FINANCIAL CONSTRAINTS, CAPITAL STRUCTURE AND INVESTMENT: EVIDENCE FROM LISTED MANUFACTURING FIRMS IN KENYA

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DECLARATION

This research is my original work and, to the best of my knowledge, has not been presented for award of a degree in any other University.

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X80/97010/2014

This thesis has been submitted for examination with our approval as University supervisors.

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DEDICATION

To my Mum, my son Kipkoech and my daughter Cheptoo

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LIST OF ABBREVIATIONS AND ACRONYMS

BPS	Budget Policy Statement
CEO	Chief Executive Officer
CH	China
CMA	Capital Market Authority
CBK	Central Bank of Kenya
DiD	Difference in Differences
EAC	East Africa Community
ESOP	Employee share options plan
EU	European Union
FC	Financially Constrained
FE	Fixed Effect Model
FMM	Finite Mixture Model
GDP	Gross Domestic Product
GMM	General Methods of Moment
GNP	Gross National Product
IFC	International Finance Corporation
IN	India

IPO	Initial Public Offer
KAM	Kenya Association of Manufacturers
KE	Kenya
KIPPRA	Kenya Institute for Public Policy Research and Analysis
KNBS	Kenya National Bureau of Statistics
MTP	Medium Term Plan
MUB	Manufacturing under Bond
NBV	Net Book Value
NFC	Not financially constrained
NPV	Net Present Value
NSE	Nairobi Securities Exchange
PoH	Pecking Order Hypothesis
RE	Random Effect Model
RER	Real Exchange Rate
RDD	Regression Discontinuity Design
SATE	Sample Average Treatment Effects
SMD	Simple Mean Difference
SME	Small and Medium Enterprises
SSA	Sub-Saharan Africa
UK	United Kingdom

USA United States of America

VAT Value Added Tax

OPERATIONAL DEFINITION OF TERMS

Asymmetric information or information asymmetry refers to the notion that firm's insiders, typically the managers, have better information than do market participants on the value of their firm's asset and investment opportunities.

Financial accelerator refers to a mechanism by which changes in financial and credit conditions propagate business cycle.

Financial constraint refers, except where otherwise noted, to frictions that prevent the firm from accessing external capital required to operate at optimal level. Financial constraint is used interchangeable with constraints on access to capital.

Firms real decision refers to decisions that lead to changes in real factors such as the productivity of the workforce, the quantity and quality of the capital stock or any other factor that affect economic growth and prosperity (B. S. Bernanke, 2007)

Tobin Q is defined as the market value of assets divided by the book value of assets. Market value of assets equals book value of assets plus the market value of common equity less the sum of the book value of common equity and balance sheet deferred taxes.

Pecking order theory is a capital structure theory where, due to information asymmetry, a firm prefers internal to external capital and debt to equity if external capital is used (Myers, 1984).

ABSTRACT

Evidence of financial constraints and its effects on firm's real decision in countries with advanced capital markets implies that the situation might be severe in countries with less developed capital markets. Despite this possibility, there is a dearth of evidence on the severity of financial constraints and its effects in Kenya. Against this backdrop, this study examined firm capital structure and investment and analysed the role of financial constraints in this context in Kenya. To this end, three specific objectives were addressed, each by an essay, using data from all manufacturing firms that were listed on Nairobi Securities Exchange between 1999 and 2016. The data was collected from published annual financial statements that companies filed at Capital Market Authority. The first essay analysed the determinants of financial constraints in Kenya. Size-age measure was found to perform better than measures of financial constraints based on endogenous switching regression and has high correlation with experienced financial constraints. Thus, size and age of the firms are the main determinants of financial constraints in Kenya. The endogenous switching regression based classifications were found to be sensitive to the choice of the starting values, and the specification of the outcome equation and the selection equation. They were inefficient and produced inconsistent sub-samples. About 67 percent of the firm-years in the manufacturing sector suffer from financial constraints. The second essay investigated the effects of financial constraints on firm capital structure. The goal of this essay was implemented in two ways. First, a financial constraints dummy variable was interacted with the determinants of capital structure. Second, incremental $F-test$ was used to test for the differences in the financing behaviour across financial constraint regimes. Pecking order theory does not hold, however, financing behaviour varies across financial constraint regimes. The third essay investigated the effects of financial constraints on firm investment. The study used investment Euler equation and Tobin Q to examine whether constrained and unconstrained firms invested differently, in terms of what drives investment. Secondly, real exchange rate shock was used to analyse firm's investment response to shock in the presence of financial constraints. The empirical strategy was to compare investment rate immediately before and after the shock for firms under different degrees of financial constraints. Financial constraints negatively affect investment and firm's response to shock depends on financial constraint status. Overall, financial constraints affect young and small firms causing them firms to forego external capital, underinvest, and alter their response to a positive shock. Policy should aim at easing constraints on access to capital by broadening the scope of assets that can be pledged as collateral and instituting policies to reduce costs associated with verification of private information, and contract enforcement including legal charge such as by creation of a central depository for collateral. Furthermore, to minimize policy related distortions, financial constraints should be taken into consideration in designing the level of interventions.

