuals from an investment regression. They find that the last three types of ownership have a negative effect on investment efficiency, while managerial ownership has no effect. While Rashed et al. (2018) uses an accounting based measure for investment efficiency, this chapter employs an economic-based measure and investigates the role of state.

The legal origin of a country can affect its ownership structures and agency costs. Egypt follows the French civil law. Countries that follow the civil laws are characterized by weak legal rights and protection compared to common law countries (La Porta et al., 1998). Due to weak protection of minority rights, investors seek to own a significant proportion of firm equity to protect their interest and exercise control

[12]This is in line with earlier study for Ben Naceur et al. (2007) who reports that the Egyptian government maintains on average 44% in the ownership structure of privatized firms by share issues.

(La Porta et al., 1999; Shleifer and Vishny, 1997). The legal origin of Egypt and the relatively constrained political system affect corporate governance; therefore the majority of Egyptian firms are either state or family owned (Omran, 2009). Actually, Elsayed and Hoque (2010) have documented that state ownership is associated with lower disclosure levels in Egypt. This implies more agency problems and asymmetric costs associated with state ownership in Egypt.

Studies on the relation between state ownership and access to finance (or financial constraints) are controversial. Egypt has a long history of financing the public sector at the cost of the private sector. State owned banks used to be the government arms to support the development process; where these banks had been used to provide loans on non-market terms to SOEs. Many SOEs' unpaid debts to public banks had to be forgiven, in preparation for privatization process. The banking sector has concentrated its lending to the government, which results among other reasons in crowding out private sector (OECD, 2013; Raballand et al., 2015; U.S. Department of State, 2014). Recently, Dang et al. (2018) find that firms with state ownership display lower financial constraints using the sensitivity of investment to the amount of cash on hand as a proxy for financial constraints for the period 2006-2011. Instead, Shahwan (2015), in studying the effect of corporate governance on firm financial distress in 2008, shows that state owned firms have an increased probability of being classified as financially distressed firms. Khlif et al. (2015) exhibit that state ownership reduces corporate efficiency by increasing cost of equity capital, while ownership dispersion reduces cost of equity capital. Therefore, it is still inconclusive whether state ownership is accompanied by increased or decreased financial constraints, and whether banking sector is still providing a preferential access to credit to these firms or not. This chapter tries to shed light on these issues.

Most of the studies mentioned so far compare firms' performance or its capital expenditure levels before and after privatization, with little attention to investment efficiency. It is highlighted that partial privatization was not effective compared to full privatization with state reluctance to leave control. This shows that there is a substantial existence of the state as a current holder of business assets that requires investigation. Moreover, studies that discuss ownership structure usually relates it to corporate governance and performance behaviour, but not to investment efficiency except Rashed et al. (2018)'s study. Therefore, this study contributes to the literature by investigating how state ownership in publicly traded firms affects the investment efficiency as well as channels of inefficiency[13].

[13]This study focuses on publicly traded firms because data for SOEs are not widely accessible.

4.4 The investment model

The study derives its model of investment as the optimal choice of a firm choosing investment spending to maximise its expected future value following the standard q-theory of investment (Hayashi, 1982; Hubbard, 1998; Wickens, 2008)[14]. The net present value of the firm's investment (V_t) is given by

$$V_t = \sum_{s=0}^{\infty}(1+r)^{-s}\{[F(k_{t+s}) - i_{t+s} - \Phi(i_{t+s})] + \mu_{t+s}[i_{t+s} - k_{t+s+1} + (1-\delta)k_{t+s}]\} \quad (4.1)$$

where $F(K_t)$ is operating profit function where capital is the sole factor of production. It is an increasing and concave function ($F' > 0$ and $F'' \leqslant 0$). $\Phi(i)$ represents the capital adjustment costs where $\Phi'(i) > 0$ and $\Phi''(i) > 0$. i_t is investment and δ is the rate of depreciation. Maximizing V_t with respect to i_t and k_t gives the first order conditions:

$$\frac{\partial V_t}{\partial i_{t+s}} = -(1+r)^{-s}[1 + \Phi'(i_{t+s}) - \mu_{t+s}] = 0$$

$$\frac{\partial V_t}{\partial k_{t+s}} = (1+r)^{-s}F_{k,t+s} - (1+r)^{-(s+1)}\mu_{t+s-1} + (1-\delta)(1+r)^{-s}\mu_{t+s} = 0$$

The first order condition for investment implies that

$$\mu_t = 1 + \Phi'(i_t) \quad (4.2)$$

where μ_t is the additional revenue from an extra unit of investment at time t. It also represent marginal Tobin's q as it is the additional revenue from an extra unit of investment divided by the price of one unit of investment which is 1. The equation implies that the marginal cost of additional capital equals additional net revenues from an extra unit of investment at time t. To obtain an investment function it is necessary to linearise the $\Phi'(i_t)$ as $\Phi'(i_t) \approx \Phi'(\bar{i}) + (i_t - \bar{i})\Phi''(\bar{i})$ and thus $i_t = \bar{i} + \frac{1}{\Phi''(\bar{i})}[\mu_t - 1 - \Phi'(\bar{i})]$ and so $\frac{\partial i_t}{\partial q_t} > 0$.

In the absence of financial frictions and agency costs, the value of the firm at the first best scenario is provided by equation 4.1. The optimal level of investment i^{FB} is determined by the first order condition to this equation as presented in equation 4.2. This means that the optimal level of investment is determined only by the productivity of firm's investment and is independent of financing since internal and external costs are perfect substitutes in this scenario. With a quadratic capital adjustment function

[14] This model is inspired by Jaslowitzer et al. (2018) and Stein (2003). However, a more general model is used as the study finds it is straightforward to obtain a multi-period solution.

$\Phi(i)$, optimal investment will become a linear function of marginal q[15]. The model can be empirically tested by taking into account the development of Hayashi (1982) investment model of linearly homogeneous profit (in k_t) and adjustment cost (in i_t and k_t) functions, and thus marginal q equals to average q, which is observable in the data[16].

The model can allow for agency costs and financial frictions, which distort investment decisions from the first best case. Of the investment I, an amount W is financed by internal resources, and an amount E is raised externally (equity or debt). Value-maximizing managers are assumed to exhaust the internal finance option before raising external finance ($I = W + E$).

First, to capture agency costs, managers (insiders) are assumed to derive linearly increasing benefits of the form B(i) from investing more[17], and at the expense of other shareholders (outsiders), following Jaslowitzer et al. (2018). Accordingly, the insider valuation of the firm can be represented by:

$$V_t^I = \sum_{s=0}^{\infty}(1+r)^{-s}\{[F(k_{t+s}) - i_{t+s} - \Phi(i_{t+s}) + B(i_t)] + \mu_{t+s}[i_{t+s} - k_{t+s+1} + (1-\delta)k_{t+s}]\}$$

The managers (insiders) first order condition for investment will imply $\mu_t = 1 + \Phi'(i_t) - B'(i_t)$, which shows an investment distortion from the first best case in form of $B'(i_t)$. Meanwhile, outsider valuation of the firm is still given by equation 4.1. For empire building behaviour of managers, $B(i)$ is required to be greater than zero.

Second, to capture financial frictions, a dead weight cost associated with funds raised externally is assumed, following Jaslowitzer et al. (2018). These costs are given by $C(E, \theta)$, where $C(., \theta)$ is an increasing convex function and θ is the measure of the degree of the financing frictions, and $E = I - W$. Therefore, the value of the firm by insider given the agency and friction costs is represented by:

$$V_t^I = \sum_{s=0}^{\infty}(1+r)^{-s}\{[F(k_{t+s}) - i_{t+s} - \Phi(i_{t+s}) + B(i_{t+s}) - C(i_{t+s} - w_{t+s}, \theta)] + \mu_{t+s}[i_{t+s} - k_{t+s+1} + (1-\delta)k_{t+s}]\}$$

Accordingly, the first order condition for maximizing V_t^I is as follow:

$$\mu_t = q^* = \begin{cases} 1 + \Phi'(i_t) - B'(i_t), & if\ i^* \leq w \\ 1 + \Phi'(i_t) - B'(i_t) + C'(i_t - w_t, \theta), & if\ i^* > w \end{cases} \tag{4.3}$$

[15]If new investment imposes an adjustment cost in the form of $\frac{\phi}{2}\frac{i_t}{k_t}$ for each unit of investment, arranging the first order condition of investment will give $\frac{i_t}{k_t} = \frac{1}{\phi}[\mu_t - 1]$.

[16]The market value of existing capital to its replacement cost.

[17]Every dollar of investment generates a marginal B dollars of utility for the manager.

To obtain the new investment function, it is necessary to linearise $\Phi'(i_t)$, $B'(i_t)$ and $C'(i_t - w_t, \theta)$ as $\Phi'(i) \approx \Phi'(\bar{i}) + (i - \bar{i})\Phi''(\bar{i})$

$B'(i) \approx B'(\bar{i}) + (i - \bar{i})B''(\bar{i})$

$C'(i - w, \theta) = C'(\bar{i} - w) + ((i - w) - (\bar{i} - w))C''(\bar{i})$

Hence, $i_t = \bar{i} + \frac{1}{\Phi''(\bar{i})+B''(\bar{i})+C''(\bar{i})}[\mu_t - 1 - \Phi'(\bar{i}) + B'(\bar{i}) - C'(\bar{i} - w)]$

Equation 4.3 refers to the distortions in the linear investment-q relation from the first best case by $B'(i_t)$ which captures direct agency costs, and by $C'(i_t - w_t, \theta)$ which captures the financial distortion if $i^* > W$ and $\theta > 0$. Therefore, firm investment will depend on W beside q, as the former will determine a firm's need for external finance[18]. This theoretical foundation can be easily compatible with empirical investment-q equations in the following form.

$$I_{it} = \beta_0 + \beta_1 Q_{i,t-1} + \beta_2 CF_{it} + \beta_3 Q_{i,t-1} \times State_{i,t-1} + \beta_4 CF_{it} \times State_{i,t-1} + \beta_5 State_{i,t-1} + X_{i,t-1}\beta_6 + \epsilon_{it}$$

However, the model is augmented with a variable for state ownership and its interactions terms with Q and CF (cash flow; as the measure of internal finance) to investigate the effect of the state through these two channels of distortions. Further detail discussion of the empirical specification is presented in Section 6.

4.5 Developing hypothesis testing

The investment model shows that agency costs and financial frictions distort investment from the first best. Accordingly, the investment becomes less sensitive to Q and cash flow plays a role. It is hypothesized here that state ownership is associated with both channels of distortions and therefore affects the investment levels, the sensitivity of investment to Q (as a proxy for investment efficiency) and investment sensitivity to CF (as a proxy for financial constraints). Accordingly, the first three hypotheses of the chapter can be formulated as the following:

H1: State ownership can lead to overinvestment or underinvestment relative to the optimal level. The direct effect of state ownership on the level of investment is positive (negative), consistent with overinvestment (underinvestment) hypothesis.

H2: State ownership is associated with investment inefficiency. In other words, the sensitivity of investment to growth opportunities (Q) is negatively related to state ownership.

[18] Jaslowitzer et al. (2018) argue that the last observation provides a rational for ICFS as empirically observed by Fazzari et al. (1988). However, the positive ICFS does not prove the severity of financial constraints, per se.

H3: State ownership can be either associated with increased or decreased capital constraints which affect investment efficiency. Specifically, investment-cash flow sensitivity is positively (negatively) related to state ownership due to capital constraints (soft budget constraints), if investment activities of the firm require external finance.

The developing of these hypotheses is discussed as follows. The first channel of distortion through which state ownership affects investment behaviour is agency costs. It influence investment decisions leading to sub-optimal investment in the form of either overinvestment or underinvestment causing investment to be less efficient, as discussed in the literature review. Empire building preferences lead to overinvestment as supported by the free cash flow theory of Jensen (1986), whereas private costs, quiet life or conservative behaviour of managers cause underinvestment (Aggarwal and Samwick, 2006; Bertrand and Mullainathan, 2003; John and Knyazeva, 2006). These managerial mechanism can be similarly applied to state firms through the lens of principal-agent as well as principal-principal problems. From a principal-agent perspective, poor monitoring of managers in state firms can give them the discretion to undertake non-value maximizing behaviour that is related empire building, and thus overinvesting (Laffont and Tirole, 1993; Vickers and Yarrow, 1991). On the other hand, weak monitoring and incentives schemes may lead to underinvestment, as managers are public employees who face private cost but do not enjoy the benefit of good investment decisions (Hart et al., 1997). From a principal-principal perspective, state controlling shareholder can direct a firm investment decisions according to its agenda that can be either aggressive or conservative in investments (D'Souza and Nash, 2017; Young et al., 2008).

The political dimension of agency costs associated with state ownership, which is the non-economic objectives, can also lead state firms to either overinvest or underinvest and thus affects negatively investment efficiency. Firth et al. (2012) find that the state firms overinvest especially when investment opportunities are poor as they may invest in wasteful or politically favoured projects. On the other hand, state ownership can lead to underinvestment. Fogel et al. (2008) illustrate that a powerful state may influence firms to have conservative investments so as to stabilize social benefits and employment. Boubakri et al. (2013) show that residual state ownership is negatively related to risk-taking and that heavy government intervention may lead firms to purse conservative investment. This risk-taking behaviour is discouraged by government if it wants to keep extracting non-market rents (John et al., 2008). Other studies discuss the effect of non-economic objectives on investment efficiency, without specifying the type of sub-optimality. For example, Chen et al. (2011) argue that state intervention leads to investment inefficiency both ex ante and ex post. Ex ante, state controlled firms may miss investment opportunities due to their focus on a political agenda. Ex post, managers find it difficult to terminate failed projects or react to diminishing investment opportunities due to its conflicts with government plans and policies. Indeed, Egypt has a long history of interventionist behaviour to accomplish certain objectives such as providing employment and delivering social services, which can affect the behaviour of state firms leading to either over or underinvesting.

The second channel of effect on investment is asymmetric information or financial constraints, which lead to the phenomenon of underinvesting. State ownership can influence investment and financing decisions through its effect on the access or cost of external finance. On the one hand, state ownership may lead to increased cost of external finance. For example, state ownership is more likely to be associated with low financial disclosure. Governments may lead managers/bureaucrats in state owned firms to manipulate earnings or selectively disclose accounting information to hide expropriation of corporate resources, which results in a less informative environment and greater information asymmetry (Ben-Nasr and Cosset, 2014) and probably higher cost of external finance. Borisova et al. (2015) and Beuselinck et al. (2017) report that state ownership has a negative effect on the cost of debt for publicly traded firms, however, this cost is lower during a crisis due to implicit guarantee by state ownership. Cost of equity is also found to be increasing in government ownership (Ben-nasr et al., 2012). Jaslowitzer et al. (2018) exhibit that state ownership is associated with increased capital constraints for European firms, while Lin and Bo (2012) show that state ownership neither helps in reducing financial constraints nor leads to more borrowing from state banks for Chines firms. In fact, state ownership is associated with lower disclosure levels in Egypt (Elsayed and Hoque, 2010), which affect information asymmetry. Khlif et al. (2015) find that state ownership increases the cost of equity capital whereas Shahwan (2015) reports that state owned firms have an increased probability of being classified as financially distressed firms.

On the other hand, state ownership can reduce firm financial constraints as state firms can benefit from soft budget constraints. The literature shows earlier evidences of easier access to credit for state firms from state owned banks (Frydman et al., 2000; Sapienza, 2004; Schaffer, 1998). Recently, Borisova et al. (2015) find that a decrease in state ownership is associated with an increase in cost of debt measured by the credit spread. This results from decreasing government guarantees, ownership uncertainty and bondholder-shareholder conflicts. Indeed, Egypt has a long history of favouring the public sector at the cost of the private sector with a concentration of banking lending to the government. Dang et al. (2018) show that Egyptian firms with state ownership face lower financial constraints. Therefore, it is still unclear whether state ownership increases or decreases firm's financial constraints, and whether the banking sector still provides preferential treatment to listed state firms or not.

Although SBC can help mitigating financial constraints, it can lead to investment inefficiency because it weakens the managerial effort to maximize profits, reduce costs or innovate (Kornai et al., 2003; Netter and Megginson, 2001; Schaffer, 1998). It may lead to overinvestment as it boost investors' propensity to invest by reducing the risks they face due to the anticipation of support in case of poor results (Kornai et al., 2003). Instead, it might lead to underinvestment if the government is a rent seeker and risk averse.

In investigating the effect of state ownership on investment efficiency, this chapter makes use of the literature that employs the sensitivity of investment expenditure to Tobin's q as a proxy for investment efficiency (Chen et al., 2017, 2011; Jaslowitzer et al., 2018; O'Toole et al., 2016). State ownership will be negatively related to investment efficiency, if it curtails the responsiveness of investment to q. This framework allows to investigate the channels of investment efficiency which are agency costs or asymmetric information that cause investment to deviate from the optimal level and thus become less sensitive to Q. To examine which channel is associated with investment inefficiency, this chapter exploits the literature that was initiated by Fazzari et al. (1988) and uses the sensitivity of investment to cash flow to characterize financial constraints. Accordingly, if state ownership exacerbate firm's cost of finance (i.e. financial constraints), the investment cash flow sensitivity will be positively related to state ownership if firm investment activity depend on external financing, following Jaslowitzer et al. (2018). The reason is that financially constrained firms depend more on internal cash flow to finance investment. In contrast, if the firm enjoys soft budget constraints, its investment will be less or insensitive to cash flow (Guariglia et al., 2011; Hoshi et al., 1991; Lizal and Svejnar, 2002; Poncet et al., 2010). It worth noting, however, that positive investment cash flow sensitivity can be related to agency costs and manager empire building (Jensen, 1986; Stein, 2003; Stulz, 1990). If state ownership is associated with higher investment cash flow sensitivity, further investigation is needed to decide whether this sensitivity is due to agency costs or increased financial constraints.

Using the same framework, one can formulate the fourth hypothesis that is related to state effect in strategic compared to non-strategic sectors as follows:

H4: Investment efficiency for state ownership differs across strategic and non-strategic sectors.

Evidences in the literature show that the state maintains a presence in strategic sectors than non-strategic sectors. Indeed, Boubakri et al. (2008) find that 46% of firms remained under government's control after privatization in developing countries come mainly from strategic sectors. Omran (2009) shows that the Egyptian government still maintains more than 36% of 52 privatized firms where these firms are mainly operating in strategic sectors and/or have a monopoly position. Moreover, Boubakri et al. (2017) highlight that full privatization or restructuring in a strategic sector is more politically and socially constrained.

Firms with state ownership in a strategic sector are more likely to have political and social objectives than non-strategic sectors. Strategic sectors, in many cases, are providers of public goods from a natural or quasi-natural monopoly position and its firms are larger and employ more people (Boubakri et al., 2017; O'Toole et al., 2016). Strategically important firms are often protected from competition which weakens managers' incentives to improve efficiency (Bortolotti and Faccio, 2009; Megginson et al., 2005). Indeed, some sectors in Egypt are protected against market entrants such as energy sector, landlines telecommunication, railway and postal services, with very limited licenses in steel, aluminium and fertilizers industries. Moreover, it is more reasonable that these firms are benefiting more from soft budget constraints than other firms in non-strategic sectors. For example, Bortolotti and Faccio (2009) argue that strategically important privatized firms may enjoy preferential treatment regarding regulations, government guarantees and contracts. Therefore, investment efficiency for state firms is expected to be lower in strategic than non-strategic sectors, as well as the presence of soft budget constraints to be higher in strategic sectors.

4.6 Data and empirical specification

This study uses a sample of 120 firms of actively traded firms in the Egyptian market, and covers the period of 2006-2017. Annual financial variables are collected from Datastream and individual firms financial statements. Data on yearly ownership structure is hand collected from disclosure reports of board of directors and shareholders structure for individual firms, as discussed in details in Section 2.2.4.

To examine the effect of state ownership on investment efficiency, an investment equation is employed, which is compatible with the above theoretical investment model, following Fazzari et al. (1988), Whited (1992), Baker et al. (2003) and McLean et al. (2012). In particular, the sensitivity of investment to investment opportunities (Tobin's Q) is employed as a proxy for investment efficiency. The investment equation is augmented by adding a state variable and its interaction with Q and cash flow.

$$I_{it} = \beta_0 + \beta_1 Q_{i,t-1} + \beta_2 CF_{it} + \beta_3 Q_{i,t-1} \times State_{i,t-1} + \beta_4 CF_{it} \times State_{i,t-1} + \beta_5 State_{i,t-1} + \beta_6 X_{i,t-1} + \epsilon_{it} \quad (4.4)$$

Where I_{it} is the firm level investment measured as capital expenditure (CAPEX) scaled by the beginning of period total assets. $Q_{i,t-1}$ is a proxy for firm growth opportunities, and is defined as book value of total assets (TA) plus market value of equity (MV) minus the book value of equity (BV), scaled by book value of total assets (TA). CF_{it} is generated cash flow by the firm, measured as net income plus depreciation and amortization scaled by the beginning of period total assets. *State* is the percentage of state ownership. $X_{i,t-1}$ contains other controls for firm characteristics that may have an effect on investment, which are firm size, leverage and cash holding[19]. Size is measured as the logarithm of total assets. Leverage is the total debt over total assets. Cash is the ratio of firm cash holding to the beginning of period total assets. Finally, to avoid the influence of outliers, all firm level variables are yearly winsorized at the 1% level on both sides of the sample distribution, and Q is capped at 10 following Gutiérrez and Philippon (2016). The value of Q is changed to missing if BV is negative, as it affects Q calculation.

A positive relationship between Q and investment (β_1) is expected according to Tobin's Q theory. The coefficient of CF (β_2) is expected to be positive in imperfect capital markets according to Fazzari et al. (1988). However, according to the theoretical model, positive coefficient can also refer to agency costs related to empire building behaviour of managers. Two interaction terms with the state vriable are used to test the hypotheses; $Q_{i,t-1} \times State_{i,t-1}$ and $CF_{it} \times State_{i,t-1}$. β_3 is predicted to be negative according to H2, while β_4 can be positive or negative in line with hypothesis H3.

4.7 Descriptive statistics

Panel A of Table 4.1 provides summary statistics for the overall sample of 120 listed firms (1440 observation). The mean (median) value for investment ratio (I) is 5% (2%). The cash flow (CF), the measure of internal resources has a mean (median) of 11% (9%). The measure of growth opportunities, Tobin (Q), has a mean of 1.45 and

[19] Larger firms might have more resources to invest and thus positive coefficient for size. However, negative coefficient is also possible if smaller firms are in expansion phase or large firm exhaust its expansion opportunities. Leverage is expected to have a negative sign. This is because highly leverage firm invest less because of debt overhang (Myers, 1977) or debt can play a role in reducing managerial discretion over free cash flow, limiting overinvestment bias (Jensen, 1986). Cash is used as a control because it may affect both investment and cash flow sensitivities, as firm may finance its investment from cash rather than cash flow (Moshirian et al., 2017).

median of 1.15. The average percentage of state ownership in the sample is 24% (state). Firm-year observations in which state ownership is greater than 5% constitute 55% of the sample (Dstate). The state owns more than 20% of firms' shares in 39% of sample observations (Dcont20) and control above 50% stake in 27% of sample observations (Dcot50). Privatizing and listing firms in stock exchange since 1990s have changed the ownership structure of firms (mainly decreasing state ownership). Privatized firms form 38% of the sample' observations (privatized). Majority (minority) privatized firms through public offering composes 15% (17%) of observations (Prig50 and PriL50). Correlations among variables are presented in Panel B of Table 4.1. It is shown that investment is positively correlated with Q, CF, size, sales, leverage and external finance (debt or equity). State ownership is negatively correlated with investment, leverage and issuance of external finance, while positively correlated with Q, CF, cash, and dividends as a percentage of total assets.

Summary statistics across state and non-state firms are reported in Panel A of Table 4.2. The sample is divided using a dummy variable (Dstate) which takes the value of one if firm has state ownership over 5% in any firm-year observations, and zero otherwise[20]. The average of state ownership in state firms' observations is 44.8%. The difference in mean value for variables between state and non-state firms is presented in the last column, where stars refer to significance of the t-test of the difference. Compared to private firms, firms with state ownership have lower mean values of investment (I), leverage (LEV) and issuance of external finance (Debt iss. and Equity iss.) ratios at 1% significance level, meanwhile having higher mean values of cash flow (CF), cash stock, dividend, sales and Q.

The lower investment for state firms beside negative correlation between investment and state ownership drive an early evidence for the effect of state ownership in regressions to come. The lower leverage of state firms is consistent with Omran (2004) who reports a significant decrease in leverage for state firms after privatization. One can argue that private firms are more leveraged due to the phenomenon of crony capitalism in Egypt especially during 2003-2011, in which politically connected private firms have a disproportionate amount of debt from banks (Diwan et al., 2018). They can also be more leveraged due to easier access to international markets, as Cortina et al. (2018) observe that Arab firms issuer of loans or bonds tend to be more leveraged and mostly funded from international markets.

[20] In other words, non-state section presents purely private firms where state ownership is zero, while state section presents firms with state ownership at any percentages above 5%.

Table 4.1 Summary statistics and correlation matrix

Panel (A): Summary statistics of the full sample

	Count	Mean	std	Med	Min	Max
I	1389	0.05	0.08	0.02	0.00	0.82
Q	1355	1.45	1.01	1.15	0.32	10.00
CF	1301	0.11	0.12	0.09	-0.67	0.91
Size	1407	13.71	1.65	13.61	9.43	18.11
LEV	1398	0.16	0.20	0.08	0.00	2.49
Cash	1394	0.18	0.25	0.12	0.00	4.58
Div	1384	0.05	0.07	0.02	0.00	0.66
sales	1392	0.84	0.81	0.65	0.00	6.83
Debt iss.	1376	0.02	0.16	0.00	-1.98	2.85
Equity iss.	1321	0.02	0.15	0.00	0.00	2.43
State	1397	0.24	0.30	0.10	0.00	0.97
Dstate	1397	0.55	0.50	1.00	0.00	1.00
Dcont20	1397	0.39	0.49	0.00	0.00	1.00
Dcont50	1397	0.27	0.45	0.00	0.00	1.00
privatized	1440	0.38	0.49	0.00	0.00	1.00
fullP	1440	0.07	0.25	0.00	0.00	1.00
Prig50	1440	0.15	0.36	0.00	0.00	1.00
PriL50	1440	0.17	0.37	0.00	0.00	1.00

Panel (B): Correlation matrix

	State	I	Q	CF	Size	LEV	cash	Div	sales	Debt iss.	Equ iss.
State	1										
I	-0.0925***	1									
Q	0.169***	0.0656**	1								
CF	0.192***	0.202***	0.356***	1							
Size	0.0447	0.101***	-0.0971***	0.0601**	1						
LEV	-0.322***	0.160***	-0.141***	-0.242***	0.270***	1					
Cash	0.218***	-0.0160	0.218***	0.424***	-0.0708**	-0.312***	1				
Div	0.275***	0.0114	0.314***	0.626***	0.0353	-0.290***	0.328***	1			
sales	0.00308	0.0862***	0.0474	0.268***	-0.199***	0.00349	0.117***	0.211***	1		
Debt iss.	-0.104***	0.201***	-0.0589**	0.0290	0.121***	0.341***	-0.00190	0.0690**	0.135***	1	
Equity iss.	-0.0479*	0.131***	0.0805***	0.0713**	-0.0449	-0.0329	0.465***	-0.0586**	-0.0201	-0.0206	1

This table reports summary statistics of full sample in panel (A) whereas correlation between variables in panel (B). I is firm investment. Q is Tobin Q measure for growth opportunities. CF is the cash flow of the firm. logTA is firm size (the log of total assets). LEV is leverage. Div is dividends. Debt iss. (Equity iss.) refers to issuance of debt (equity). State is a continuous variable for the percentage of state ownership. Variables are defined in details in Table C.1 in the appendix. Dstate is a dummy which takes the value of one if the firm has government ownership over 5% in any firm-year observation and zero otherwise. Dcont20 and Dcont50 are dummy variables for government controls at threshold of 20% and 50% for any firm-year observation. Privatized is adummy for privatized firms, where fullP, Prig50 and PriL50 present full privatization, majority (> 50%) and minority (< 50%) privatization, respectively.

Table 4.2 Summary statistics across subsamples

Panel (A): Descriptive statistics between state and non state firms

	Non-state						State						
	Obs.	Mean	sd	Median	Min	Max	Obs.	Mean	sd	Median	Min	Max	mean diff.
state	634	0.000	0.00	0.00	0.00	0.05	763	0.448	0.28	0.50	0.05	0.97	
I	622	0.061	0.09	0.03	0.00	0.82	754	0.038	0.07	0.01	0.00	0.70	0.023***
Q	609	1.397	0.92	1.14	0.43	10.00	739	1.498	1.09	1.15	0.32	10.00	-0.100*
CF	618	0.096	0.11	0.07	-0.25	0.67	671	0.116	0.13	0.10	-0.67	0.80	-0.020***
Size	628	13.820	1.98	13.66	9.54	18.11	761	13.607	1.31	13.56	9.43	17.77	0.213**
LEV	624	0.209	0.18	0.19	0.00	0.93	757	0.115	0.20	0.03	0.00	2.49	0.094***
Cash	623	0.160	0.28	0.09	0.00	4.58	758	0.204	0.21	0.15	0.00	2.87	-0.044***
Div	624	0.034	0.06	0.00	0.00	0.37	747	0.064	0.07	0.05	0.00	0.66	-0.031***
sales	624	0.781	0.64	0.65	0.00	4.48	756	0.884	0.93	0.64	0.00	6.83	-0.103**
Debt iss.	616	0.040	0.19	0.00	-0.75	2.85	748	0.004	0.12	0.00	-1.98	1.04	0.035***
Equity iss.	587	0.037	0.18	0.00	0.00	2.34	722	0.014	0.12	0.00	0.00	2.43	0.023***

Panel (B): Distribution of firms and state ownership across industries

Industry	Obs.	Percent	Firms	State ownership	State		Non-state	
				mean	obs.	%	obs.	%
Basic Materials	156	10.83	13	0.42	48	14.15	108	7.57
Consumer Goods	420	29.17	35	0.22	163	31.45	240	25.71
Consumer Services	120	8.33	10	0.22	52	8.13	62	8.2
Real estate	168	11.67	14	0.19	89	8.78	67	14.04
Health Care	84	5.83	7	0.35	36	6.29	48	5.68
Industrials	384	26.67	32	0.19	191	25.03	191	30.13
Oil & Gas	36	2.5	3	0.37	13	3.01	23	2.05
Technology	24	1.67	2	0.37	12	1.57	12	1.89
Telecommunications	48	3.33	4	0.23	30	1.57	12	4.73
Total	1,440	100	120	0.24	634	100	763	100

Panel A of the table presents summary statistics of variables between state and non-state firms. The sample is divided using a dummy variable (Dstate) which takes the value of one if firm has state ownership above 5% in any firm-year observations, and zero otherwise. Non-state section presents wholly private firms where state ownership is zero, while State section presents firms in which state has ownership at any percentages above 5%. The last column refer to the t-test of the difference in mean values of sample variables where figures refer to the mean difference and stars show significance level of the test. * $p < 0.1$, ** $p < .05$, *** $p < 0.01$. Panel b presents the distribution of sample' firms and its state ownership across industries. Industries are categorized following the main source of data: Datastream.

Distribution of firms across industries is presented in panel B of Table 4.2. State ownership is concentrated more in Basic materials, Oil& Gas, Technology and Health care industries with higher mean of state ownership at 42%, 37%, 37% and 35%, respectively. This is consistent with the history of the state intervention in investment policy where government continues to protect against market entrance in some sectors due to its strategic importance. Comparing between state and non-state firms, state's higher stake in basic materials (14.15%) and oil &gas (3%) industries is confirmed. The higher stake in consumer goods industry at 31.45% is mainly due to the state existence in the flour milling sector which deals with a strategic commodity used in the production of subsidized bread. For example, Upper Egypt flour mill and Middle and West delta flour mills are majority privatized firms through IPO, however, government still the largest single owner of these firms where the holding company (27%) and public investment funds own almost 39% of shares together.

4.8 Empirical results

4.8.1 State ownership and level of investment

For an early investigation of the effect of state ownership on investment, the direct effect of state ownership on the level of investment is examined, which is H1. It is argued that state ownership can lead to either overinvestment or underinvestment relative to the optimal level, due to the accompanied non-economic objectives, agency costs or/and financial constraints. Therefore, the study runs investment regressions of the empirical specification but without the interaction terms, and using alternative variables representing state ownership.

Table 4.3 presents OLS estimation results, including year and industry fixed effects. The study does not include firm fixed effect in this table to take into account the less variability of state ownership through time in the sample period. Furthermore, it controls for other firm characteristics that could affect the investment levels such as leverage, firm size and corporate liquidity (cash) as specified in the empirical specification. The study also controls for dividends payments (Div) because state firms are highly dividend paying firms (see Tables 4.1 and 4.2), and separating the effect of the state from its dividend policy is valuable[21]. Results shown in columns (1-5) are without controlling for other firm level characteristics, while columns (6-10) are with controls. *state* variable in row (3) is a continuous variable representing the

[21] Firms provide high payout to keep investors activity in the stock market, as investors in emerging Arab markets prefer to receive periodic income. Moreover, high payout can provide signal to the market that a firm is in good condition.

percentage of state ownership, while other variables are dummy variables. *Dstate* is a dummy for firm-year observation in which state ownership is greater than 5%. *Dcont*20 and *Dcont*50 present state control variables, where state ownership is above 20% and 50% respectively. *Dcont*50 is created following Claessens et al. (2000) who assume that larger owner who controls more than 50% of votes is classified as the single ultimate controller. Choosing 20% as threshold for control is in line with earlier studies that suggest that 20% ownership can be sufficient for effective control (Faccio and Lang, 2007; La Porta et al., 1999). Finally, *DstateL* is a dummy if the state is the largest shareholder in any firm-year observations following Lin and Bo (2012).

The negative effect of state ownership on the level of investment is confirmed across alternative definitions of state ownership. The coefficients of the continuous and dummy variables are significant at 5% or 1%. Except when the government controls more than 50% of shares, *Dcont*50 becomes insignificant when controlling for other firm characteristics (column 9). Results show that an 1% increase in state ownership lowers investment by -0.04% (column 1). Being a firm with at least 5% ownership leads to a decrease in investment ratio by -0.025% compared to firms without state ownership (column 2). In economic terms, given mean levels of state ownership and investment at 24.5% and 5% respectively, a 10% increase in state ownership leads to an approximately 2% decrease in investment ratio (10×-0.039×0.245 /0.05).

It is worth noting that for different levels of state ownership, the negative effect on investment starts to be significant for levels of ownership above 20%. This is proven by running regression with dummies at different cut off of state ownership compared to private sector with less than or equals 5% ownership (see Table C.2 in the appendix). This is expected since the definition of state ownership includes any types of government owned or controlled entities, including financial entities. In other word, if a private firm has ownership by public financial institutions (such as public banks, insurance companies or investment fund) up to 20%, it might still behave as a private firm would.

These findings support the underinvestment behaviour for state firms for hypothesis H1. Government ownership using alternative definitions leads to underinvestment compared to the optimal level and to private firms. This result does not support the overinvestment behaviour for the state which is more common in the literature for emerging market such as China (Firth et al., 2012). It is also consistent with Omran (2004) who finds that capital expenditure increased after privatization (mainly for majority IPO) in Egypt, referring to the role of private entrepreneur in increasing investment. Nevertheless, at this point, it is not clear yet whether underinvestment accompanied state ownership is related to agency cost or financial constraints.

Table 4.3 Direct effect of state ownership

	(1) I	(2) I	(3) I	(4) I	(5) I	(6) I	(7) I	(8) I	(9) I	(10) I
Q_{t-1}	0.00676	0.00571	0.00592	0.00604	0.00572	0.00873*	0.00788*	0.00808*	0.00828*	0.00793*
	(0.00440)	(0.00434)	(0.00434)	(0.00441)	(0.00431)	(0.00458)	(0.00448)	(0.00453)	(0.00461)	(0.00451)
CF_t	0.0976**	0.0961**	0.101**	0.0908**	0.0946**	0.165***	0.164***	0.167***	0.164***	0.165***
	(0.0400)	(0.0389)	(0.0397)	(0.0398)	(0.0394)	(0.0461)	(0.0469)	(0.0463)	(0.0461)	(0.0459)
$state_{t-1}$	-0.0396***					-0.0303**				
	(0.0146)					(0.0146)				
$Dstate_{t-1}$		-0.0252***					-0.0191**			
		(0.00775)					(0.00785)			
$Dcont20_{t-1}$			-0.0244***					-0.0182**		
			(0.00813)					(0.00793)		
$Dcont50_{t-1}$				-0.0191**					-0.0130	
				(0.00856)					(0.00812)	
$DstateL_{t-1}$					-0.0221***					-0.0161**
					(0.00820)					(0.00800)
$size_{t-1}$						0.00365	0.00330	0.00353	0.00331	0.00298
						(0.00224)	(0.00226)	(0.00225)	(0.00223)	(0.00227)
LEV_{t-1}						0.0241	0.0227	0.0252	0.0334	0.0291
						(0.0278)	(0.0278)	(0.0276)	(0.0269)	(0.0272)
$Cash_{t-1}$						0.0132	0.00939	0.0125	0.0135	0.0140
						(0.0179)	(0.0182)	(0.0177)	(0.0177)	(0.0177)
Div_{t-1}						-0.204***	-0.198**	-0.201***	-0.209***	-0.208***
						(0.0760)	(0.0764)	(0.0757)	(0.0774)	(0.0767)
Constant	0.0463**	0.0505**	0.0460**	0.0409**	0.0454**	-0.0120	-0.00273	-0.0107	-0.0146	-0.00517
	(0.0198)	(0.0197)	(0.0197)	(0.0193)	(0.0197)	(0.0345)	(0.0367)	(0.0347)	(0.0340)	(0.0361)
Observations	1157	1157	1157	1157	1157	1137	1137	1137	1137	1137
Adjusted R^2	0.118	0.123	0.119	0.108	0.115	0.144	0.146	0.144	0.138	0.142

OLS regression of the empirical specification without interaction terms are presented in this table with year and industry fixed effects. I is firm investment as the dependent variable. Q is Tobin Q measure for growth opportunities. CF is the cash flow of the firm. State is a continuous variable for the percentage of state ownership. Variables are defined in details in Table C.1. Dstate is a dummy which takes the value of one if the firm has government ownership over 5% in any firm-year observation and zero otherwise. Dcont20 and Dcont50 are dummy variables for government controls at threshold of 20% and 50% for any firm-year observation. Finally, DstateL is a dummy if the state is the largest shareholder for any firm-year observation. Robust standard errors clustered at firm level are in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.8.2 State ownership and investment efficiency

It is argued that state ownership does not only affect the level of investment, but also impacts the sensitivity of investment to Q and CF. The latter effects are represented by the two interaction terms of the empirical specification in equation (4.4). These interactions provide insight about the state influence on a firm investment efficiency and financial constraints. To check the state effect on investment sensitivities, firm and year fixed effects regressions are run for the empirical specification.

Regression results are reported in Table 4.4. Column (1) displays the default investment regression, while column (2) introduces the state (continuous) variable and its interactions with Q and CF, which are found to be negative. Column (3) controls for other firm characteristics, as indicated in the empirical specification. Further controls are added to check coefficients stability as follows. Column (4) adds extra controls for different industry effects across years (industry × year dummies). Columns (5) controls for dividends payments to take into account the effect that dividend policy might have on investment[22]. Column (6) adds a squared value of CF to the regression to control for any non-monotonic relationship between investment and cash flow, if any, as argued by Cleary et al. (2005)[23]. The last Column adds interactions of state ownership with the main control variables. Results for columns (2-7) show that investment opportunities are positively and significantly associated with investment for non-state firms which is consistent with the main prediction of Tobin's Q theory (first row). Similarly, CF is significantly and positively related to investment (second row), which is expected because of market imperfection due to asymmetric information or agency costs. Paying dividends affects negatively investment level, which is reflected in the significant coefficient for Div. The coefficients for state interaction with Q and CF are negative and highly significant at 1%. The comparison between the first two columns reveals an interesting observation that state ownership drags down the effect of Q and CF in explaining investment behaviour which might have led some papers to discard using Tobin's Q in explaining investment behaviour. This emphasizes the importance of exploring state's role while explaining firms' investment behaviour in the Egyptian market.