Keywords: Financial constraints, manufacturing, investment, capital structure, endogenous switching regression.

JEL classification: D82; D92; E22, G31, G32, G33, L60.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

1.1.1 Capital Market Imperfection and its Effects

Capital market imperfections arise due to a number of factors that include: transaction cost, asymmetric information, cost of contract enforcement, and debt overhang. Under information asymmetry, for instance, firm's management has more information about the returns on investment or the quality of assets than providers of external capital. Thus, the providers of external capital are in a disadvantaged position if they choose to invest in the firm. Consequently, they are exposed to losses in the form of low returns on investment or low resale value of collateral due to low quality of firm's assets in case of foreclosure.

Providers of external capital cushion themselves from these losses and the costly processes of acquiring additional information about the firm by either demanding lemon premium over and above the opportunity cost of internal funds or rationing external capital to the firm. These correspond, respectively, to the price and quantity constraints on access to external capital. Price and quantity constraints also coincide with the two formal definitions of financial constraints. The first definition is based on the wedge between internal and external capital and the other based on elasticity of supply of capital (Farre-Mensa & Ljungqvist, 2015).

One of the implications of capital market imperfections is to substantially raise the cost of external capital relative to the opportunity cost of internal funds

(Fazzari, Hubbard, Petersen, Blinder & Poterba, 1988), for a subset of firms, leading to differences in firm access to external capital. The higher the cost of external capital relative to internal capital the more severe the financial constraint is. Another formal definition of financial constraints arises due to inelastic supply curve of external capital (Almeida, Campello & Weisbach, 2002; Stiglitz & Weiss, 1981; Whited & Wu, 2006). The steeper the supply curve the more inelastic the supply of external capital and the more severe the financial constraint is. Firms are shut out of the capital market when the supply curve is perfectly inelastic.

High cost of external capital raises the marginal cost of capital which, depending on the magnitude, might cause net present value (NPV) of some investments to switch from positive to negative position hence reducing investment opportunity set of the affected firms[1]. Thus, under imperfect capital markets external capital is disadvantaged and the capital market respond by making it costly, which in turn causes financial constraints (Hoberg & Maksimovic, 2014). Financial constraints prevent firms from perfectly substituting external capital for internal capital and vice versa. Firms that are unable to operate at optimal level of investment due to costly or inadequate supply of external capital are said to be constrained, otherwise they are unconstrained.

Capital market imperfections cause quantity and price constraints on access to external capital with asymmetrical effects on firm's real decisions[2]. Constraints on access to external capital among listed firms has been shown to negatively affect investments (Campello, Graham & Harvey, 2010; Fazzari, Hubbard

[1]This is price constraints in access to external capital which is different from the quantity constraints first discussed in Stiglitz and Weiss (1981).

[2] Decisions that lead to changes in real factors such as the productivity of the workforce, the quantity and quality of the capital stock or any other factor that affect economic growth and prosperity are referred to as real decisions (B. S. Bernanke, 2007).

& Petersen, 2000; Fazzari et al., 1988) and employment (see for instance: Benmelech, Bergman & Seru, 2011; Campello et al., 2010), thereby constraining future economic growth (Campello et al., 2010).