[22]Dividend payments variable is also added as it can proxy for firm's financial constraints because a firm pays low dividends if it is financially constrained (Fazzari et al., 1988). Despite using the investment sensitivity to cash flow as a measure of financial constraints, it might be useful to control for this variable which is related to financial constraints. This control is also useful to check if result changes when controlling for this variable, which is used in Table 4.3 while exploring the direct effect of state ownership without firm fixed effect.

[23]Cleary et al. (2005) argue that the relation between investment and internal fund is U-shaped, challenging the conventional view of positive relation between investment and internal fund everywhere.

The negative coefficient for the interaction of $Q \times state$ is consistent with hypothesis H2 that state ownership curtails investment sensitivity to Q, which proxies for investment efficiency. This interaction is economically meaningful. Using column (3) for interpreting the results, the investment-Q sensitivity evaluated at the mean level of state ownership (44.8%) is 0.00155, which is 90% below the coefficient for firms without state ownership[24]. For non-state firms, one standard deviation change in Q (0.915) leads to 16.7% standard deviation change in investment[25], while leads to only 2.6%[26] standard deviation change in investment at the mean level of state ownership. The association between state ownership and investment inefficiency is consistent with empirical work for other countries[27]. Moreover, investment of firms with state ownership is less sensitive to cash flow compared to private firms. This is confirmed by the negative and significant coefficient for CF×state at 1%. Investment-cash flow sensitivity (ICFS) evaluated at the mean level of state ownership is 0.0275, which is 85% lower than its sensitivity for private firms[28].

Investment efficiency can be distorted by agency costs or information asymmetry. To explore the channels of distortion, it is important to check CF×state coefficient. The negative coefficient of CF×state excludes the empire building hypothesis and thus overinvestment argument of agency costs (mainly the free cash flow theory) which requires higher ICFS sensitivity for state owned firms. This is consistent with results in Table 4.3. The negative coefficient CF×state can refer to lower financial constraints. Lower financial constraints associated with state ownership excludes the interpretation of underinvestment in Table 4.3 as a result of financial constraints. Therefore, one can argue that underinvestment phenomenon for firms with state ownership is explained more by agency costs. The weak incentives schemes associated with state controlled firms can be linked to Aggarwal and Samwick (2006) model of managers private costs and the quiet life hypothesis of Bertrand and Mullainathan (2003). Managers are reluctant to invest because they face private costs and are more inclined to shirk as they are mainly public employees who bear the costs and do not enjoy the benefits. Moreover, because of weak monitoring or poor corporate governance associated with state ownership and less exposure of managers to market pressures (due to protection from the government in form of subsidies, barriers against competitions or managerial posts held by political nominee), managers are reluctant to spend effort in screening investment opportunities and take the risk of new investment. The latter can be

[24] 0.0158-(0.0318×0.448)= 0.00155

[25] (0.0158×0.915 /0.086)×100 = 16.8%

[26] (0.00155×1.085 /0.065)×100 = 2.6%

[27] Chen et al. (2017), Jaslowitzer et al. (2018), Chen et al. (2011) and O'Toole et al. (2016).

[28] 0.187- (0.356×0.448)= 0.0275

Table 4.4 State and investment sensitivities

	(1) I	(2) I	(3) I	(4) I	(5) I	(6) I	(7) I
Q_{t-1}	0.00813*	0.0175**	0.0158**	0.0156**	0.0164**	0.0159**	0.0134**
	(0.00442)	(0.00735)	(0.00731)	(0.00766)	(0.00740)	(0.00733)	(0.00669)
CF_t	0.107**	0.205***	0.187**	0.180**	0.208***	0.154**	0.165**
	(0.0460)	(0.0719)	(0.0727)	(0.0730)	(0.0767)	(0.0663)	(0.0730)
$Q_{t-1} \times state_{t-1}$		-0.0332***	-0.0318***	-0.0308**	-0.0319***	-0.0316**	-0.0213**
		(0.0119)	(0.0121)	(0.0123)	(0.0120)	(0.0123)	(0.00940)
$CF_t \times state_{t-1}$		-0.363***	-0.356***	-0.367***	-0.365***	-0.366***	-0.317**
		(0.126)	(0.134)	(0.136)	(0.134)	(0.138)	(0.134)
$state_{t-1}$		0.0222	0.0251	0.0291	0.0203	0.0200	-1.165**
		(0.0441)	(0.0507)	(0.0681)	(0.0486)	(0.0532)	(0.518)
$size_{t-1}$			-0.00967	-0.00705	-0.00789	-0.00882	-0.0245**
			(0.0128)	(0.0135)	(0.0130)	(0.0128)	(0.0111)
LEV_{t-1}			-0.0372	-0.0485	-0.0436	-0.0376	-0.0618
			(0.0391)	(0.0412)	(0.0394)	(0.0395)	(0.0491)
$Cash_{t-1}$			0.0176	0.0230	0.0186	0.0173	0.0150
			(0.0160)	(0.0161)	(0.0162)	(0.0154)	(0.0168)
Div_{t-1}					-0.135*		
					(0.0689)		
CF^2						0.108	
						(0.101)	
$size_{t-1} \times state_{t-1}$							0.0880**
							(0.0395)
$LEV_{t-1} \times state_{t-1}$							0.0568
							(0.116)
$Cash_{t-1} \times state_{t-1}$							-0.0659
							(0.0765)
$Constant$	0.0270***	0.0236	0.159	0.0786	0.142	0.150	0.364**
	(0.0102)	(0.0154)	(0.175)	(0.246)	(0.176)	(0.174)	(0.148)
Observations	1248	1157	1146	1146	1137	1146	1146
Adjusted R^2	0.067	0.114	0.117	0.122	0.124	0.118	0.144
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
inds × year	No	No	No	Yes	No	No	No

This table presents firm and year fixed effects regressions of the empirical specification. State is a continuous variable for the percentage of state ownership. Other main variables are defined in details in Table C.1 in the appendix. Robust standard errors clustered at firm level are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

related to the argument of John and Knyazeva (2006) for underinvestment due to risk aversion. On the other hand, Egyptian firms with high state ownership are usually old and large firms with large employment size, where some of them sell strategic products with social considerations. Therefore, the state as a controlling holder might adopt conservative investment behaviour (forgo projects that would be value enhancing/profitable to shareholders) to purse its social objectives and to keep its extracted rents such as tax concessions, energy subsidies or even high dividend payout. This view is in line with Fogel et al. (2008) and Boubakri et al. (2013).

The reduced financial constraints, implied by the negative coefficient of CF×state, suggests the existence of soft budget constraints (SBC), which offers an answer to H3. A firm facing SBC can enjoy different kinds of external support such as implicit or explicit government guarantee, tax discounts and preferential access to finance; hence its investment will be less or insensitive to cash flow[29]. This means that privatizing or listing SOE firms does not help that much in hardening the soft budget constraints in Egypt. This is possible given its long history of favouring the public at the cost of private sector, socialist economic legacy, long term relationship with state owned banks, as well as the state reluctance to leave control after IPO privatization especially in strategic sectors. This implies that firms with controlling state ownership are of strategic importance, so they still enjoy SBC. The role of state ownership in reducing firm financial constraints is consistent with Dang et al. (2018) for Egypt. Despite interpreting the negative coefficient of CF×state as reduced financial constraints, the interpretation would be more valid if a firm depends on external finance, which is tackled in the next section.

The coefficient of the state itself is negative but insignificant. The overall sign of this coefficient is computed after taking the interaction term into account. For an average level of Q at 1.497 (for firms with state ownership above 5%), the effect of the state is negative at -0.0275 [30], which is in line with results in Table 4.3. The insignificant coefficient of state implies that the effect of state works mainly through its effect on the sensitivity of investment to Q and CF.

To check the robustness of the result to alternative state control measures, Dcont20 and Dcont50 which are dummies for state control with state ownership above 20% and 50% respectively, are used instead of the state continuous variable. The estimates in Table 4.5 confirm previous results. Columns (3-4) include firm control variables as in Table 4.4, whereas columns (1-2) are for regressions without controls. Finding in this table confirms positive and significant coefficients for Q and CF for non-state firms, and the negative and significant coefficients for the interaction of dummies with Q and CF. However, the coefficient for $CF \times Dcont50$ is marginally significant at 10%.

It worth noting that coefficients of the interactions are higher than their basis effect coefficients. For example, in column (3), the investment-Q sensitivity for state controlled firms (above 20% of ownership) is -0.0041 (0.0139-0.0180), while the investment cash flow sensitivity is -0.039 (0.180-0.219). The negative coefficient for Q is hard to be explained by either Q-theory or Baker et al. (2003)'s mis-pricing argument (Lewellen and Lewellen, 2016). Instead, two possible explanation; managerial and

[29]See for example; Hoshi et al. (1991), Lizal and Svejnar (2002), Poncet et al. (2010) and Guariglia et al. (2011).

[30]0.0222-0.0332×1.497 = -0.0275

Table 4.5 State and investment sensitivities and alternative state controls

	(1) I	(2) I	(3) I	(4) I
Q_{t-1}	0.0160**	0.0141**	0.0139*	0.0140**
	(0.00761)	(0.00659)	(0.00746)	(0.00628)
CF_t	0.197***	0.154**	0.180**	0.150***
	(0.0742)	(0.0623)	(0.0752)	(0.0569)
$Q_{t-1} \times Dcont20_{t-1}$	-0.0194**		-0.0180**	
	(0.00846)		(0.00846)	
$CF_t \times Dcont20_{t-1}$	-0.220**		-0.219**	
	(0.0950)		(0.100)	
$Dcont20_{t-1}$	0.0316*		0.0271	
	(0.0177)		(0.0177)	
$Q_{t-1} \times Dcont50_{t-1}$		-0.0237***		-0.0226***
		(0.00875)		(0.00777)
$CF_t \times Dcont50_{t-1}$		-0.183*		-0.142*
		(0.0957)		(0.0773)
$Dcont50_{t-1}$		0.0354		0.0341**
		(0.0256)		(0.0153)
Constant	0.0183	0.0215	0.196	-0.0280
	(0.0143)	(0.0131)	(0.177)	(0.0314)
Observations	1157	1157	1146	1146
Adjusted R^2	0.102	0.096	0.106	0.101
Controls variables	No	No	Yes	Yes

Regressions include firm and year fixed effects. Dcont20 and Dcont50 are dummy variables for government controls at threshold of 20% and 50% for any firm-year observation. Robust standard errors clustered at firm level are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

political can be drawn from agency cost theory. From a managerial view, a weakly governed manager will be reluctant to increase investment after a temporary increase in industry growth opportunities, while they lower long term growth of investment after a decline in industry investment opportunities even after recovery of growth opportunities. This is known as manager conservatism argued by John and Knyazeva (2006). From a political view, government may miss investment opportunities or become unwilling to respond to diminishing investment opportunities due to conflicts between efficiency and government objectives.

The negative ICFS for state controlled firms can imply either availability of external resources than cash flow that can finance investment, or disinvestment despite the availability of cash flow. The former can be explained by the SBC. Lizal and Svejnar (2002) interpret the negative ICFS as strong form of SBC when poor performing firms can get access to banks and thus invest more compared to profitable firms[31]. Related to soft budget constraints, is the availability of other resources such as trade credit or access to internal capital market between pyramids chains, given that the public

[31] They interpret zero coefficient as weak form of soft budget constraints where firms have an access to bank credit irrespective of their profitability.

sector in Egypt is mainly structured as holding and affiliated companies. On the other hand, disinvestment can be explained by deliberate choice taken by the firm not to invest due to socio-political preference or other policies such as dividend policy.

To sum up, findings either using continuous or dummy state variables show that state ownership leads to lower investment-Q and investment-CF sensitivities, and thus reduced investment efficiency and financial constraints. Channels of investment inefficiency are mainly agency costs and SBC. Despite enjoying SBC (or reduced capital constraints), firms with state ownership adopt conservative investment choices. This is owing to high agency costs; managers on the one hand are reluctant to invest due to incurring private costs, and the state as a controlling shareholder (at the cost of minority holders) is pursing social objectives keeping its extracted rent on the other.

4.8.3 State ownership and financial constraints

In order to develop a better understanding of the relation between state ownership and investment cash flow sensitivity and to ensure that SBC are effective in reducing firm financial constraints, it is important to distinguish firms a priori according to the presence of financial constraints. By splitting the sample on the basis of ex-ante financial constraints, it is expected that SBC will reduce the constraints for the constrained more than unconstrained firms. Accordingly, the coefficient for $state \times CF$ should be negatively larger in the constrained than unconstrained group. This distinction is also important because positive ICFS in the theoretical model came from the intuition that internal resources determine the need of external finance. Therefore, the coefficient of $state \times CF$ should keep the negative sign especially if firm depends on external finance (or for financially constrained firms).

Well-known measures of financial constraints in the literature are employed to divide the sample: size measured as sales and/or logarithm of total assets, dividend payout ratio (POR), and Whited and Wu (WW) (2006) and Kaplan-Zingales (KZ)(Lamont et al., 2001) indexes[32]. For all proxies, the firm is considered to be financially

[32] Using KZ index for other samples is adapted by Lamont et al. (2001). They estimate an ordered logit model using Kaplan and Zingales (1997)' classification and relate the degree of financial constraints to five accounting variables. Accordingly, the KZ index is calculated as

$$KZ_{it} = -1.002\frac{CF_{it}}{A_{i,t-1}} - 39.368\frac{DIV_{it}}{A_{i,t-1}} - 1.315\frac{Cash_{it}}{A_{i,t-1}} + 3.139LEV_{it} + 0.283Q_{it}$$

Where CF_{it} is cash flow measured as net income plus depreciation and amortization, $A_{i,t-1}$ is lagged total assets, DIV_{it} is dividends, $Cash_{it}$ is cash stock, LEV_{it} is the leverage measured as total debt over total assets and Q_{it} is proxy for Tobin Q, measured as book value of total assets plus market value of equity minus the book value of equity scaled by book value of total assets.

WW index is based on coefficients obtained from structural model (Whited and Wu, 2006). It is calculated as:

$$WW_{it} = -0.091\frac{CF_{it}}{A_{i,t-1}} - 0.062DIVPOS_{it} + 0.021LTD_{it} - 0.044LNTA_{it} + 0.102ISG_{it} - 0.035SG_{it}$$

constrained (unconstrained) if its proxy value is above (below) the yearly median for all firms belonging to the same industry[33]. Firms are ranked on an annual basis to allow the firm to change its status over the sample period[34]. In addition to financial constraints proxies, a measure of firm's dependence on external finance is used following Rauh (2006) and Jaslowitzer et al. (2018). A firm is deemed to be highly dependent on external finance if the fraction of years in which its capital expenditure (CAPEX) above cash flow (CF) is greater than 30% while CAPEX and CF are positive.

Table 4.6 presents investment regression results for sub-samples based on ex-ante financial constraints (calculated at the end of the previous year). Odd (even) columns refer to constrained (unconstrained) firms for each proxy. Specifically, constrained categories are small firms, low POR, or high values of KZ and WW indexes. Column 11 (12) refers to high (low) firm's dependence on external finance. The negative coefficient of $state \times CF$ is confirmed in Table 4.6 across sub-samples in most of the cases. This is consistent with the argument of SBC, where the existence of state ownership reduces the capital constraints a firm is facing. However, the effective role of SBC in reducing financial constraints for constrained firms is only present using conventional measures of financial constraints such as size and POR (columns 1, 3 &5)[35] and for the measure of external dependence (column 11), where the negative coefficient of $state \times CF$ is larger and significant for constrained firms than unconstrained firms. The opposite case is for the synthetic KZ and WW indexes, where the negative coefficient is larger and significant for the unconstrained (columns 8 &10) rather than constrained firms.

One possible explanation for these mixed results is related to the technical issues associated with sorting on different measures of financial constraints. It is still debatable in the literature whether known proxies for financial constrains are actually measuring financial constraints, and what is the best proxy for financial constraints. Some papers criticize using KZ and WW indexes as measures of financial constraints. Fazzari et al. (2000) criticize Kaplan and Zingales (1997) for using low cash and high leverage as a measure of financial constraints. They argue that firms may have low leverage, because they are not able to get funds, thereby they are actually facing financial constraints. Hadlock and Pierce (2010) cast serious doubt on the validity of the KZ index as a measure of financial constraints, while showing mixed evidences for the WW index. In contrast to KZ, they find that firms hold more cash for precautionary savings and thus they are more likely to be constrained. They do

Where CF_{it} is cash flow, $DIVPOS_{it}$ is a dummy for dividend payment, LTD_{it} is long-term debt to total assets, $LNTA_{it}$ is the logarithm of total assets, ISG_{it} is industry sales growth and SG_{it} is firm's sales growth.

[33]Following Guariglia and Yang (2016).

[34]Following, for example, Moshirian et al. (2017) and Jaslowitzer et al. (2018).

[35]except for size measured by total asset, it is larger but insignificant.

not recommend using KZ and WW, given the endogenous nature of cash flow and particularly leverage, and encourage a more conservative approach that uses only firm size and age as measures of financial constraints. Hennessy and Whited (2007) argue that WW and KZ indexes are not good proxies for the cost of external fund, while small size is a good proxy for high cost of external fund. One can further add the concerns about using the KZ and WW indexes' parameters across different samples and time periods, especially for emerging markets. For example, in Egypt, state firms are holding more cash, but this is mainly due to the prevalence use of cash in economic transactions. Therefore, high cash stocks in this case may neither be a good indicator for financial health nor precautionary saving to smooth investment.

Nevertheless, if findings of these synthesized measures of financial constraints are accepted cautiously, given their common use in literature, interesting insights can be drawn from it. It can be argued that the existence of SBC does not necessarily mean that firms are heavily relying on bank channel, through political connections to state banks, to reduce financial constraints nor it is extended to the form of bailing out by banks in case of financial distress. SBC can work through other forms such as trade credit, tax concession, regulatory protection, or implicit guarantee from the government to raise capital if a firm is struggling. Financially constrained firms according to the KZ and WW indexes are highly leveraged and less profitable firms, and the negative coefficient for $state \times CF$ (and thus SBC) accordingly may be weakened by the less dependence on the credit channel (columns 7 & 9) as a way of softening the constraints. It seems rational that banks are not treating all firms with state ownership the same way, banks tend to lend firms in good condition, given the increasing competition between private and public banks and regulations by the Central Bank of Egypt.

Regarding investment-Q sensitivity, the negative effect of the state on investment efficiency is likewise confirmed using sub-samples. The coefficient of $state \times Q$ is negative across sub-samples. It is large and significant for constrained categories (small firms, firms with low POR, firms with higher KZ and WW indexes and in high dependent firms on external finance) which are presented in odd columns, compared to unconstrained categories. This means that the existence of the state exaggerates the unresponsiveness of investment to Q especially for small and constrained firms. Investment inefficiency is likewise noted in unconstrained groups by the negative coefficient of $state \times Q$ across proxies, and it is significant in columns 2,8,10 & 12. This means that the firm is even unable to overcome the influence of the state when financial conditions are good.

Table 4.6 State ownership and financial constraints

	Size (sales)		size (logTA)		POR		KZ		WW		External dependence	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Q_{t-1}	0.0181*	0.00950	0.0195**	0.00922	0.0223**	-0.000585	0.0238**	0.0163*	0.0245**	0.000981	0.0189*	0.00812
	(0.00909)	(0.00882)	(0.00891)	(0.00911)	(0.00923)	(0.00306)	(0.0102)	(0.00879)	(0.0107)	(0.00564)	(0.00992)	(0.00708)
CF_t	0.221**	0.126	0.162**	0.233	0.237**	0.0163	0.0582	0.259**	0.0620	0.290**	0.255**	0.119
	(0.0996)	(0.0972)	(0.0728)	(0.144)	(0.0965)	(0.0490)	(0.0730)	(0.129)	(0.0580)	(0.126)	(0.124)	(0.0920)
$Q_{t-1} \times state_{t-1}$	-0.0421*	-0.0267**	-0.0284*	-0.0268	-0.0796***	-0.00809	-0.0657**	-0.0301**	-0.0291*	-0.0252***	-0.0653**	-0.0161*
	(0.0215)	(0.0113)	(0.0149)	(0.0164)	(0.0227)	(0.00494)	(0.0278)	(0.0122)	(0.0159)	(0.00854)	(0.0250)	(0.00859)
$CF_t \times state_{t-1}$	-0.616*	-0.253**	-0.433	-0.384**	-0.342*	-0.0821	-0.119	-0.475*	0.175	-0.497**	-0.551**	-0.215
	(0.314)	(0.113)	(0.272)	(0.172)	(0.181)	(0.114)	(0.142)	(0.255)	(0.163)	(0.217)	(0.210)	(0.141)
$state_{t-1}$	0.00693	0.0802	-0.0132	0.0811	0.0478	-0.00329	-0.0292	0.104	-0.0363	0.102	-0.0448	0.0284
	(0.0702)	(0.0732)	(0.0570)	(0.0897)	(0.0666)	(0.0388)	(0.0733)	(0.0853)	(0.0441)	(0.0810)	(0.111)	(0.0321)
$size_{t-1}$	-0.00227	-0.0314**	0.00206	-0.0414**	-0.00705	-0.0263*	-0.0200	-0.00667	-0.0230	-0.0498**	-0.0211	-0.0119
	(0.0173)	(0.0147)	(0.0205)	(0.0160)	(0.0163)	(0.0146)	(0.0123)	(0.0323)	(0.0154)	(0.0193)	(0.0270)	(0.00809)
LEV_{t-1}	-0.0663	0.0171	-0.0540	0.0714	-0.0970*	0.0602	-0.0798	0.0739	-0.0921	0.0642	-0.0947	-0.00533
	(0.0629)	(0.0542)	(0.0638)	(0.0507)	(0.0557)	(0.0499)	(0.0535)	(0.0636)	(0.0643)	(0.0553)	(0.0761)	(0.0314)
$Cash_{t-1}$	-0.0201	0.0353	0.0239	0.000454	0.0125	0.00981	0.102***	-0.0113	0.0279	-0.0120	0.0715**	0.00186
	(0.0290)	(0.0331)	(0.0158)	(0.0251)	(0.0184)	(0.0256)	(0.0369)	(0.0166)	(0.0207)	(0.0190)	(0.0308)	(0.0132)
$Constant$	0.0644	0.476**	0.00815	0.612***	0.150	0.389*	0.319*	0.0698	0.326*	0.743***	0.352	0.176
	(0.226)	(0.205)	(0.260)	(0.230)	(0.226)	(0.197)	(0.165)	(0.439)	(0.192)	(0.276)	(0.380)	(0.107)
Observations	596	548	589	557	582	554	533	576	500	558	432	711
Adjusted R^2	0.114	0.128	0.098	0.171	0.215	0.034	0.224	0.076	0.200	0.189	0.182	0.061

This table presents firm and year fixed effects investment regressions for sub-samples sorted on proxies of financial constraints measured at the end of the previous year, and a measure of external dependence. Sub-samples are divided using the proxies' yearly median for all firm belonging to the same industry. Odd (even) columns refer to constrained (unconstrained) firms for each proxy. Size is measured by firm sales and logarithm of total assets. POR is the payout ratio measured as dividend over net income. KZ and WW indexes are calculated following Lamont et al. (2001) and Whited and Wu (2006) respectively. External dependence is measured as the fraction of years in which its capital expenditure (CAPEX) above cash flow (CF) is greater than 30% while CAPEX and CF are positive following Rauh (2006). State is a continuous variable for the percentage of state ownership. Robust standard errors clustered at firm level are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

As for the base effect, the significance of Q across constrained firms (odd columns, first row) is consistent with the Baker et al. (2003) argument that the sensitivity of investment to price increases in the level of capital constraints faced by the firm[36]. It is also consistent with the O'Toole et al. (2016) observation that credit constrained enterprises should have a greater sensitivity of investment to fundamentals. These results might match Allini et al. (2018)'s study for Egypt, in which firms follow a revised pecking order theory behaviour, where equity is preferred to debt after internal resources, and that firms prefer equity to debt in case of financial deficit.

In this subsection, after dividing the sample a priori based on different proxies of financial constraints, evidences of SBC are still found. However, mixed results are shown regarding the effective role of SBC in reducing the constraints more for the constrained firms, where synthetic KZ and WW indexes are showing a different result. It is argued to be due to the criticism around using theses indexes as measures of financial constraints, and especially for an emerging market case, or it can refer to the effect of different channels of SBC where the credit channel is weakened.

4.8.4 State ownership, SBC and credit channel

Previous evidence of the existence of SBC and the mixed results across the constrained and unconstrained firms provide a motivation to examine a common mean in the literature of softening the budget constraints which is bank/credit channel. It is found, so far, that state ownership reduces financial constraints. However, if the softening the budget constraints is assumed to happen through a bank channel, it is expected to see a positive association between state ownership and the use of debt.

As discussed before in the literature review, evidences highlight that state firms can enjoy easier access to credit from state owned banks, which can be extended to an implicit guarantee of a bailout during financial distress e.g. (Faccio et al., 2006; Frydman et al., 2000; Khwaja and Mian, 2005; Kornai et al., 2003; Sapienza, 2004; Schaffer, 1998). This is due to political consideration of state owned banks that might affect their lending policies. Such evidence is common as well in the Egyptian case (OECD, 2013; Raballand et al., 2015; U.S. Department of State, 2014). Therefore, it is expected that state controlled firms will take advantage of government support and increase debt (Boubakri and Saffar, 2019; Firth et al., 2012), and that the disciplinary and monitoring role of banks will be compromised (Firth et al., 2008) in terms of scrutiny of firms' projects before lending and monitoring performance after lending. In

[36]Baker et al. (2003) attribute this result to the impact of mispricing, which drive equity dependent (constrained) firms to decrease their investment when stocks are undervalued and issue equity and invest at the first best level when prices increase easing financial constraints.

contrast, a firm can choose less debt to insulate itself from bank monitoring (Boubakri and Saffar, 2019; Lin et al., 2013).

To explore the debt financing channel of state firms, the study follows Boubakri and Saffar (2019) and Firth et al. (2012) and runs OLS regression for state ownership on bank debt and control for other factors that influence access to debt such as size, profitability, growth opportunities, tangibility and lagged leverage. It further controls for industry and year fixed effects. In the Egyptian market, bank loans are the main source of external debt finance due to an underdeveloped public (corporate) debt market. Therefore, it is assumed that debt is mainly from banks. Various variables for debt structure are applied such as debt issues to the beginning of year total assets, leverage (total debt to total assets) and short run debt (as percentage of total debt).

Regressions results are shown in Table 4.7. It is found that the state coefficient is negative and significant at 1% using different forms of debt, which indicates that firm reliance on debt is decreasing with the level of state ownership[37]. This implies that firms with state ownership do not have preferential access to banks than private firms. Result is consistent with descriptive statistics in which state firms have lower mean values of leverage and negative correlation with leverage. Therefore, softening the budget constraints through credit channel is weakened in the Egyptian market once firms are privatized and/or listed on the exchange. Nevertheless, this does not eliminate the idea of SBC given the positive relation between state ownership and long term debt as implied from the negative coefficient for short term debt (at -0.377) in column 3 [38]. This is because SBC may allow state owned firms to bypass the collateral requirements of bank loans and contract long term debt (Boubakri and Saffar, 2019).

The less reliance on debt for state controlled firms implies high agency costs in the form of principal-principal problems in which controlled state holders do not choose debt finance to avoid scrutiny and bank monitoring[39]. This argument is consistent with Lin et al. (2013) and Shleifer and Vishny (1997). The latter, for example, argue that large investors' expropriation of minority resources might led to a decline in external finance. Moreover, result might be consistent with Borisova et al. (2015) and Beuselinck et al. (2017) who exhibit a higher cost of debt associated with state equity ownership. On the other hand, result is inconsistent with previous literature for Egypt about easier access of state owned firms to bank credit. One can argue that previous literature mainly focuses on unlisted firms and uses data from much earlier periods. This finding might also reflect other phenomena in Egypt such as

[37]This is consistent with Firth et al. (2012).

[38]As total debt = short term debt + long term debt

[39]Principal-agent type of agency costs may be precluded because if it is dominant, shareholder would issue more debt to discipline managers' behaviour.

Table 4.7 State ownership and debt financing channel

	(1) Debt iss./TA	(2) LEV	(3) SRdebt
state	-0.0833***	-0.0298***	-0.377***
	(0.0215)	(0.0112)	(0.110)
LEV_{t-1}	-0.137***	0.790***	-0.174
	(0.0465)	(0.0362)	(0.133)
Q	0.00268	0.000543	-0.0277
	(0.00466)	(0.00226)	(0.0235)
size	0.0122***	0.00713***	-0.0672***
	(0.00450)	(0.00221)	(0.0231)
ROA	-0.262***	-0.207***	0.394
	(0.0718)	(0.0463)	(0.309)
$TANG$	-0.0111	0.0225	-0.0562
	(0.0277)	(0.0151)	(0.146)
Constant	-0.0000142	-0.0326	1.749***
	(0.0449)	(0.0260)	(0.299)
Observations	1008	1320	1011
Adjusted R^2	0.058	0.809	0.117

This table presents OLS regression for state ownership on various dependent variables representing debt in the form of ($Debt = \alpha_0 + \alpha_1 state + \alpha_2 LEV_{t-1} + \alpha_3 Q + \alpha_4 size + \alpha_5 ROA + \alpha_6 TANG +$Industry dummies +Year dummies $+\epsilon$). Debt iss./TA is the debt issues to the beginning of year total assets. Debt issues is calculated as the change in total debt. LEV is firm leverage measured as total debt to total assets. SRdebt is the short term debt as percentage of total debt. State is measured as percentage of state ownership. ROA is firm profitability measured as net income over total assets. TANG is firm tangibility calculated as PPE (Property, plant and equipment) over total assets. Robust standard errors clustered at firm level are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

crony capitalism, in which politically connected private firms have a disproportionate amount of debt from banks, especially during 2003-2011 (Diwan et al., 2018).

In sum, it is shown that firms with state ownership rely less on debt finance, and this is mainly to avoid monitoring given the high agency costs associated with state ownership. This result is consistent with earlier analysis of underinvestment of state controlled firms due to agency costs. It further provides a supporting explanation for the mixed results across constrained and unconstrained firms in Table 4.6 that the role of the state in reducing financial constraints is weakened by the less dependence on credit channel. It might indicate that SBC in Egypt work through other forms such as trade credit, tax concession, regulatory protection, or implicit guarantee from government to raise capital if firm is struggling. It adds further evidence for investment inefficiency that the agency costs associated with state ownership make the firm reluctant to issue debt, forgiving positive NPV projects due to other socio-political considerations.

4.8.5 State ownership across strategic and non-strategic sectors

To test the last hypothesis H4 of whether investment efficiency for state ownership differs between the strategic and non-strategic sectors, the investment regression of the empirical specification is run for two sub-samples (strategic and non-strategic sectors). Strategic sectors are defined as fixed line telecommunication, oil and gas, and basic materials (chemicals and metal) sectors while the rest are considered as non-strategic[40]. Results in Table 4.8 show that the negative coefficient for $Q_{t-1} \times state_{t-1}$ and $CF_t \times state_{t-1}$ is higher for the strategic than non-strategic sectors. This means that investment efficiency accompanied with state ownership is lower in strategic sectors. Indeed, the investment-Q sensitivity evaluated at the mean level of state ownership in the strategic sector is 71% below the coefficient for firms without state ownership, whereas it is 42.8% below the coefficient for firms without state ownership in non-strategic sector [41]. Evidence of SBC is higher in strategic sectors as indicated by lower investment cash flow sensitivity. Investment-CF sensitivity evaluated at the mean level of state ownership in the strategic sector is 91% below the coefficient for firms without state ownership, whereas it is 33% below the coefficient for private firms in non-strategic sector. This result supports hypothesis H4, and it is expected given that firms with state ownership in strategic sectors are more likely to have political and social objectives than non-strategic ones, and to enjoy preferential treatment regarding regulations, government guarantees, and contracts. It is likewise consistence with previous evidences on the reluctance of the government to leave control in strategic industries (Boubakri et al., 2008; Omran, 2009).

For the base effect of private firms, Q is larger in the strategic than non-strategic sector, which can be because private firms, mostly politically connected firms, are benefiting from subsidies or limited entry to strategic sectors which increase their tendency to follow growth opportunities to maximize their profits. On the other hand, higher competition in non-strategic sector might drive down returns and increase uncertainty; hence lower investment responsiveness to growth opportunities (O'Toole et al., 2016).[42]

To conclude, empirical findings show that state ownership is accompanied by poor investment efficiency. State controlled firms underinvest relative to the optimal level

[40]This is in spirit of Kikeri et al. (1994) and taking into consideration the historical background for Egypt, in which these sectors are protected to some extent against market entrants.

[41]The mean level of state ownership in strategic (non-strategic) sectors is 43.33% (21.25%).

[42]An interesting observation is the positive and significant coefficient for the state in the strategic sector (0.216). For an average Q at 1.56 for the strategic sector, the effect of the state is positive at 0.1146 (0.216-0.0650*1.56). This refers to the important role of the state in investing in the strategic sector which requires heavy investments or large scale production that the private sector lacks.

Table 4.8 Investment efficiency across sectors

	Strategic sectors (1) I	Non-strategic sectors (2) I
Q_{t-1}	0.0394***	0.00973*
	(0.0103)	(0.00580)
CF_t	0.425	0.162**
	(0.267)	(0.0764)
$Q_{t-1} \times state_{t-1}$	-0.0650***	-0.0196**
	(0.0117)	(0.00882)
$CF_t \times state_{t-1}$	-0.902*	-0.252**
	(0.431)	(0.124)
$state_{t-1}$	0.216**	-0.0672
	(0.0752)	(0.0532)
$size_{t-1}$	0.0344	-0.0112
	(0.0778)	(0.00787)
LEV_{t-1}	-0.244	0.000792
	(0.145)	(0.0330)
$Cash_{t-1}$	0.0204	0.0141
	(0.0833)	(0.0159)
$Constant$	-0.486	0.196*
	(1.117)	(0.106)
Observations	167	979
Adjusted R^2	0.346	0.090

This table presents investment regressions of the empirical specification for two sub samples (strategic and non-strategic sectors). Strategic sectors refer to fixed line telecommunication, oil and Gas, and basic materials (chemicals and metal industries). Regression include firm and year fixed effects. Robust standard errors clustered at firm level are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

and their investment sensitivity to Q is weak. Channels of inefficiency are agency costs and SBC. Results refer to the dependence on other form of SBC than credit channel, as state firms are found to be less dependent on debt. At the same time, this does not eliminate the idea of SBC given state positive association with long term debt. The inefficiency associated with SBC is not due to overinvestment and taking excessive risk but it is related to the behaviour of the state as a rent seeker and thus conservative investment behaviour. Investment inefficiency and SBC are found to be higher in strategic sectors which is consistent with high agency costs and special treatment for firms in these sectors.

4.9 Robustness checks and additional analyses

To verify the robustness of the results, some robustness checks and additional analysis are conducted. The study checks first the sensitivity of the results to an alternative definition of state ownership, as government investors may not be considered as a homogeneous group (Holland, 2016; Megginson, 2017). Moreover, firm fixed effects regressions in the default analysis were used, however, empirical literature highlights some concerns around measurement error in q for these type of regressions, in addition to possible endogeneity problems. Therefore, other methods of estimations are employed, which are Erickson et al. (2014)'s higher-order cumulants estimators and dynamic system-GMM (Arellano and Bover, 1995; Blundell and Bond, 1998) to tackle measurement error in q and endogeneity problems. In addition, a data pre-processing technique (entropy balancing) is applied to further address state ownership endogeneity. Finally, an additional analysis is conducted to ensure that other interpretations of investment sensitivities in the literature are not driving the results.

4.9.1 Robustness checks

In this subsection, number of additional tests are performed for robustness checks, specifically, the examination of alternative definition of state ownership, estimation methods and data pre-processing (matching) technique.

- **Alternative definition of state ownership**

Recent innovations in the literature show that various definitions of state ownership can have different valuation, control and government effects (Megginson, 2017). Holland (2016) shows that the market does not view government investors as a homogeneous group, and market investors differentiate them according to the implied level of political interference[43]. One can argue that public banks, insurance companies and investment funds can be classified as institutional investors which might have different characteristics, objectives or political interference. Therefore, a narrow definition of state ownership is applied excluding public banks, insurance companies and investment funds in order to assess the sensitivity of the results to the definition of state ownership. Institutional investors can generally affect the real decisions of firms either through monitoring or active ownership (Ferreira and Matos, 2008; Kacperczyk et al., 2018). However, these investors are classified as grey institutional investors which tend to be 'pressure sensitive' or 'passive'. In other words, they may hold shares without

[43] For example, Holland (2016) classifies government investors into three groups; political group (national governments, treasuries, industrial and finance ministries, central bank, regulatory boards), local governments (regional, city, municipal) and national funds.

influencing management actions that are not in line with the interests of shareholders, in order not to harm their business relationship with the firm (Brickley et al., 1988; Ferreira and Matos, 2008). This effect may be exaggerated when these investors are already state owned. Moreover, this narrow definition reclassify some state firms from the previous definition as private, if a firm is majority controlled by the private sector but has some public holdings by financial institutions. Results in Table 4.9 confirm the main conclusion that state ownership reduces firms' investment efficiency and financial constraints. This is implied by negative and significant coefficients of $Q_{t-1} \times state_{t-1}$ and $CF_t \times state_{t-1}$ either by using continuous (state) or dummy variables (Dcont20 and Dcont50) of state ownership. Finding provides further evidence that public institutional investors are not playing an effective monitoring role, since the results are qualitatively the same either using the default or narrow definition of state ownership. It also emphasizes that public holding firms and public firms components of state ownership are mainly driving the main effect.

Table 4.9 Narrow definition of state ownership and investment sensitivities

	(1) Gov=State I	(2) Gov=Dcont20 I	(3) Gov=Dcont50 I
Q_{t-1}	0.0117*	0.0116*	0.0119*
	(0.00608)	(0.00620)	(0.00607)
CF_t	0.170***	0.158**	0.156**
	(0.0641)	(0.0634)	(0.0603)
$Q_{t-1} \times Gov_{t-1}$	-0.0242***	-0.0203**	-0.0211**
	(0.00916)	(0.00822)	(0.00831)
$CF_t \times Gov_{t-1}$	-0.403***	-0.280***	-0.331***
	(0.128)	(0.0942)	(0.102)
Gov_{t-1}	0.0291	0.0339*	-0.00752
	(0.0423)	(0.0185)	(0.0542)
Constant	0.175	0.201	0.204
	(0.175)	(0.172)	(0.167)
Observations	1146	1146	1146
Adjusted R^2	0.109	0.108	0.118
Controls variables	Yes	Yes	Yes

This table presents investment regressions including firm and year fixed effects of the empirical specification. Gov presents either state, Dcont20 or Dcont50. State is the % of state ownership using the narrow definition of state ownership. Dcont20 and Dcont50 are dummy variables for government controls at threshold of 20% and 50% for any firm-year observation using the same definition. Robust standard errors clustered at firm level are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

- **Measurement error in Q and the endogeneity problem**

One of the most common problems for investment-q regressions is possible measurement error in Q, which causes a deviation of average measured Tobin's q from unobserved marginal q (Alti, 2003; Cummins et al., 2006; Erickson and Whited, 2000, 2002; Gomes, 2001). Another problem is the endogeneity of firm characteristics, including state ownership. State ownership might be shaped by firm characteristics including firm performance. For example, the method of privatization through stock market was more suitable in Egypt for profit making firms than less profitable firms (Awadalla, 2003). The government might choose to retain control in some sectors than others, especially with high state ownership in strategic sectors in Egypt. On the other hand, it may maintain control in inefficient firms because they are hard to sell to investors. To control for the aforementioned sources of potential endogeneity and measurement error in q, Erickson et al. (2014)'s estimation method is employed to purge the effect of measurement error in the proxy for investment opportunities (Q). Afterwards, system-GMM is applied, which is more robust, and tackles both the endogeneity and measurement error problems and overcomes the first estimation method's limitation.