The common view is that listed companies have access to various sources of finance and therefore face no or little difficulties in access to capital. Empirical evidence, however, show that listed companies even in countries with advanced capital markets such as USA (Almeida & Campello, 2007; Fazzari et al., 1988; Hadlock & Pierce, 2010; Kaplan & Zingales, 1997), UK (see: Bond & Meghir, 1994; Guariglia, 2008) and Japan (Goyal & Yamada, 2001; Hoshi, Kashyap & Scharfstein, 1991) as well as emerging markets (Blalock, Gertler & Levine, 2008) face financial constraints. Despite empirical evidence of negative effects of financial constraints on investment and employment among listed firms, there is a dearth of evidence on the severity of financial constraints and its effects in Kenya.

In a frictionless world of Modigliani and Miller (1958), capital markets are perfect and therefore internal and external capital are perfect substitutes. Therefore, firms are able to fully finance and undertake all investments with positive net present values. Although, the assumption of perfect capital market has been very influential in the standard neoclassical model of investments, market failure due, for instance, to information asymmetry and agency problem call into question the validity of this assumption in practice.

Starting with the seminal work of Fazzari et al. (1988), several studies have challenged the assumption of perfect capital markets, by examining the impact of capital market imperfection on firms' investment (Agca & Mozumdar, 2012; Cummins, Hassett & Oliner, 2006; Hoshi et al., 1991; Kaplan & Zingales, 1997). The standard approach in the literature is to classify firms into groups with

differing degrees of financial constraints[3], fit an investment equation augmented with financial variable (such as cash flow) for each subset of firms and assess the sensitivity of investment to financial variables by comparing the coefficient of the financial variable across the sub-samples. The higher the coefficient of financial variable the higher the sensitivity and the more severe financial constraints are. If a firm cannot raise funds externally, then it will only use internally generated funds – cash flow – to invest; hence cash flow for such firms should drive investments. This approach has been widely applied, however, with mixed results.

While some studies have shown that investment is sensitive to cash flow for firms facing higher degrees of financial constraints (see for instance: Agca & Mozumdar, 2012; Almeida & Campello, 2007; Fazzari et al., 2000, 1988; Hoshi et al., 1991) others have shown that investment can be sensitive to current cash flow for firms without difficulties in access to external capital (Cleary, 2006; Kaplan & Zingales, 1997) while other studies have shown that investment is not sensitive to cash flow, when measurement errors in Tobin q[4] is taken care of, even for financially constrained firms (Cummins et al., 2006; Erickson & Whited, 2012).

Theoretically, there is no basis to expect investment-cash flow sensitivity to be monotonic on the degree of financial constraints (Kaplan & Zingales, 1997, 2000) and thus, the interpretation of results is contentious (Romer, 2012). Moreover, if cash flow is related to omitted variables that proxy for profitability or captures measurement errors in Tobin q, then the investment-cash flow relationship is spurious (Kaplan & Zingales, 1997, 2000).

[3]Using proxies of financial constraints such as dividend payout ratio, age of the firm, size of the firm, affiliation of the firm to financial institution(s) and Chief Executive Officers (CEOs) statements on financial difficulties.

[4]Tobin Q is defined as the market value of assets divided by the book value of assets.

The controversy in the interpretation of investment-cash flow sensitivity is complicated further by the challenges in the classification of firms. Various proxies such as dividend payout ratio, age of the firm, size of the firm, affiliation of the firm to financial institution(s) and Chief Executive Officers (CEOs) statements on financial difficulties have been used in the literature to classify firms into different financial constraints sub-samples. The assumption is that the proxies of financial constraints chosen varies with the severity of the informational problem such that more informationally opaque firms face higher cost of information asymmetry and thus are financially constrained. This approach suffers from endogeneity problem since proxies of financial constraints such as dividend payout ratios are often correlated with key variables that affect real decisions in the presence of financial constraints such as cash flow.

In addition, classification of firms is complicated since the financial constraints faced by a firm cannot be observed. Consequently, a number of studies have taken a different direction by validating their proxies of financial constraints and even classifying firms using indices (Fazzari et al., 1988; Hadlock & Pierce, 2010; Kaplan & Zingales, 1997; Whited & Wu, 2006). However, classification generated using these indices are inconsistent across different indices (Farre-Mensa & Ljungqvist, 2015). In an attempt to improve on classification some studies have used survey methods to directly obtain financial constraint status from the firm (see for instance; Campello et al., 2010; Savignac, 2008). However, directly asking firms to state their financial constraint status introduces biases.