First, Erickson and Whited (2000, 2002) propose a consistent GMM estimator based on higher-order moments of the joint distribution of the observed regression variables. They show that Tobin's q theory has good explanatory power once the measurement error in q is addressed and thus cash flow effect become insignificant, as mismeasured q leads to an overstated relationship between investment and cash flow. To mitigate the effect of measurement error in the proxy for investment opportunities (Q), higher-order cumulant estimators recently developed by Erickson et al. (2014) are used. Cumulants estimators are polynomial functions of moments and are asymptotically equivalent to the moment estimators from Erickson and Whited (2002). However, they have a closed-form solution which stem from the linearity of estimation equations in the third and higher order cumulants of the joint distribution of the observable variables. They also have better finite sample performance than moment estimators. In Table 4.10, both third and fourth cumulants for GMM estimation (GMM3 and GMM4 respectively) are employed. Demeaned variables are used in columns (3&4) to control for firm fixed effect, following Agca and Mozumdar (2017). The estimates confirm previous results of the negative coefficient for $Q_{t-1} \times state_{t-1}$ and $CF_t \times state_{t-1}$ but the latter is insignificant as predicted by this estimation method. Moreover, the coefficient of Q and its interaction are larger than OLS estimation. Therefore, state ownership is still associated with investment inefficiency after purging the model of measurement error, confirming earlier results.

Second, system-GMM estimation developed by Arellano and Bover (1995) and Blundell and Bond (1998) employing longer lags of instruments is used. This is inspired by Almeida et al. (2010) and Agca and Mozumdar (2017) who show that IV-type estimators with longer lags of instruments are more robust and efficient than

Table 4.10 Alternative estimation methods

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GMM3	GMM4	GMM3	GMM4		System-GMM	
	Levels		Demean				
	I	I	I	I	I	I	
Q_{t-1}	0.0790***	0.0798***	0.0556***	0.0605***	0.0174**	0.0165*	0.0178**
	(0.00886)	(0.00599)	(0.0131)	(0.00868)	(0.00858)	(0.00900)	(0.00873)
CF_t	0.0824	0.0808	0.0766	0.0725	0.260**	0.329***	0.214**
	(0.0639)	(0.0641)	(0.0536)	(0.0552)	(0.115)	(0.116)	(0.108)
$Q_{t-1} \times state_{t-1}$	-0.108***	-0.109***	-0.170**	-0.179*	-0.0283**	-0.0264**	-0.0276**
	(0.0153)	(0.0141)	(0.0815)	(0.0970)	(0.0121)	(0.0122)	(0.0119)
$CF_t \times state_{t-1}$	-0.0153	-0.0130	-0.0299	-0.0545	-0.0626	-0.248	-0.00135
	(0.123)	(0.122)	(0.262)	(0.267)	(0.257)	(0.257)	(0.202)
$state_{t-1}$	0.144***	0.146***	-0.0143	-0.0144	0.0147	-0.0530	0.00411
	(0.0309)	(0.0300)	(0.0385)	(0.0396)	(0.0492)	(0.0545)	(0.0469)
$size_{t-1}$	0.00583**	0.00588**	0.0117	0.0148	0.00641	-0.00462	0.0123
	(0.00258)	(0.00260)	(0.0138)	(0.0143)	(0.0125)	(0.0106)	(0.0111)
LEV_{t-1}	0.0715***	0.0715***	-0.00427	-0.00314	0.00659	-0.0460	-0.0202
	(0.0247)	(0.0248)	(0.0287)	(0.0284)	(0.0388)	(0.0387)	(0.0406)
$Cash_{t-1}$	-0.000959	-0.00118	0.0108	0.0104	-0.0323	-0.0109	-0.0227
	(0.0192)	(0.0191)	(0.0149)	(0.0153)	(0.0244)	(0.0241)	(0.0206)
I_{t-1}					0.354***	0.339***	0.293***
					(0.0701)	(0.0764)	(0.0815)
$I_{t-1} \times state_{t-1}$							0.412**
							(0.182)
Constant	-0.158***	-0.160***	-0.000736	-0.000786	-0.0942	0.0793	-0.177
	(0.0404)	(0.0396)	(0.00134)	(0.00137)	(0.179)	(0.154)	(0.162)
Observations	1146	1146	1146	1146	1143	1143	1143
Hansen(p-value)	.	0.854	.	0.368	0.408	0.319	0.733
Ar1(p-value)					0.0082	0.0085	0.0066
Ar2(p-value)					0.111	0.114	0.120
Instruments No.					116	119	127

This table presents Erickson et al. (2014)'s (columns 1-4) and two-step System GMM (columns 5-7) estimation methods of the empirical specification. The dynamic nature of the latter method allows the addition of lagged investment to the regression which was not possible in OLS-fixed effect regressions. GMM3 refers to an exactly identified system of Erickson and whited, while GMM4 is an overidentified systems using the 4th cumulants. The first two columns employ variables' levels, whereas the second two columns use demeaned variables to control for firm fixed effect. System-GMM estimation is done using xtabond2 Stata package of Roodman (2009). The GMM instruments for difference equations are from lag 2 and earlier, and one lag for level equations. Column (5&7) considers all variables as endogenous variables. Column (6) considers control variables as predetermined variables (where one lag and earlier is the default) for difference equations. Year dummies are included as exogenous variables. The instrument set is collapsed. Column (7) further controls for the state interaction with lagged investment. Hansen test provides tests for the overidentifying restrictions under the null that all instruments are valid. Ar(1) Ar(2) are Arellano-Bond test in first difference for autocorrelation, under the null of no serial correlation.

high-order moment estimators when dealing with measurement error in investment equations. System-GMM takes into account unobserved firm heterogeneity, possible endogeneity of financial variables or state ownership, and measurement error in q. Another advantage of using system-GMM is that it overcomes the limitation of Erickson and Whited procedures in panel data estimation with fixed effects. For two-step system-GMM implementation for dynamic panel data, lag 2 and earlier for variables are used as instrument for difference equations and one lag for level equations. Year dummies are considered as strictly exogenous variables. Column (5) considers all other variables as endogenous variables, whereas Column (6) considers control variables as predetermined variables (where one lag and earlier is the default) for difference equations. Robust standard errors are used to control for heteroskedasticity as well as forcing small sample corrections.

Results of model specification tests are reported. AR(1) and AR(2) are the Arellano-Bond test in first difference for autocorrelation, under the null of no serial correlation. The AR(2) test yields a p-value of 0.11, which means that the null of no serial correlation cannot be rejected. The Hansen test of over identification yields a p-value of 0.408 and 0.319 in columns (5 & 6) respectively which indicates that the null of all instrument are valid cannot be rejected at usual significance levels. For these two columns, the coefficient of $Q_{t-1} \times state_{t-1}$ and $CF_t \times state_{t-1}$ are negative, but the latter is insignificant. This suggests that after controlling for potential endogeneity and measurement error, state ownership is negatively related to investment efficiency. Nonetheless, channels of investment inefficiency can not be explored by the same way as fixed effect regressions because of the insignificant but negative coefficient for cash flow as predicted by these methods that impose different assumptions. However, this does not contradict the qualitative discussion of the results.

On a different note, the dynamic nature of system-GMM model provides an interesting framework for further exploring firms' adjustment speed to target (optimal) investment levels, and testing if adjustment speed varies between state and private firms. This adds more understanding of the persistence in investment behaviour and willingness of firms to obtain optimal levels. While being away from optimal investment levels (investment inefficiency) for a prolonged time is costly and negatively affects the firm value, adjustment to the optimal level through time involves costs, which affects the speed of adjustment. Agency costs and asymmetric information are relevant capital market imperfection affecting adjustment costs and thus the ability/willingness of firm to return to optimal investment (Coldbeck and Ozkan, 2018; Ozkan et al., 2020). Given that these frictions are accompanied with state ownership, it is expected that investment adjustment speed is lower for state firms, which may imply the persistence of investment inefficiency. To test this, the regression is augmented by an interaction term between the state and lagged investment in column (7), where the speed of adjustment is estimated by 1 minus the estimated coefficient for lagged investment (Coldbeck and Ozkan, 2018). Result shows that the investment adjustment speed for state firms (52%)[44], evaluated at the mean level of state ownership, is lower than that of private firms at 71%, which affirms the limited ability and willingness of state firms to invest at optimal levels that correspond to growth opportunities.

- **Entropy balancing technique and the endogeneity of state ownership**

To address further state ownership's endogeneity and ensure that observed firm characteristics are not linking state ownership effect on investment, entropy balancing (Hainmueller, 2011) is applied; a data pre-processing procedure prior to the parametric analysis[45]. It allows the covariates (firm characteristics) distribution of state (treat) and non-state (control) groups of firms in the pre-processed data to match exactly on all specified moments by assigning a weight to each sample unit. These weights are then used in the parametric regression of the empirical specification. This approach has the property of being doubly robust, which means that treatment estimates will be consistent either if matching is correct, but the model is misspecified or if matching is incomplete, but the model is correctly specified (Ho et al., 2007). It creates balance in covariates across treated and control firms, reducing model dependence.

To implement this procedure, the treatment (the state) is defined using dummies (Dstate and Dcont20) for state ownership constructed at firm-year level. All independent variables are employed as covariates for balancing (Q_{t-1} ,CF_t , $size_{t-1}$, LEV_{t-1}, $cash_{t-1}$ beside industries and years[46]). Industries are used to make sure that state treatment is closer to be independent from being in certain industry than another. The first three moments are specified for exact matching (mean, variance, and skewness). Ebalance Stata package is used for this procedure (Hainmueller and Xu, 2013). The test for covariate balance (Pstest) is employed to ensure that the %bias of the mean difference between covariates across treated and control groups after balancing is not significant. Tables 4.11 and 4.12 show regression results for both the direct effect of state ownership and investment sensitivities, respectively. Results after balancing (columns 3-4) are shown in comparison to previous results (without balancing) of the main analysis (columns 1-2).

Result after balancing the covariates across state and non-state firms confirms previous evidence of the negative direct effect of state ownership on investment

[44] 1-(0.293 + 0.412*0.477)=0.52

[45] This technique is superior to other data pre-processing methods such as neighbour matching or propensity score matching. It avoids the need for balance checking and iterative searching over propensity score models that can stochastically balance the distribution of pre-specified covariates between two groups. It likewise controls for the information loss problem for matching techniques as it does not discard units.

[46] Div_{t-1} can not be included in the covariates list, as entropy algorithm could not converge while using this extra variable.

Table 4.11 Entropy balancing and the direct effect of state ownership

	Without Balancing		**After Balancing**	
	Gov=Dstate	Gov=Dcont20	Gov=Dstate	Gov=Dcont20
	(1)	(2)	(3)	(4)
Q_{t-1}	0.0079*	0.0082*	0.0068	0.0071
	(0.0045)	(0.0045)	(0.0101)	(0.0133)
CF_t	0.1645***	0.1686***	0.3693**	0.3779**
	(0.0472)	(0.0467)	(0.1553)	(0.1653)
Gov_{t-1}	-0.0191**	-0.0184**	-0.0472**	-0.0471**
	(0.0078)	(0.0080)	(0.0190)	(0.0190)
constant	-0.0030	-0.0111	0.0531	0.0540
	(0.0368)	(0.0349)	(0.1500)	(0.1458)
Observations	1135	1135	1135	1135
R^2	0.165	0.163	0.359	0.335
Controls variables	Yes	Yes	Yes	Yes

This table reports OLS regression with year and industry fixed effects similar to Table 4.3 and using its same control variables. Dstate (Dcont20) is the treatment variable which is a dummy that takes the value of one if the firm has government ownership over 5% (20%) in any firm-year observation and zero otherwise. Columns (1-2) are taken from Table 4.3, whereas columns (3-4) are for investment regression after entropy balancing of firm covariates. Standard errors clustered at firm level are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4.12 Entropy balancing and investment sensitivities

	Without Balancing		**After Balancing**	
	Gov=Dstate	Gov=Dcont20	Gov=Dstate	Gov=Dcont20
	(1)	(2)	(3)	(4)
Q_{t-1}	0.0177*	0.0139*	0.0224***	0.0185*
	(0.0090)	(0.0075)	(0.0056)	(0.0101)
CF_t	0.1941*	0.1798**	0.5332*	0.5677
	(0.1020)	(0.0759)	(0.3191)	(0.3471)
$Q_{t-1} \times Gov_{t-1}$	-0.0227**	-0.0180**	-0.0294***	-0.0254***
	(0.0097)	(0.0084)	(0.0060)	(0.0082)
$CF_t \times Gov_{t-1}$	-0.1395	-0.2214**	-0.4697	-0.6260*
	(0.1232)	(0.1007)	(0.3095)	(0.3552)
Gov_{t-1}	-0.0050	0.0284	-0.0109	0.0742*
	(0.0273)	(0.0185)	(0.0569)	(0.0377)
constant	0.2083	0.1968	0.7100*	0.5408
	(0.1979)	(0.1766)	(0.3983)	(0.5047)
Observations	1144	1144	1144	1144
R^2	0.124	0.120	0.690	0.644
Controls variables	Yes	Yes	Yes	Yes

This table presents OLS regression with year and firm fixed effects similar to Tables 4.4 and 4.5. Dstate and Dcont20 are the treatment variables as in the previous table. Columns (1-2) are for main results before balancing, whereas columns (3-4) present results after entropy balancing of firm covariates. Standard errors clustered at firm level are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

levels. Coefficients of Gov_{t-1} in Table 4.11 are around 0.047 using either Dstate or Dcont20 (columns 3-4) as definitions of state ownership (treatment). They are higher compared to their counterparts without balancing (columns 1-2), which implies that the independent effect of state ownership becomes higher after balancing observed characteristics. In Table 4.12, negative and statistically significant coefficients for $Q_{t-1} \times Gov_{t-1}$ at 1% using both definitions are found, which confirm earlier evidence (presented in column 1&2 for comparison purposes) that state ownership is associated with lower investment efficiency. The coefficients for $CF_t \times Gov_{t-1}$ continue to be negative after balancing, and significant when using Dcont20.[47]

4.9.2 Additional analyses

An additional analysis is done to preclude other interpretations in the literature that might drive the relation between state ownership and investment sensitivities. Specifically, other variables that proxy for price informativeness and assets tangibility, separately are controlled for due to the following reasons. First, Chen et al. (2007) exhibit that price informativeness (measured by price non-synchronicity and probability of informed trading) is positively correlated with the sensitivity of investment to price, and negatively correlated with investment-cash flow sensitivity. This argument is inspired by the managerial learning hypothesis from stock prices. In particular, if prices contain private information that is new to managers, their investment decisions will be improved by learning from it, and thus higher sensitivity of investment to prices. Gul et al. (2010) and Ben-Nasr and Cosset (2014) find that state ownership is associated with lower price informativeness. Therefore, the lower sensitivity of investment to prices for state firms might be driven by lower price informativeness of their stocks. To address this possibility, the study controls for price informativeness and its interaction with Q and CF. Price informativeness is measured by price non-synchronicity following Chen et al. (2007). Specifically, weekly stock returns are regressed on current and lagged value-weighted market portfolio for firms included in the sample ($R_{it} = \alpha_i + B_1 mkt_t + B_2 mkt_{t-1} + \epsilon_{it}$). Lagged market returns are included to account for delays in information incorporation into prices and to alleviate the concerns of non-synchronous trading following Gul et al. (2010)[48]. Price non-synchronicity (firm-specific return variation) is computed each year by $1 - R^2$ from the previous regression.

Second, some papers question the interpretation of investment cash flow sensitivity as financial constraints. Recently, Moshirian et al. (2017) argue that asset tangibility determines ICFS, rather than financial constraints, on the ground that tangibility

[47]Another interesting observation is the positive and significant coefficient for Gov_{t-1} in column 4 after controlling for investment sensitivities to Q and CF. This effect might be consistent with the residual positive role of state in strategic sectors.

[48]Firm year observation for stocks that trade less than 25 weeks per year as well as missing observations are also excluded, following Jaslowitzer et al. (2018).

predicts the intensity of physical investment. It also determines the information content in cash flow about future cash flow, and thus the persistence/predictability of cash flow[49]. To account for this possibility, asset tangibility (measured by PPE over total assets) is controlled for by a dummy variable (HighTang) that equals one if tangibility is higher than the yearly median for firms belonging to the same industry, and its interaction with CF and Q.

Table 4.13 Alternative explanations of investment sensitivities

	(1) I	(2) I
Q_{t-1}	0.0141	0.0089*
	(0.0117)	(0.0049)
CF_t	0.2341**	0.2041**
	(0.1167)	(0.0875)
$Q_{t-1} \times state_{t-1}$	-0.0317**	-0.0321***
	(0.0123)	(0.0108)
$CF_t \times state_{t-1}$	-0.3108**	-0.3405**
	(0.1355)	(0.1383)
$state_{t-1}$	0.0274	0.0244
	(0.0452)	(0.0527)
$Q_{t-1} \times PI_{t-1}$	0.0029	
	(0.0123)	
$CF_t \times PI_{t-1}$	-0.0947	
	(0.1130)	
PI_{t-1}	-0.0240	
	(0.0234)	
$Q_{t-1} \times HighTang_{t-1}$		0.0192**
		(0.0083)
$CF_t \times HighTang_{t-1}$		-0.0550
		(0.0917)
$HighTang_{t-1}$		-0.0258*
		(0.0141)
constant	0.1636	0.1626
	(0.1967)	(0.1722)
Observations	1025	1146
Adjusted R^2	0.084	0.130
Controls variables	Yes	Yes

This table reports firm and year fixed effect investment regressions similar to Table 4.4. Column 1 (2) adds controls for price informativeness (asset tangibility) and its interaction with Q and CF. HighTang is a dummy variable for whether asset tangibility is higher than the yearly median for firms belong to the same industry. Standard errors are robust and clustered at firm level are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Results are reported in Table 4.13, where column 1 controls for price informativeness and column 2 controls for asset tangibility. Controlling for these extra variables does not affect the significance of the main coefficients of interest; $Q_{t-1} \times state_{t-1}$ and

[49]However, Almeida and Campello (2007) argue that ICFS is increasing in asset tangibility for constrained firms, and hence they relate it to financial constraints. This is because tangibility, as a proxy for a pledged collateral, can amplify the effect of exogenous income shock on investment as it can support more borrowing. This is known as credit multiplier channel.

$CF_t \times state_{t-1}$. The coefficient for $Q_{t-1} \times PI_{t-1}$ ($CF_t \times PI_{t-1}$) is positive (negative) as expected but insignificant. This shows that the negative coefficient for $Q_{t-1} \times state_{t-1}$ is not driven by the explanation that state stocks have lower price informativeness, and thus lower sensitivity of investment to prices (or Q). Moreover, the negative and insignificant coefficient of $CF_t \times HighTang_{t-1}$ excludes the interpretation that ICFS is driven by asset tangibility approach. Accordingly, ICFS explained as financial constraints remains a valid explanation. An interesting observation is the positive and significant coefficient for $Q_{t-1} \times HighTang_{t-1}$, away from the focus in the literature on the relation between tangibility and cash flow (not Q). This implies that firms with higher assets tangibility have higher investment efficiency than other firms with lower tangibility.

To summarize, the finding of lower investment efficiency associated with state ownership is robust to the use of a narrow definition of state ownership, advanced methods that control for measurement error in Q (Erickson et al., 2014) and the endogeneity of financial variables and state ownership (System-GMM). The possibility that observed firm characteristics are linking the relation between state and investment (state endogeneity) are excluded by using the entropy balancing technique. Finally, it is assured that results are not driven by other interpretations of investment sensitivities such as price informativeness and asset tangibility.

4.10 Discussion and Conclusion

This chapter aims to investigate the relation between state ownership and investment for listed firms on the Egyptian stock market during the period (2006-2017). An investment model in line with recent investment literature is employed, where the sensitivity of investment to growth opportunities (Tobin's Q) is used as a proxy for investment efficiency. Findings can be summarized as follow. First, state ownership is associated with poor investment efficiency. It negatively affects both the level of investment and its responsiveness to growth opportunities. Indeed, state ownership has a negative direct effect on investment, controlling for firm's growth opportunities and cash flow besides other firm characteristics. The sensitivity of investment to growth opportunities evaluated at the mean level of state ownership (44.8%) is 90% below the sensitivity of firms without state ownership. The underinvestment, compared with the optimal level, is best explained by agency costs rather than financial constraints problems. The state as a controlling shareholder adopts conservative investment principles to purse social objectives and to keep its extracted rents. Furthermore, given the weak incentive schemes for managers and poor corporate governance in state controlled firms, managers as public employees/bureaucrats are less likely to screen investment opportunities and take on the risks of new investment due to private costs associated with this effort. These results are inconsistent with the popular view that the state is inefficient because it overinvests in non-value maximizing projects.

Second, it is found that state ownership reduces firms' financial constraints such that it decreases investment's sensitivity to cash flow. This can be due to soft budget constraints (SBC) that state controlled firms enjoy. The existence of SBC is expected in Egypt given the socialist economic legacy, the long history of favouring the public at the cost of private sector, long term relationship with state owned banks and the remaining equity stake of the state after privatization especially in strategic sectors. Despite enjoying SBC which reduces firm's financial constraints, state controlled firms are not investing efficiently. The inefficiency associated with SBC appears not to be due to the excessive risk taken by state firms and overinvestment benefiting from looser constraints as the popular view in the literature for state inefficiency claims. It is because the state is a risk averse and a rent seeker; hence it follows conservative investment principles. This is consistent with the distortion that SBC create in weakening the managerial effort to maximize profit, reduce costs or to innovate. Therefore, it is concluded that channels of investment inefficiency are agency costs and SBC.

Third, it is argued that the existence of SBC does not necessarily mean that firms are heavily relying on the credit/bank channel, through political connections to state banks, to reduce financial constraints, nor it is extended to the form of bailing out by banks in case of financial distress. This argument is supported empirically, at least partially, by two observations; the less effective role of SBC in reducing the constraints for highly constrained firms according to KZ and WW indexes and by investigating debt channel and showing that firm reliance on debt is decreasing with the level of state ownership. The low dependence on debt by state firms reflects higher agency costs such that firms avoid bank monitoring. This result is inconsistent with the previous literature for Egypt about preferential access of state owned firms to credit from state owned banks. Nevertheless, the previous literature mainly focuses on unlisted firms and uses data from much earlier period. One cannot preclude, however, the relations between state owned firms and banks (or SBC) given the positive association between state ownership and long term debt, which can reflect other form of easing the constraints. SBC might work through other forms such as trade credit, tax concession and implicit guarantees from the government as owner to raise capital if a firm is struggling.

Finally, by dividing the sample into strategic and non-strategic sectors, investment efficiency is shown to be lower in the strategic than non-strategic sectors, whereas SBC are highly visible in strategic sectors. This is expected given that firms with state ownership in strategic sectors are more likely to have political and social objectives than non-strategic ones, and to enjoy preferential treatment regarding regulations, government guarantees and contracts. This is also consistent with the empirical literature on the reluctance of the state to leave control in strategic sectors. Result of lower investment efficiency associated with state ownership is robust to the use of a narrow definition of state ownership and to advanced methods that control for endogeneity problems and measurement error in Q. Finally, it is assured that results are not driven by other interpretations of investment sensitivities such as price informativeness and asset tangibility.

Chapter 5

Conclusion

This thesis consists of three essays covering two main areas in the economic literature; asset pricing and firms real investment. Chapters 2 and 3 undertake empirical analysis on asset pricing for the Egyptian stock market, with the aim of exploring the cross sectional variation of stock returns and its underlying risk factors, given the limited studies in this area from emerging markets and particularly Egypt. Chapter 4 tackles firms investment behaviour from the lens of the ownership-investment channel, and investigates specifically the effect of state ownership on firm's investment efficiency. This is inspired by the significant role of the state as a holder of business assets in the Egyptian economy.

Building a reliable dataset for the cross section of stocks is the first crucial step for investigating the existence of anomalies patterns in return as well as testing factor models for an emerging market. Accordingly, the first contribution of Chapter 2 is constructing a unique, large and reliable dataset for the Egyptian stocks together with the required variables to test Fama-French factor pricing models. This chapter also provides an Egyptian version of Fama-French factors which are not publicly available at any source, and that can be available upon request for future researchers.

Chapter 2 further explores size, value, profitability, investment and momentum patterns in average returns of the Egyptian stocks. Portfolios sorts show that size and value effects are more vital in the Egyptian market. Value effect is robust for micro and small stocks, whilst size effect is stronger for high B/M, low profitability, low investment stocks as well as for all momentum categories. Other patterns in returns such as profitability, investment and momentum exist. However, profitability and investment patterns are less strong and monotonic across the cell of the sort compared to the value effect. Interestingly, there is reverse profitability patterns for micro stocks and investment patterns for big stocks, which are not consistent with Fama and French (2015), but match an evidence by Lin (2017) from the Chinese emerging market. The reverse investment patterns for big stocks, accompanied with the observation from portfolios characteristics that big profitable firms are not investing more than less profitable firms, provide early evidences of different return and investment dynamic as well as indefinite firms investment behaviour in the Egyptian market, which are further investigated in later chapters. On the other hand, cross sectional regressions on individual stocks, which allow for the estimation of the marginal effect of each anomaly in explaining the average returns, exhibit the important roles of B/M and profitability in predicting returns. Size mainly plays a part in explaining micro stocks returns, while momentum and asset growth are insignificant. The difference in inference between the sorts and regression, especially for momentum, investment and to some extent profitability, can be either due to individual regressions' limitations such as sensitivity to outliers or it can refer to present but weak patterns in returns using sorts. These results refer to the existence of anomalies pattern as those found in the US market albeit weaker, which imply the validity of applying factor models for the Egyptian markets.

Chapter 3 answers the questions of whether four principal factor model - the CAPM, the Fama-French three, five and six-factor models - can explain the cross section of stock returns in the Egyptian stock market, and whether the five and six-factor models outperform the traditional three-factor model. Results confirm the limitation of the CAPM in explaining average returns, which emphasizes that multi-factor models are of necessity. Models performance tests reveal that the five-factor model performs well in explaining average return. GRS tests do not reject the five-factor model in most of the cases or its reduced version which is the four-factor model precluding the investment factor. The five-factor model is favoured by factor spanning regressions and multi-factor GRS tests (RHS approach) in comparison to the three and six-factor models. This superiority is due to the role of profitability factor which generates average returns that could not be explained by the linear combination of other factors. However, one can argue that the outperformance of the five-factor model is not fully satisfactory. Some metrics of dispersion and regressions details offer better support to the three-factor model for other test assets than Size-Prof portfolios. The three-factor model is still successful in explaining average return of test assets except Size-Prof portfolios, owing to its role in pricing micro stocks, which remain a challenge for all factor models tested. The less powerful role of the five-factor model can be explained by many reasons such as the insignificant role of the investment factor, high negative correlation between value and profitability factors, less strong patterns in return to challenge factor models compared to those in the US market, and the lower fit of the model that refers to good but incomplete description of the cross sectional variation of the Egyptian stocks.

The insignificant roles of investment and momentum factors confirm the varying importance of risk factor across countries. It also show that the value factor is not redundant as in the case of the US market, away from the debate in the literature around value and investment factors motivations and roles. The redundancy of the investment factor is justified by the observed weak asset growth effect in Egypt similar to some other emerging markets. The insignificant spread in VW returns between high and low investment from quintile portfolios (as well as from portfolios sorts) points to weak asset growth effect in Egypt which is supported by earlier evidences by Titman et al. (2013) and Watanabe et al. (2013). Weak asset growth effect can be interpreted by the less willingness of managers to align their investment with the cost of capital as a result of pursing social objectives rather value maximization, which is more common in less financially developed markets like Egypt. This opens the door for future research on how valuation and investment CAPM theories work in emerging markets. This is because both theories highlight the important role of the investment factor, but it is empirically found to be negligible particularly in emerging markets. On the other hand, the redundancy of the momentum factor is consistent with earlier evidences from Egypt (Shaker and Elgiziry, 2014; Taha and Elgiziry, 2016). However, future investigation is needed to clarify the momentum factor insignificance. For example, one possible explanation is that momentum returns are weak when the market faces transitions than when it continues to be in the same state (Cheema and Nartea, 2017; Hanauer, 2014). This can be a valid examination owing to the fact that EGX was negatively affected in 2008, 2011 and 2015 by external shocks as well as the political tensions. The other potential explanation can be related to culture differences where low individualism countries are characterized by weak momentum returns (Chui et al., 2010).

Findings also reveal that the priced factors in the Egyptian market are market, size, value and profitability. This suggests that the sources of risk that explain the size and value effects might be relative profitability and distress. Indeed, it is shown that the introduction of the profitability factor reduces the power of the value factor in explaining returns as indicated in HML factor's loadings. This implies that the RMW factor might capture the earning effect in valuation, given the high value relevance of earning-based measures in the Egyptian market. Results in this thesis have many important implications, as they provide information to investors to improve their investment decisions in the Egyptian market. For example, investment and finance community should overstep the use of the CAPM and apply the Fama and

French four-factor model, excluding the investment factor, in various asset pricing applications such as cost of capital calculation, performance evaluation and optimal portfolio choice. However, applying this model should be conducted with caution as it does not fully describe the cross section variation of returns. Moreover, fund or portfolios managers should avoid using momentum and investment factors in their investment strategies in the Egyptian market. Investing in micro stocks should also be done with caution, as they are not be fully priced by Fama-French factors. Results also indicate that the five-factor model is applicable in the Egyptian market despite different market characteristics compared to developed markets, and thus these results can be generalized to other similar countries in the MENA region.

Other possible extensions for future research on asset pricing for the Egyptian market can be discussed as follows. Despite the good performance of the five-factor model in explaining average return, it does not offer a full description of the cross sectional variation of returns. Therefore, searching for a better model that describe returns is vital. On the one hand, one can think of additional factors that further reflect the characteristics of the market such as illiquidity and ownership concentration. For instance, the liquidity factor of Pastor and Stambaugh (2003) is a potential factor due to the less liquidity of the Egyptian markets that is reflected in the difficulty of pricing micro stocks with all tested models, and given the mixed previous result regarding its significance (Shaker and Elgiziry, 2014; Taha and Elgiziry, 2016). One the other hand, one can explore another framework such as conditional asset pricing models by relaxing the assumptions of time-invariant expected stock returns, betas and factor risk premiums. This is because the economic and political uncertainties that were prevalent in Egypt after the political uprising in 2011 might question these assumptions. Furthermore, it is important to do research not only on defining priced risk factors but also on uncovering the sources of macroeconomic risks that drive the movement of asset prices, or the specific macroeconomic variables that the priced factors proxy for. One possible avenue is to check whether these factor can capture or forecast GDP growth following Vassalou (2003) and Liew and Vassalou (2000). It would be also interesting to extent the research to include other countries in the MENA region for better understanding of stocks return dynamics in the region. Moreover, the characteristics of the market such as illiquidity and state or family owned firms can provide a proper framework to further explore optimal portfolio allocation in the presence of illiquid assets.

Chapter 4 moves to firm capital investment, aiming to examine the state ownership's effect on investment efficiency and explore its channels. Findings show that state ownership is associated with poor investment efficiency. State ownership negatively affects both investment level and its responsiveness to growth opportunities (q). More precisely, state ownership leads to underinvestment controlling for firm's q, cash flow and other characteristics. Including the interaction terms, the sensitivity of investment to q evaluated at the mean state level is 90% lower for firms with state ownership compared to pure private firms. Furthermore, it is found that state ownership decreases firm's financial constraints as it reduces investment sensitivity to cash flow, which can be justified by the soft budget constraints (SBC) that state controlled firms may enjoy. Accordingly, the channels of investment inefficiency are agency costs and SBC, which are mainly due to private costs, risk aversion and rent seeking behaviour. Results are not consistent with the popular view that state firms are not efficient because they overinvest or take excessive risk exploiting the looser budget constraints. Instead, state firms are inefficient because they underinvest owing to high agency costs. These high costs are due to state firms tendency to to purse social objectives. They are also because weak incentives schemes for managers and weak corporate governance discourage managers as public employees from spending effort and taking the risk of new investment. Add to this the distortion that SBC create by weakening the managerial efforts to maximize profit, innovate or reduce costs.

In an attempt to explore bank credit channel as a well-known channel for softening budget constraints due to firm-bank relations, it is shown that state firms do not have preferential access to bank credit compared to private sector. However, one can not preclude the relations between state firms and banks, given the positive association between state ownership and long term debt, which refers to other forms of easing the constraints. Confirming the substantial influence of the state, investment efficiency is shown to be lower in strategic compared to non-strategic sectors, while SBC are visible in strategic sectors. This is consistent with state reluctance to leave control in strategic sectors. Finally, poor investment efficiency accompanied with state ownership is robust to the use of a narrow definition of state ownership and other methods of estimation that overcome endogeneity problems and measurement error in q. The study further assures that lower investment sensitivity to q is not driven by the argument of lower price informativeness for state firms, and the reduced investment sensitivity to cash flow is not interpreted by asset tangibility approach.

Various implications can be drawn from previous findings. They suggest that policy makers should take further actions to improve corporate governance and enhance shareholder minority rights to avoid any expropriation of firms value by state controlled principals, which in turn help improving firm investment efficiency. State firms should improve corporate decisions and policies by encouraging profit motive and risk-taking behaviour while limiting rent seeking behaviour. Providing effective performance-based incentives to managers is a good way to reduce their private costs and increase their risk appetite for new investments. Results can provide lessons for future privatizations, which is one of the objectives of the current economic reform program in Egypt to reduce the state's role in the economy. Policy makers should be aware that privatizing firms while retaining a state's controlling stake-holding is not effective for sustainable performance improvements, at least, without corporate restructuring and change of the management. Findings also recommend increasing competition and new entrance to strategic sectors to improve resources allocation and investment efficiency.

Connecting the dots backwards, Chapter 4 can reflect on some earlier findings of Chapters 2 and 3, and highlights further implications of the thesis results. The observation from Chapter 2 that big firms invest less despite being profitable can be partially explained by the underinvestment phenomenon for state firms compared to private ones. Moreover, the investment factor redundancy and weak asset growth effect which are justified by the less willingness of manager to align their investment with cost of capital as prescribed by q-theory and investment CAPM, together with the result of lower investment response to growth opportunity by ownership type using a q-theory framework, can shed light on a possible link between stock return anomalies and firm ownership structure that can be deeply examined in future work. It also suggests that investors should take into consideration firms ownership structure while investing in emerging markets stocks. Moreover, asset pricing models can be investigated by taking into account ownership type, particularly state ownership which is more common in emerging markets. For example, it would be interesting to explore if Fama-French models explain average returns of private firms better than state ones. On the other hand, results show that the application of Tobin's Q theory in the Egyptian market is affected by ownership type through agency costs and asymmetric information channels. This should pave the way for further exploration of how investment as well as valuation theories work in emerging markets.

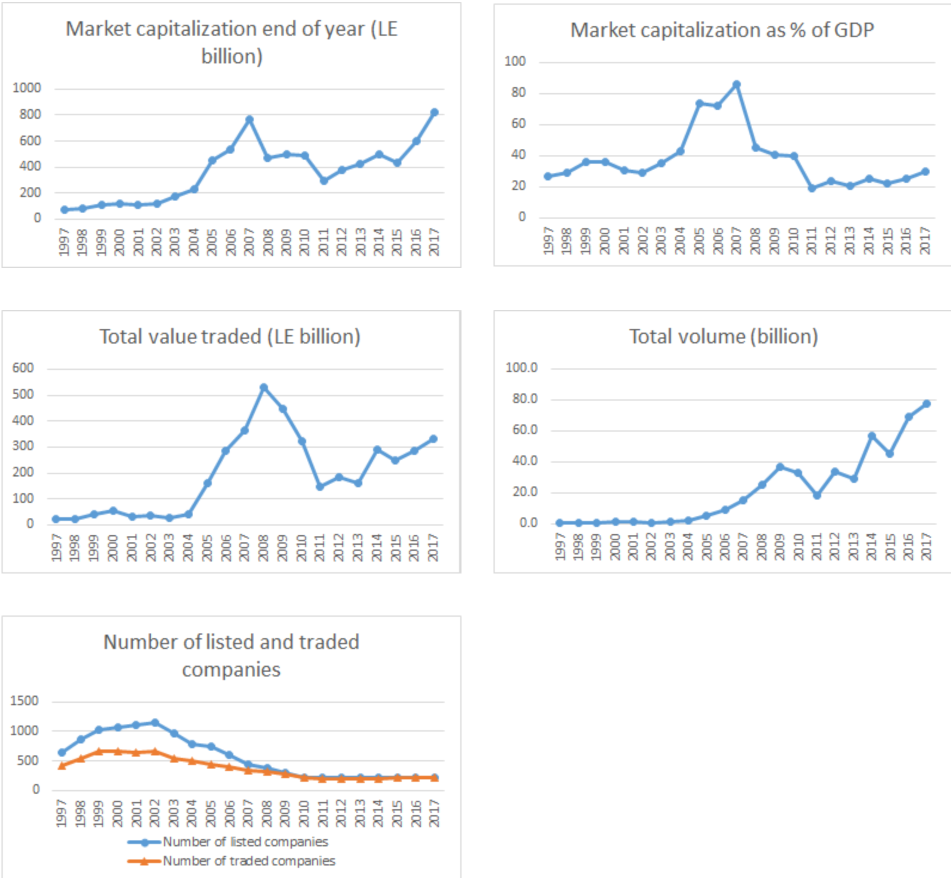
The influence of state ownership highlighted in this thesis can open extra avenues for future research. Other explicit sources of SBC such as trade credit and tax concession can be investigated for deep understanding of SBC channels in reducing financial constraints. For instance, Chen et al. (2018) show that state ownership is positively associated with the provision of trade credit, which is considered as alternative source of fund especially when access to credit is limited. Moreover, the public sector in Egypt is mainly structured as holding and affiliated firms. This pyramids structure (or business group) can work as internal capital market in which capital can be allocated amongst affiliated firms. Therefore, it is interesting to check this mechanism and how it affects firm performance. Although results show that state ownership is accompanied with lower financial constraints measured by the debatable measure of investment-cash flow sensitivity, it is interesting to directly investigate the state effect on the cost of capital using other financial measures for thorough understanding of the relation between state ownership and financial constraints in the Egyptian market. A further important extension for future research is to increase sample coverage to include other countries in the MENA region for more generalization of state's influence on investment efficiency. It is also promising to explore other dimensions of ownership structure such as ownership concentration and family ownership on various corporate actions. The role of the state itself can be tackled from a different angle by examining state effect on the role of institutional investors, for example, in improving price informativeness. This is inspired by the fact that largest domestic institutional investors in Egypt are state owned such as public banks, insurance companies and pension funds, and from the implied result of using the narrow definition of state ownership which is that these public institutional investors are not playing active roles in influencing firms decisions.

Appendix A

Appendix to Chapter 2

A.1 Main characteristics of the Egyptian Exchange (EGX)

Fig. A.1 The EGX main characteristics



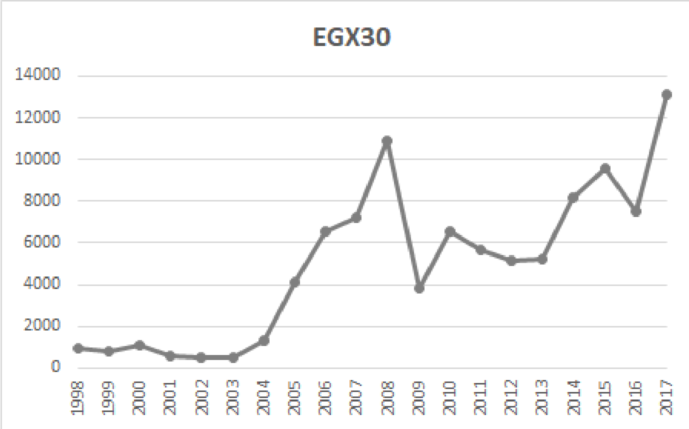
Source: Table A.1. Regarding the number of listed firms, new rules for listing securities have been introduced in 2002 by the capital market authority. Afterwards, there was a massive delisting of non-actively traded firms according to certain criteria. Before that, there was a large number of listed firms because of tax law no.1981, in which firms listed on the official and unofficial exchange are eligible for a tax exemption which is equivalent to 3 months treasury bills on the paid up capital. The aim was to enhance stock activity by encouraging listing.