These biases might arise due to the following reasons. First, self-reported financial constraint statuses are linked to the interviewee's perceived severity of the financial constraints and thus, are likely to be measured with a lot of noise. Second, unprofitable firms might have a tendency to blame it on financial constraints. Third, the response is likely to depend on the interviewee's

expectation on the use of the information. If they expect the information to be used in the design of financial assistance such as bailouts during a crisis, then they might overstate the reported financial constraints in order to increase the likelihood of benefiting. Finally, self-reported financial constraints do not capture the experienced financial constraints such as the actual amount of investment or research and development forgone in the previous year due to inability to fully meet the external financing needs.

Other studies have used endogenous switching regressions, a method which eliminates the need for ex ante sample separation, to address static and dynamic misclassification problem. In this approach, the process by which firms are sorted into financial constraint status is endogenously related to the factors that determine the outcome variable (Almeida & Campello, 2007). Endogenous switching regression approach does not require a priori classification of firms, a regime selection equation is specified instead, in addition to the outcome equation and starting values.

Evidence that covariates used to generate Kaplan and Zingales (1997) index, Whited and Wu (2006) index and Hadlock and Pierce (2010) index in a single equation context produce inconsistent sub-samples and therefore do not accurately measure financial constraints (Farre-Mensa & Ljungqvist, 2015) imply that endogenous switching regressions indices might be sensitive to the choice of the starting values and the specification of the outcome and selection equation. Therefore, they might suffer from the same limitation as their single equation counterparts. Thus, accurate identification of financially constrained firm-years remains elusive. However, determining the effects of financial constraints on firm's real decisions hinges on identifying a proxy of financial constraints that capture experienced financial constraints.

Beside investment, research and development, and employment; financial constraints are likely to affect the choice of the source of funds and cumulatively the capital structure of the firm. Firms, which according to pecking order theory[5] should issue debt, have been found to bypass debt to issue equity due to financial constraints (Brown, Fazzari & Petersen, 2009). Furthermore, pecking order theory has been found to fail where it should not and hold where it should not (Fama & French, 2002; Frank & Goyal, 2003). Since financial constraints affect the choice of the source of finance, then it might explain the "reversal of pecking order prediction". In this context, it is natural to ask; what are the effects of financial constraints on capital structure and investment in Kenya given the possibility of financial constraints among listed firms?

1.1.2 Manufacturing Sector and Capital Markets in Kenya

Kenya is a sub-Saharan African country located in East Africa with a population of about 45.4 million in 2016 and real per capita GDP (2009 constant prices) of Kshs 94,757.3 in 2016 (Republic of Kenya, 2017). During the period covered by this study, the Kenyan economy registered mixed performance in terms of economic growth. The early 1990s depression occasioned by a severe drought, high inflation, and foreign aid suspension (Gertz, 2009), ended in early 2000s and was followed, from 2003, by a period of economic recovery. The implementation of Economic Recovery Strategy for Wealth and Employment Creation development program between 2003 and 2007 brought the economy into the recovery path. Save for 2007 post-election violence and the 2011 macroeconomic shocks, the economy registered strong performance between 2003 and 2016.

[5] A firm is said to follow a pecking order if it prefers internal to external capital and debt to equity if external capital is used (Myers, 1984).

Capital market registered tremendous growth since late 1990s following market regulation and liberalization reforms. The establishment of Capital Market Authority (CMA) in 1989 to regulate activities in the capital market was followed by reforms geared towards liberalization of the capital market. However, up to early 2000s capital market remained largely self-regulated with intermittent interventions (Gakeri, 2012). Bond markets have remained largely underdeveloped in Kenya despite being regarded as a relatively cheaper source of capital.