Table A.1 Main market indicators of the EGX (1997-2016)

Years	Market capitalization end of year (LE billion)	Market capitalization as % of GDP	Total value traded (LE billion)	Total volume (billion)	Average daily value traded (LE million)	Number of trading days	Number of listed companies	Number of traded companies	Foreign participation as % of value traded (Arab +non Arab)
1997	71	27	24	0.4	97	249	645	416	17
1998	82	29	23	0.6	96	245	870	551	20
1999	112	36	39	1.1	157	249	1033	663	22
2000	121	36	54	1.1	218	248	1076	659	21
2001	112	31	32	1.3	129	246	1110	643	16
2002	122	29	34.2	0.9	137	249	1151	671	19
2003	172	35	27.8	1.4	114	244	978	540	20
2004	234	43	42.3	2.4	170	249	795	503	27
2005	456	74	160.6	5.3	645	249	744	441	30
2006	534	72	287	9.1	1176	244	595	407	30
2007	768	86	363	15.1	1488	244	435	337	31
2008	474	45	529.6	25.5	1656	244	373	322	30
2009	500	41	448.2	36.6	1822	249	306	289	19
2010	488	40	321	33	1300	247	213	212	22
2011	294	19	148	18.5	543	207‘	213	204	36
2012	376	24	185	34	518	145	213	204	28
2013	427	21	162	29	428	243	212	206	27
2014	500	25	291	57	883	244	214	206	21
2015	430	22	248	45	567	244	221	217	27
2016	602	25	285	69	820	245	222	213	26
2017	825	30	332	78	1183	244	222	213	28

Source: various issues of the annual reports, The Egyptian exchange (EGX).
Note: Total value traded and total volume include the main market (stocks, deals, bonds), NILEX and OTC market. For average daily value traded, calculation has excluded bonds and deal from the indicator since 2011. For foreign participation as % of value traded, since 2008, the indicator is reported after excluding deals and bonds. Finally, the Exchange was closed from 30/1/2011 till 22/3/2011.

Fig. A.2 Main stock market index: EGX30



Source: Series is collected from Thomson Datastream.

A.2 Summary of the dataset

Table A.2 Variables definitions in Datastream and Worldscope

Variable	Datatype	Definition
Adjusted prices	P	Official closing prices adjusted for subsequent capital actions.
Unadjusted prices	UP	Official closing prices not adjusted for bonus and right issues.
A Return index	RI	Represents a theoretical growth in value of a share, holding over a specified period, assuming that dividends are re-invested to purchase additional units of an equity at the closing price applicable on the ex-dividend date.
Number of shares	NOSH	The total number of ordinary shares.
Market value	MV	Share price (UP)$\times$ the number of ordinary shares in issue.
Dividend	DDE	Cash income dividend payment adjusted for any capital change
Book equity (BE)	WC03501	Common shareholders' investment in a company. (Common equity)
Total asset (TA)	WC02999	The sum of total current assets, long term receivables, investment in unconsolidated subsidiaries, other investments, net property plant and equipment and other assets. The definition is different in case of bank, insurance and other financial companies.
Net Income available to common (NI)*	WC01706	Net income represents the net income the company uses to calculate its earnings per share. It is generally net income after preferred dividends and before extraordinary items.

Note*: All the following items have the same values for Egypt on TDS; net Income available to common (WC01751), net Income after preferred dividends (WC01706), and net Income before extra item/Preferred Dividends (WC01551), and net Income before preferred dividends (WC01651).

Table A.3 Summary of the dataset

No. of equities	Active	Dead	Total
Panel (A): Phase one			
Market data (P, RI, MV)	154	22	176
Corporate data (BE, TA, NI)	149	16	165
Panel (B): Final dataste (All sources)			
Market data (P, RI, MV)	205	22	227
Corporate data (BE, TA, NI)	201	16	217

This table provides a summary of the dataset. It shows the number of available stocks for each type of data; market data (price, return index and market value) and corporate data (book equity, total asset, and net income) and whether stocks are active or dead. Panel (A) provides data for phase one which depends on TDS, Osiris and Mubasher sources. Panel (B) shows the overall available data for both phase one and two, which adds EGID and decypha sources.

Table A.4 Annual number of available stocks for sorting variables

	Size	**Book to market ratio**			**Investment**	**Profitability**		
Years	**Numbers**	**Numbers**	**negative BV**	**Numbers excluding negative BV**	**Numbers**	**Numbers**	**negative NI**	**Numbers excluding negative NI**
2003	**113**	74	0	**74**	**52**	88	11	**77**
2004	**145**	96	1	**95**	**102**	132	17	**115**
2005	**154**	123	1	**122**	**138**	138	13	**125**
2006	**162**	143	2	**141**	**145**	162	14	**148**
2007	**171**	150	4	**146**	**161**	168	13	**155**
2008	**180**	169	3	**166**	**169**	181	9	**172**
2009	**184**	178	3	**175**	**180**	188	11	**177**
2010	**190**	176	4	**172**	**183**	190	24	**166**
2011	**180**	177	0	**177**	**186**	186	19	**167**
2012	**185**	179	0	**179**	**184**	192	37	**155**
2013	**198**	186	1	**185**	**187**	198	37	**161**
2014	**201**	197	4	**193**	**198**	201	34	**167**
2015	**203**	198	4	**194**	**200**	200	39	**161**
2016	**203**	198	3	**195**	**197**	198	47	**151**
2017	**202**	196	6	**190**	**194**	196	39	**157**

This table presents the numbers of available stocks of each of the sorting variables. Size is measured as market value (market equity) at the end of June, year t. Book to market ratio is book equity for the fiscal year ending in calendar year t-1, divided by market equity at the end of December of t-1. The investment ratio is the change in total assets from the fiscal year ending in year t-2 to the fiscal year ending in t-1, divided by t-2 total assets. The ROE, which is the alternative profitability measure, is earnings for the fiscal year ending in t-1, divided by book equity at the end of year t-1.

Table A.5 Average monthly returns by year

	Equal-weight average return				Value-weight average return			
Year	Market	Micro	Small	Big	Market	Micro	Small	Big
2003/04	2.38	2.05	3.25	3.64	4.81	3.82	4.73	5.34
2004/05	3.92	2.97	3.81	5.99	9.83	4.93	5.36	10.3
2005/06	4.11	4.96	3.96	2.7	2.44	11.81	7.18	1.99
2006/07	7.42	9.84	6.81	3.85	5.21	11.73	10.36	4.46
2007/08	5.68	8.74	3.58	2.29	3.44	11.26	4.82	3.08
2008/09	-1.24	-0.24	-1.46	-2.41	-1.18	0.45	-0.36	-1.34
2009/10	1.47	2.53	0.76	0.77	2.17	3.8	4.94	1.84
2010/11	1.96	2.77	1.93	0.89	0.94	2.28	2.54	0.75
2011/12	-1.57	-2.24	-1.35	-0.79	0.37	-1.71	-0.76	0.47
2012/13	0.13	-0.79	0.63	0.96	1.42	-0.02	1.73	1.44
2013/14	5.43	6.37	4.98	4.41	4.33	7.7	5.69	4.07
2014/15	-1.03	-1.15	-1.58	-0.29	0.43	0.2	-0.82	0.5
2015/16	-0.72	-0.58	-0.64	-1.04	-0.22	0.66	-0.19	-0.17
2016/17	4.26	2.75	5.07	6.03	6.39	4.89	6.47	7.04
Total	2.3	2.71	2.13	1.93	2.9	4.43	3.7	2.85

This table displays the detailed numbers for Figure 2.1. It shows the average yearly returns of equal-weight and value-weight micro, small, big and all (market) stocks. The left panel is for EW returns, while the right panel is for VW returns. To match the procedure that stocks are assigned to each size group at June each year, a year represents months from July to June of the following year. For example, year 2003/2004 is for the average of monthly data from July 2003 to June 2004.

A.3 Portfolios construction alternatives

The whole sample One might choose other options for portfolio construction for factor returns. Three options can be defined as follow:

(1) Use the biggest 50 firms as big portfolio and the rest as small portfolio, and use the 30th-70th percentiles of the 50 big firms as B/M, investment and profitability breakpoints, in the spirit of Chiah et al. (2016).

(2) Assign the first n number of firms after ranking that make up 90% of market cap to big portfolio, while the rest for small portfolio, and use the 30th-70th percentiles of the 50 big firms as a breakpoints for corporate sorting variables, in the spirit of Brailsford et al. (2012).

(3) Define the first n number of firms after ranking that constitute 90% of market cap as big portfolio and the rest as small portfolio, and use the 30th-70th percentiles of the big portfolio as breakpoints for corporate variables, in the spirit of Cakici et al. (2016) and Fama and French (2016).

Non-financials sample Due to the smaller sample size and time series coverage of non-financial firms, different choices of breakpoints are made. First, year 2003 is excluded from portfolio construction. For factor returns using (2×3) portfolios, we use the median of the big 70 stocks (biggest 35 stocks account for 90% of market cap on average) and the 40th-60th percentiles of the big 70 firms for B/M, profitability and investment breakpoints. For test assets (3×3) portfolios, size breakpoints of the 92% and 98% of market cap is used. This is to avoid empty cells in both 2×3 and 3×3 matrices.

Appendix B

Appendix to Chapter 3

B.1 Robustness checks

Table B.1 Asset growth effect

INV quintiles	low	q2	q3	q4	high	H-L
VW returns	1.60	1.83	1.94	2.26	2.49	0.888

This table reports the Value-weight monthly percent excess returns of quintiles portfolios sorted on investment. Investment is measured as the change in total assets from the fiscal year ending t-2 to fiscal year ending t-1, divided by total assets at t-2. H-L is the difference between high and low investment portfolios.

Table B.2 Means and standard deviation of factors returns (Non-financials)

	Mkt	**SMB**	**HML**	**RMW**	**CMA**	**WML**
Mean	1.815	0.748	0.870	0.689	-0.046	-0.014
std	8.122	5.703	5.725	5.965	5.693	6.663
t-stat	2.782	1.633	1.892	1.437	-0.100	-0.026

This table reports summary statistics of factors returns for the non-financials sub-sample for period from July 2004 to June 2017.

Table B.3 Spanning regressions (Non-financials)

Panel (A): six-factor model spanning regressions

	Coefficent							t(Coefficent)							
LHS	α	**Mkt**	**SMB**	**HML**	**RMW**	**CMA**	**WML**	α	**Mkt**	**SMB**	**HML**	**RMW**	**CMA**	**WML**	R^2
Mkt	2.04		-0.11	0.08	-0.32	-0.08	-0.10	3.30		-0.71	0.73	-2.02	-0.51	-0.81	0.08
SMB	1.18	-0.05		-0.24	-0.17	0.24	0.05	2.83	-0.74		-2.02	-1.53	2.17	0.57	0.13
HML	1.19	0.04	-0.24		-0.29	0.08	0.05	2.83	0.71	-2.65		-1.84	0.49	0.61	0.15
RMW	1.39	-0.16	-0.18	-0.32		0.01	0.00	3.72	-1.78	-1.84	-1.83		0.03	-0.05	0.16
CMA	-0.24	-0.04	0.25	0.09	0.01		0.02	-0.52	-0.51	2.22	0.51	0.03		0.22	0.07
WML	-0.001	-0.07	0.08	0.08	-0.01	0.03		0.00	-0.80	0.57	0.63	-0.05	0.22		0.02

Panel (B): Multi-factor test

Model	**LHS**	**GRS**	**p(GRS)**
CAPM	SMB & HML	3.32	0.039
Three-factor model (FF3F)	RMW & CMA	4.525	0.012

This table reports factor spanning regressions for the non-financials sub-sample. Panel (A) presents factor spanning regression for the Fama and French's six-factor model. α is the regression intercept, R^2 is the adjusted R^2. Panel (B) presents the GRS statistics and their p-values for the test that additional factors are jointly improving the maximum sharp ratio of the base model, either the CAPM or the three-factor model.

Table B.4 GRS tests and other metrics (Non-financials)

	GRS	**P(GRS)**	AR^2	$\lvert A \rvert$	$\frac{A(a_i^2)}{A(r_i^2)}$	$\frac{As^2(a_i)}{A(a_i^2)}$	**GRS**	**P(GRS)**	AR^2	$\lvert A \rvert$	$\frac{A(a_i^2)}{A(r_i^2)}$	$\frac{As^2(a_i)}{A(a_i^2)}$
	Size-BM portfolios						**Size-Prof portfolios**					
CAPM	1.23	0.28	0.50	0.59	1.21	0.72	1.92	0.05	0.52	0.83	1.44	0.35
FF3F	1.22	0.29	0.66	0.35	0.38	1.27	2.02	0.04	0.63	0.56	0.69	0.48
FF4F	1.74	0.09	0.68	0.38	0.64	0.76	0.93	0.50	0.70	0.47	0.41	0.77
FF5F	1.70	0.09	0.68	0.38	0.64	0.74	0.90	0.52	0.70	0.47	0.41	0.77
FF6F	1.69	0.10	0.69	0.38	0.64	0.75	0.90	0.53	0.70	0.47	0.41	0.78
	Size-INV portfolios						**Size-Mom portfolios**					
CAPM	0.56	0.83	0.54	0.46	1.15	0.94	1.14	0.34	0.56	0.76	0.88	0.32
FF3F	0.25	0.99	0.66	0.27	0.32	2.16	1.02	0.43	0.65	0.53	0.38	0.53
FF4F	0.62	0.78	0.68	0.34	0.54	1.35	1.54	0.14	0.67	0.63	0.60	0.38
FF5F	0.59	0.80	0.71	0.34	0.50	1.30	1.53	1.53	0.67	0.65	0.56	0.40
FF6F	0.59	0.80	0.71	0.34	0.50	1.31	1.52	0.15	0.72	0.65	0.60	0.33

This Table presents the GRS test and other metrics using the non-financials sub-sample. Columns and rows are explained as in Table 3.6.

Table B.5 FF3F regression results (Non-financials)

	Size-BM portfolios						Size-prof portfolios						Size-INV portfolios						Size-Mom portfolios					
	Low	**N**	**High**	**Low**	**N**	**High**	**Weak**	**N**	**Robust**	**Weak**	**N**	**Robust**	**Cons-**	**N**	**Aggr-**	**Cons-**	**N**	**Aggr-**	**Loser**	**N**	**Win-**	**Loser**	**N**	**Win-**
		α			**t(α)**			**α**			**t(α)**			**α**			t(α)			**α**			**t(α)**	
Micro	-0.29	-0.27	0.74	-0.42	-0.49	1.59	0.26	0.17	0.72	0.50	0.28	1.41	0.08	-0.54	-0.48	0.15	-0.83	-0.98	0.64	1.15	1.17	1.37	1.67	2.02
small	0.55	0.27	-0.28	1.18	0.57	-0.83	-0.79	0.56	1.09	**-2.21**	0.98	**2.32**	-0.25	0.36	0.27	-0.70	0.62	0.70	-0.10	0.28	-0.65	-0.27	0.50	-1.59
Big	-0.13	-0.09	-0.52	-0.77	-0.22	-1.64	-1.09	0.32	0.04	**-3.27**	0.68	0.19	-0.21	-0.24	0.03	-0.54	-0.57	0.12	-0.40	-0.38	-0.02	-1.04	-1.09	-0.05
		b			**t(b)**			**b**			**t(b)**			**b**			**t(b)**			**b**			**t(b)**	
Micro	0.91	0.91	1.10	7.49	7.77	13.86	1.05	0.87	0.96	9.03	6.68	13.48	1.08	0.97	1.11	11.04	10.61	12.22	1.00	1.10	1.09	12.73	10.39	12.94
small	0.75	0.87	0.97	10.72	8.91	12.45	1.02	0.92	0.65	14.54	10.34	7.76	1.00	0.92	0.82	14.97	8.17	9.56	0.93	1.06	0.93	11.36	6.07	10.68
Big	1.03	0.92	0.86	37.44	10.85	13.48	0.96	0.99	0.99	15.45	13.72	18.68	0.94	0.99	1.08	18.08	10.53	15.04	1.04	0.78	0.92	14.22	12.70	13.81
		s			**s(t)**			**s**			**s(t)**			**s**			**s(t)**			**s**			**s(t)**	
Micro	1.03	0.96	0.84	5.36	4.67	8.81	0.95	0.74	0.56	7.07	4.50	5.60	0.94	0.79	0.82	7.60	4.56	7.28	0.69	0.83	0.89	6.52	5.45	6.09
small	0.71	0.86	0.79	5.63	4.40	5.92	0.70	0.78	0.76	7.21	4.26	5.18	0.88	0.57	0.74	7.09	2.80	5.59	0.64	0.48	0.77	5.79	1.73	6.77
Big	-0.12	-0.16	-0.09	-2.94	-1.37	-0.87	0.08	0.01	-0.18	0.98	0.15	-2.46	0.08	0.09	-0.34	1.17	0.69	-3.24	-0.08	0.07	-0.11	-0.83	0.94	-1.33
		h			**h(t)**			**h**			**h(t)**			**h**			**h(t)**			**h**			**h(t)**	
Micro	0.25	0.16	0.32	1.09	0.96	1.95	0.50	0.39	0.11	2.19	1.65	1.01	0.36	0.16	0.23	2.19	0.85	1.35	0.17	0.16	0.40	1.41	0.87	1.50
small	-0.22	0.19	0.71	-1.71	1.05	4.08	0.33	0.28	0.21	2.79	1.93	0.89	0.55	0.57	0.22	2.80	2.18	1.58	0.23	-0.04	0.51	1.58	-0.28	3.91
Big	-0.24	-0.01	0.78	-6.99	-0.15	4.90	0.35	-0.12	-0.20	3.03	-1.20	-4.35	0.05	0.21	-0.17	0.64	1.63	-2.65	0.10	0.05	-0.03	0.98	0.55	-0.53
		R^2			**Root MSE**			**R^2**			**Root MSE**			**R^2**			**Root MSE**			**R^2**			**Root MSE**	
Micro	0.48	0.54	0.71	9.62	8.34	6.52	0.60	0.42	0.61	8.20	9.55	6.60	0.65	0.51	0.66	7.46	8.66	7.20	0.67	0.53	0.59	6.23	9.29	8.49
small	0.59	0.56	0.75	6.27	7.53	5.54	0.77	0.51	0.49	5.05	8.36	6.96	0.74	0.48	0.65	5.73	8.86	5.81	0.70	0.55	0.67	5.39	8.01	6.26
Big	0.94	0.66	0.75	2.16	5.50	5.18	0.75	0.65	0.88	4.70	5.86	2.98	0.72	0.63	0.87	4.83	6.28	3.43	0.71	0.64	0.74	5.46	4.73	4.44

This table reports the regression results for the three-factor model; $R_{it} - R_{ft} = \alpha_i + b_i Mkt_t + s_i SMB_t + h_i HML_t + \epsilon_{it}$, where α is the intercept, b, s, h are the factor loading for excess market returns, SMB and HML factors, respectively. R^2 is the adjusted R-squared. The regression is run using the sub-sample that exclude financial stocks.