From late 1990s, firms in Kenya have slowly embraced corporate bonds in financing their long term investment; however, the uptake is still very low. The bulk of funds for financing capital investment come from internal finance followed by bank loans and overdraft. Since the bulk of investors in the bond market are institutional investors consisting mainly of banks, the lack of closer monitoring mechanism in the bonds market might explain why it has remained unattractive channel of investment for banks. The value of corporate bonds stood at 86.76 billion Kenya shillings in 2016. Equity is however unimportant in financing capital expenditures even though it is the main security listed and traded in the Kenyan capital markets. Between 1999 and 2016, there were only three incidences where shares were issued by firms in the manufacturing sector after initial public offer (IPO)[6].

Bank loans continue to remain one of the major sources of external funds for firm's investment despite the commercial banks' inadequate structure to provide long term capital needs (Ziorklui, Nyagetera & Rutasitara, 2001). In addition, during the period 1999 to 2016, interest rate spread averaged about 9.8 percent (World Bank, 2017). High interest rate spread suggests low returns on savings on

[6]These include Unga Ltd in 2001, EABL in 2004 and ARM in 2007. The ARM additional shares in 2007 was issued through Employee share options plan (ESOP).

one hand and high (and possibly prohibitive) interest rate on borrowings, on the other. This imply that commercial banks might not be able to mobilize enough savings to meet the demand for credit. Thus, some firms' demand for credit goes unfulfilled due to credit rationing and, additionally, due to high (and possibly prohibitive) interest rate on borrowings.

Low participation and the sluggish growth in the bond market can be partly explained by the affinity for bank loans and overdraft as well as reluctance by banks, who are the major players, to invest in the bond market. For example, by 2016 there were only 18 companies that had issued corporate bonds (3 of which are not listed in Nairobi Securities Exchange), up from 5 in 2005, with a total value of 86.76 billion Kenya shillings (Capital Markets Authority, 2012). With a total of 62 listed firms, this translates to corporate bonds utilization rate of about 24.2 percent in 2016.

Owing to the capital market's fundamental role of mobilizing financial resources for investment and growth, a great deal of effort and resources has been devoted towards the development of capital market. This effort, which begun with the joint study by Central Bank of Kenya and International Finance Corporation in 1984, culminated into the establishment of Capital Market Authority with six objectives. Foremost of these objectives is the development of the capital market with particular emphasis on the removal of impediments to longer term investments in productive enterprises (Capital Market Authority, undated).

In 1990s, an attempt was made to reduce the cost of listing by making the cost of issuing debentures, bonds and shares (initial public offering) tax-deductible expenses (Nyasha & Odhiambo, 2014). This was aimed at reducing the cost of obtaining external capital by firms. Other reforms during the period includes exempting listed companies from paying taxes such as stamp duty, capital gain taxes and VAT as well as other tax concessions. Despite this and other efforts

to revitalize stock and bond markets in 1980s and 2000s, respectively, the stock market is still shallow, narrow and thin while bond market which is at its infancy attracts more of government bonds and less corporate bonds, (Ngugi, Amanja & Maana, 2009). The foregoing shows that there is a higher likelihood of financial constraints amongst listed firms in Kenya.

Between 1999 and 2016, the manufacturing sector expanded marginally leading to a fall in its contribution to GDP. The manufacturing sector declined in importance from the second place, contributing about 10.8 percent to GDP in 2008 (KNBS, 2012) to the fourth place in 2012, accounting for about 9.5 percent of GDP before declining further to 9.1 percent in 2016 (KNBS, 2014, 2018). Its contribution to GDP in 2012 falls behind those of agriculture (24.6 percent), wholesale and retail trade (10.5 percent), and transport and communication (9.6 percent). This implies that the manufacturing sector has not expanded fast enough to sustain its contribution to GDP. Investment in research and development and capital have been identified as key in achieving technological improvement and efficiency gains in production at aggregate and sectoral levels of the economy. However, this has not been achieved partly due to low private investment in Kenya, which has constrained the expansion of the manufacturing sector (Bigsten, Kimuyu & Söderbom, 2010).

Besides its contribution to GDP, the manufacturing sector contribute 70 percent of the industrial sector output (Republic of Kenya, 2013), about 25 percent of exports and about 13 percent to the total employment (Republic of Kenya, 2012). Figure 1.1 on the following page shows the trend of the manufacturing sector contribution to GDP and exports between 1999 and 2015.