Table B.6 FF5F regression results (Non-financials)

Size-BM portfolios

	Low	N	High	Low	N	High
	α			**t(α)**		
Micro	0.09	-0.05	1.14	0.13	-0.10	2.47
small	0.50	0.22	-0.76	1.07	0.46	-2.40
Big	-0.19	0.06	-0.45	-1.12	0.13	-1.29
	s			**s(t)**		
Micro	1.06	1.00	0.81	4.86	4.12	7.83
small	0.83	0.77	0.88	7.15	3.56	6.94
Big	-0.12	-0.08	-0.08	-3.04	-0.68	-0.65
	h			**h(t)**		
Micro	-0.11	-0.14	0.00	-0.52	-0.99	0.03
small	-0.39	-0.02	0.60	-3.64	-0.10	4.61
Big	-0.20	-0.02	0.80	-5.90	-0.17	5.36
	r			**r(t)**		
Micro	-0.43	-0.30	-0.38	-2.34	-1.79	-3.11
small	-0.12	0.03	0.26	-1.23	0.16	1.89
Big	0.06	-0.17	-0.06	1.71	-1.65	-0.43
	c			**c(t)**		
Micro	0.06	0.10	0.13	0.30	0.67	0.95
small	-0.10	0.13	0.26	-1.02	0.96	2.18
Big	0.02	0.06	-0.17	0.48	0.48	-1.43
	R^2			**Root MSE**		
Micro	0.54	0.58	0.74	9.10	7.96	6.07
small	0.63	0.51	0.81	5.94	7.96	4.85
Big	0.94	0.65	0.76	2.14	5.52	5.10

Size-prof portfolios

	Weak	N	Robust	Weak	N	Robust
	α			**t(α)**		
Micro	0.89	0.50	0.66	1.69	0.78	1.27
small	-0.47	0.66	-0.21	-1.30	1.24	-0.58
Big	-0.28	0.30	-0.23	-1.01	0.64	-1.09
	s			**s(t)**		
Micro	0.99	0.73	0.56	7.79	4.20	4.41
small	0.69	0.86	0.99	8.37	4.13	11.25
Big	-0.08	-0.06	-0.13	-1.26	-0.65	-2.46
	h			**h(t)**		
Micro	0.11	0.11	-0.02	0.92	0.51	-0.20
small	0.07	0.05	0.30	0.96	0.43	2.59
Big	0.14	-0.12	-0.09	1.76	-1.21	-1.85
	r			**r(t)**		
Micro	-0.65	-0.35	0.00	-4.29	-1.70	-0.03
small	-0.32	-0.23	0.82	-3.18	-1.97	7.53
Big	-0.55	0.07	0.21	-7.77	0.75	3.82
	c			**c(t)**		
Micro	-0.15	0.28	0.13	-0.99	1.20	1.11
small	0.02	-0.03	0.12	0.22	-0.22	1.10
Big	0.18	0.04	-0.07	2.67	0.38	-1.37
	R^2			**Root MSE**		
Micro	0.71	0.48	0.61	7.01	9.03	6.59
small	0.80	0.55	0.74	4.65	8.04	4.93
Big	0.87	0.64	0.90	3.46	5.88	2.75

Size-INV portfolios

	Cons-	N	Aggr-	Cons-	N	Aggr-
	α			**t(α)**		
Micro	0.57	-0.51	-0.14	1.10	-0.80	-0.27
small	-0.69	0.39	0.17	-2.11	0.67	0.50
Big	0.26	0.09	-0.26	0.83	0.20	-1.47
	s			**s(t)**		
Micro	0.87	0.83	0.85	7.04	3.87	6.50
small	0.85	0.75	0.89	7.89	3.98	6.93
Big	-0.12	-0.05	-0.21	-1.72	-0.36	-3.42
	h			**h(t)**		
Micro	0.00	-0.06	-0.06	-0.01	-0.33	-0.56
small	0.40	0.42	0.06	3.68	1.77	0.57
Big	-0.09	0.11	-0.01	-1.29	0.98	-0.18
	r			**r(t)**		
Micro	-0.44	-0.13	-0.38	-2.80	-0.69	-2.54
small	0.30	-0.21	-0.11	2.62	-1.28	-0.91
Big	-0.24	-0.17	0.17	-3.35	-1.21	2.95
	c			**c(t)**		
Micro	0.30	-0.01	-0.02	1.75	-0.10	-0.14
small	0.55	-0.20	-0.36	5.07	-1.27	-3.52
Big	0.55	0.01	-0.37	7.04	0.12	-6.23
	R^2			**Root MSE**		
Micro	0.72	0.52	0.70	6.69	8.65	6.75
small	0.84	0.53	0.71	4.55	8.44	5.28
Big	0.85	0.63	0.92	3.55	6.27	2.69

Size-Mom portfolios

	Loser	N	Win-	Loser	N	
	α			**t(α)**		
Micro	0.86	1.50	1.53	1.89	1.82	2.58
small	0.30	0.26	-0.39	0.79	0.50	-0.95
Big	-0.35	-0.60	-0.05	-0.82	-1.60	-0.12
	s			**s(t)**		
Micro	0.70	0.73	0.85	6.37	3.69	6.13
small	0.59	0.55	0.84	5.66	2.17	7.95
Big	-0.09	0.07	-0.11	-0.84	0.98	-1.09
	h			**h(t)**		
Micro	-0.06	-0.15	0.09	-0.56	-0.77	0.35
small	-0.02	-0.16	0.25	-0.26	-1.50	3.54
Big	0.11	0.07	0.00	0.98	1.21	-0.01
	r			**r(t)**		
Micro	-0.25	-0.29	-0.35	-2.15	-1.25	-2.06
small	-0.35	-0.08	-0.34	-3.15	-0.45	-3.73
Big	-0.03	0.17	0.03	-0.30	2.53	0.46
	c			**c(t)**		
Micro	0.10	0.33	0.19	0.70	1.16	1.26
small	0.02	0.06	-0.06	0.22	0.32	-0.54
Big	-0.04	0.20	0.01	-0.42	2.74	0.10
	R^2			**Root MSE**		
Micro	0.71	0.56	0.62	5.91	9.08	8.19
small	0.73	0.56	0.73	5.12	7.89	5.65
Big	0.71	0.67	0.74	5.48	4.52	4.47

This table presents the results of the following regression for the five-factor model: $R_{it} - R_{ft} = \alpha_i + b_i Mkt_t + s_i SMB_t + h_i HML_t + r_i RMW_t + c_i CMA_t + \epsilon_{it}$, where α is the intercept. The market excess returns loadings (b) are excluded for the ease of presentation. s, h, r and c represents factors loadings for SMB, HML, RMW and CMA factors respectively. R^2 is the adjusted R-squared. The regression is run using the sub-sample that exclude financial stocks.

Table B.7 GRS tests and metrics of dispersion: Alternative options

	GRS	P(GRS)	AR^2	$\lvert A \rvert$	$\frac{A(a_i^2)}{A(r_i^2)}$	$\frac{As^2(a_i)}{A(a_i^2)}$		GRS	P(GRS)	AR^2	$\lvert A \rvert$	$\frac{A(a_i^2)}{A(r_i^2)}$	$\frac{As^2(a_i)}{A(a_i^2)}$
Panel (A): Option 1													
Size-BM portfolios							**Size-Prof portfolios**						
CAPM	1.75	0.08	0.57	0.55	0.90	0.66	**CAPM**	1.12	0.35	0.55	0.79	1.32	0.36
FF3F	1.00	0.44	0.76	0.27	0.17	2.04	**FF3F**	1.43	0.18	0.67	0.54	0.65	0.49
FF5F	1.20	0.30	0.76	0.36	0.33	1.09	**FF5F**	0.71	0.70	0.74	0.44	0.38	0.75
Size-INV portfolios							**Size-Mom portfolios**						
CAPM	1.08	0.38	0.58	0.58	0.72	0.58	**CAPM**	1.80	0.07	0.60	1.05	1.08	0.17
FF3F	0.90	0.53	0.72	0.28	0.16	1.49	**FF3F**	1.64	0.11	0.72	0.66	0.42	0.31
FF5F	0.90	0.52	0.78	0.30	0.18	1.25	**FF5F**	1.82	0.07	0.73	0.73	0.53	0.28
Panel (B): Option 2													
Size-BM portfolios							**Size-Prof portfolios**						
CAPM	1.75	0.08	0.57	0.55	0.90	0.66	**CAPM**	1.12	0.35	0.55	0.79	1.32	0.36
FF3F	0.98	0.46	0.76	0.31	0.26	1.24	**FF3F**	1.19	0.30	0.69	0.43	0.43	0.71
FF5F	1.73	0.09	0.77	0.35	0.33	0.96	**FF5F**	0.65	0.75	0.75	0.37	0.27	1.05
Size-INV portfolios							**Size-Mom portfolios**						
CAPM	1.08	0.38	0.58	0.58	0.72	0.58	**CAPM**	1.80	0.07	0.60	1.05	1.08	0.17
FF3F	1.33	0.23	0.73	0.34	0.25	0.94	**FF3F**	1.28	0.25	0.71	0.57	0.32	0.42
FF5F	1.45	0.17	0.79	0.32	0.22	0.95	**FF5F**	1.56	0.13	0.72	0.67	0.46	0.32
Panel (C): Option 3													
Size-BM portfolios							**Size-Prof portfolios**						
CAPM	1.67	0.10	0.56	0.58	0.90	0.66	**CAPM**	1.09	0.37	0.54	0.77	1.35	0.38
FF3F	0.97	0.46	0.75	**0.30**	**0.26**	**1.24**	**FF3F**	1.28	0.25	0.68	0.46	0.47	0.69
FF5F	1.62	0.11	0.76	0.41	0.33	0.96	**FF5F**	0.66	0.75	0.74	0.38	0.30	0.97
Size-INV portfolios							**Size-Mom portfolios**						
CAPM	1.15	0.33	0.58	0.59	0.71	0.55	**CAPM**	1.69	0.10	0.60	1.00	1.10	0.21
FF3F	1.08	0.38	0.73	0.34	0.22	1.00	**FF3F**	1.22	0.29	0.70	0.51	0.27	0.64
FF5F	1.23	0.28	0.79	0.34	0.22	0.88	**FF5F**	1.69	0.10	0.72	0.60	0.40	0.46

This Table presents the GRS test and other metrics of dispersion to test model performance using the LHS approach. FF3F and FF5F are Fama and French (1993)'s three-factor and Fama and French (2015)'s five models. AR^2 is the average of the regression adjusted R-squared. $|A|$ is the average absolute value of the model intercepts. $A(a_i^2)$ is the average squared intercept, $A(r_i^2)$ is average squared value of r_i, which is the difference between the average return on LHS portfolio i and the average return on market portfolio. $As^2(a_i)$ is the average estimated squared standard error of the intercept. Each panel is for different portfolios construction alternatives. Option 1: uses the biggest 50 firms as big portfolio and the remaining as small, and uses the 30th-70th percentiles of big 50 firms as B/M, profitability, investment and momentum breakpoints. Option 2: ranks and use the first n number of firms that makes up to 90% of market cap as big portfolio and the rest as the small portfolio, and uses the 30th-70th percentiles of big 50 firms as before. Option 3: assigns the first n number of firms that build 90% of market cap to big portfolio and the rest are for small portfolio, and uses the 30th-70th percentiles of this big portfolio as B/M, profitability, investment and momentum breakpoints.

Table B.8 Factor spanning regressions: Alternative options

Panel (A): Option 1

Panel (A.1): six-factor model spanning regressions

	Coefficent							t(Coefficent)							
LHS	α	**Mkt**	**SMB**	**HML**	**RMW**	**CMA**	**WML**	**alpha**	**Mkt**	**SMB**	**HML**	**RMW**	**CMA**	**WML**	R^2
Mkt	2.21		-0.33	-0.13	-0.29	0.21	0.04	3.60		-2.27	-0.90	-1.99	1.52	0.35	0.11
SMB	1.23	-0.13		-0.19	-0.09	0.26	-0.02	3.05	-2.50		-1.94	-1.17	3.42	-0.29	0.13
HML	1.03	-0.05	-0.19		-0.24	0.19	0.09	2.66	-0.85	-2.10		-2.51	1.67	1.95	0.18
RMW	1.00	-0.18	-0.13	-0.37		-0.09	-0.02	2.62	-1.77	-1.38	-2.71		-0.53	-0.21	0.17
CMA	-0.55	0.10	0.30	0.23	-0.06		0.06	-1.44	1.44	3.20	1.76	-0.51		1.01	0.16
WML	0.50	0.04	-0.04	0.20	-0.03	0.12		0.81	0.36	-0.28	1.89	-0.21	0.96		0.04

Panel (A.2): Multi-factor test

Model	**LHS**	**GRS**	**p-value**
CAPM	SMB & HML	4.83	0.009
Three-factor model (FF3F)	RMW & CMA	3.177	0.044

Panel (B): Option 2

Panel (B.1): six-factor model spanning regressions

	Coefficent							t(Coefficent)							
LHS	α	**Mkt**	**SMB**	**HML**	**RMW**	**CMA**	**WML**	**alpha**	**Mkt**	**SMB**	**HML**	**RMW**	**CMA**	**WML**	R^2
Mkt	2.18		-0.25	-0.14	-0.30	0.24	0.01	3.33		-1.75	-1.05	-2.04	1.68	0.04	0.10
SMB	1.33	-0.12		-0.18	-0.06	0.25	-0.02	3.02	-2.02		-1.68	-0.66	2.61	-0.22	0.09
HML	0.66	-0.06	-0.15		-0.19	0.22	0.03	1.69	-0.98	-1.82		-1.52	1.71	0.51	0.14
RMW	0.77	-0.16	-0.07	-0.26		-0.10	-0.08	1.92	-1.80	-0.73	-1.75		-0.67	-0.94	0.14
CMA	-0.47	0.11	0.23	0.25	-0.09		0.11	-1.24	1.59	2.25	1.76	-0.62		1.51	0.17
WML	0.44	0.00	-0.03	0.06	-0.12	0.18		0.80	0.04	-0.22	0.52	-0.98	1.47		0.05

Panel (B.2): Multi-factor test

Model	**LHS**	**GRS**	**p-value**
CAPM	SMB & HML	3.83	0.024
Three-factor model (FF3F	RMW & CMA	2.448	0.090

Panel (C): Option 3

Panel (C.1): six-factor model spanning regressions

	Coefficent							t(Coefficent)							
LHS	α	**Mkt**	**SMB**	**HML**	**RMW**	**CMA**	**WML**	**alpha**	**Mkt**	**SMB**	**HML**	**RMW**	**CMA**	**WML**	R^2
Mkt	2.22		-0.25	-0.14	-0.32	0.25	-0.11	3.40		-1.81	-0.98	-2.03	1.62	-0.82	0.10
SMB	1.29	-0.12		-0.22	-0.06	0.30	0.03	2.98	-2.06		-2.02	-0.72	3.20	0.40	0.12
HML	0.66	-0.05	-0.18		-0.19	0.26	0.02	1.74	-0.92	-2.24		-1.42	1.83	0.39	0.15
RMW	0.80	-0.16	-0.07	-0.24		-0.07	-0.09	2.10	-1.88	-0.81	-1.54		-0.42	-1.10	0.13
CMA	-0.43	0.11	0.26	0.28	-0.05		0.09	-1.15	1.60	2.79	2.01	-0.39		1.27	0.19
WML	0.41	-0.09	0.05	0.05	-0.15	0.18		0.74	-0.86	0.39	0.39	-1.18	1.23		0.05

Panel (C.2): Multi-factor test

Model	**LHS**	**GRS**	**p-value**
CAPM	SMB & HML	3.73	0.026
Three-factor model (FF3F)	RMW & CMA	2.563	0.080

This table reports factor spanning regressions. Panel A, B and C are for portfolio construction alternatives as calculated in Table B.7. Panels A.1, B.1, and C.1 present factor spanning regression for the Fama and French's six-factor model for each option. It show coefficients and t-statistics of regressing each factor on other factors in the model. α is the regression intercept, R^2 is the adjusted R^2. Panels A.2, B.2, and C.2 show the GRS statistics and their p-values for the test that additional factors are jointly improving the maximum sharp ratio of the base model, either the CAPM or the three-factor model.

Table B.9 Factors statistics: Alternative options

	Mkt	SMB	HML	RMW	CMA	WML
Panel (A): Option 1						
Mean	1.98	0.60	1.08	0.22	0.03	0.70
std	7.99	5.28	5.54	6.64	5.64	7.58
t-stat	3.20	1.48	2.51	0.43	0.07	1.15
Panel (B): Option 2						
Mean	1.98	0.79	0.69	0.25	0.02	0.43
std	7.99	5.69	5.37	6.08	5.59	6.95
t-stat	3.20	1.79	1.66	0.52	0.05	0.76
Panel (C): Option 3						
Mean	1.98	0.78	0.67	0.29	0.07	0.29
std	7.99	5.70	5.39	5.83	5.38	7.10
t-stat	3.20	1.77	1.60	0.65	0.16	0.51
Panel (D): Zero returns filter						
Mean	1.98	0.63	1.13	0.23	0.25	0.74
std	7.99	5.51	6.21	6.81	5.76	7.25
t-stat	3.20	1.48	2.35	0.44	0.56	1.27
Panel (E): Penny stocks exclusion						
Mean	1.99	0.54	1.47	0.33	-0.02	0.65
std	8.00	5.41	5.70	6.91	5.77	7.34
t-stat	3.21	1.30	3.34	0.61	-0.05	1.10

This table reports summary statistics of factors returns for the period from July 2003 to June 2017 (expect for momentum factor from July 2004). MKT is the excess market portfolio above the risk free rate. SMB, HML, RMW, CMA and WML are the size, value, profitability, investment and momentum factors. Panels A, B and C are for portfolios construction alternatives calculated as in Table B.7. Panel (D) is for statistics after imposing a filter that excludes stocks with zero returns for the whole year from portfolios construction. Panel (E) shows factor statistics after excluding penny stocks the have unadjusted prices lower than one Egyptian pound.

Appendix C

Appendix to Chapter 4

Table C.1 Definitions of key variables

Variable	Symbol	Definition
Investment	I	Firm level investment is measured as capital expenditure (CAPEX) scaled by the beginning of period total assets.
Tobin's Q	Q	A proxy for firm growth opportunities. It is defined as book value of total assets (TA) plus market value of equity (MV) minus the book value of equity (BV), scaled by book value of total assets (TA).
Cash flow	CF	Net income plus depreciation and amortization scaled by the beginning of period total assets.
Size	logTA	The logarithm of total assets.
Leverage	LEV	The total debt over total assets.
Cash	cash	The ratio of firm cash holding to the beginning of period total assets.
Dividends	DIV	The cash dividends deflated by the beginning of period total assets.
Sales	Sales	Firm's sales scaled by the beginning of period total assets.
Debt issuance	Debt iss.	The change in total debt scaled by the beginning of period total assets.
Equity issuance	Equity iss.	New equity issunce deflated by the beginning of period total assets.
State	State	The percentage of state ownership. State ownership is defined as stocks holdings by any type of government owned or controlled entity. It includes public holding companies, companies, financial institution (bank, insurance companies and investment funds) and other institutions (national government ministries, public authorities or organization). Detail discussion on the construction of this variable is presented in Section 2.2.4 of Chapter 2.
Asset tangibility	TANG	Property, plant and equipment (PPE) over total assets.
Price informativeness	PI	It is measured by price non-synchronicity following Chen et al. (2007). Price non-synchronicity (firm-specific return variation) is computed each year by $1 - R^2$ from the regression of weekly stock returns on current and lagged value-weight market portfolio for firms included in the sample ($R_{it} = \alpha_i + B_1 mkt_t + B_2 mkt_{t-1} + \epsilon_{it}$). Lagged market returns are included to account for delays in information incorporation into prices and to alleviate the concerns of non-synchronous trading following Gul et al. (2010). Moreover, firm year observation for stocks that trade less than 25 weeks per year as well as missing observations are also excluded, following Jaslowitzer et al. (2018).

Table C.2 State cutoff and investment levels

	I
Q_{t-1}	0.00789*
	(0.00448)
CF_t	0.166***
	(0.0475)
1	-0.0138
	(0.00978)
2	-0.0246**
	(0.00998)
3	-0.0211**
	(0.00973)
$size_{t-1}$	0.00345
	(0.00230)
LEV_{t-1}	0.0204
	(0.0283)
$Cash_{t-1}$	0.0100
	(0.0178)
Div_{t-1}	-0.196**
	(0.0757)
$Constant$	-0.00376
	(0.0367)
Observations	1137
Adjusted R^2	0.146

OLS regression are presented in this table with year and industry fixed effects for the direct effect of state ownership on investment. We present state ownership with dummies at different cutoff (1,2 & 3). 1: refers to % of state ownership greater than 5% and less than 20%. 2: presents ownership greater than 20% and less than 50%. The last cutoff 3 presents state ownership higher than 50%. This is comparable to private firms with less than 5% state ownership. Standard errors clustered at firm level are in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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