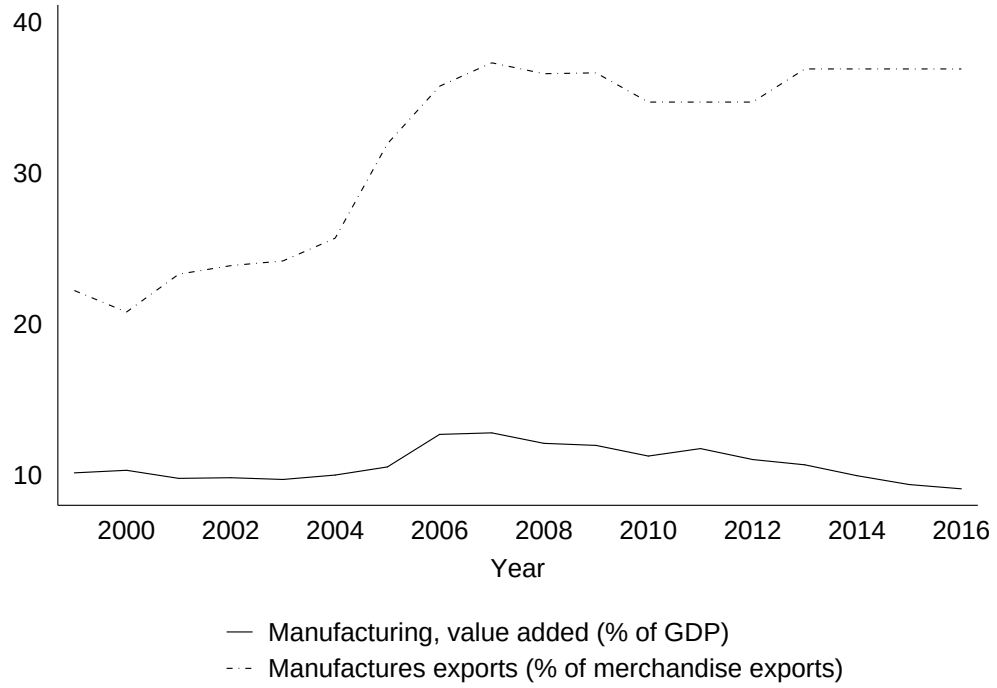

Figure 1.1: Manufacturing Value Added Output and Exports
Source: World Bank, 2017

The contribution of manufacturing sector to GDP averaged about 11 percent between 1999 and 2005. It then jumped to about 14 percent in 2006 and 2007 before falling to about 13 percent between 2008 and 2011, and dipped further down between 2012 and 2015. The manufacturing sector's contribution to exports (as a percentage of merchandise exports) was about 2 to 3 times its contribution to GDP during the period. It peaked in 2007 before declining and remaining at about 35 percent thereafter. Despite recording marginal increase in contribution to GDP, the manufacturing sector's contribution to exports expanded significantly.

The manufacturing sector has gone through three different policy regimes: import substitution, liberalization and export promotion (Chege, Ngui & Kimuyu, 2014). In pre- and post-independence period and up to early 1980s, Kenya pursued import substitution strategy. It was succeeded by market

liberalization in 1980s then by export oriented strategies in 1990s onward. Reforms in 1990s focused on export promotion and it included: establishment of Export Promotion Council in 1993, the Export Compensation Scheme, Manufacturing Under Bond scheme, Export Processing Zones, import duty remission and value added tax (VAT) drawbacks on exports.

Various development blueprints such as Kenya Vision 2030 and Medium Term Plans identify investment climate and manufacturing as key in attaining the targeted rate of economic growth. The targets set in Kenya Vision 2030 can only be attained if the economy and six key sectors among them the manufacturing sector grows at the rate of 10 percent per annum. It is hoped that a robust, diversified and competitive manufacturing sector is desirable to realize the sector's potential contribution to GDP, exports and employment. However, the sector has recorded little progress since 1960s. Contribution of the manufacturing sector has remained unchanged at about 10 percent since 1960s despite industrialization being advocated as the main driver of economic development. In addition, the first medium term plan fell short of its manufacturing sector contribution to GDP target[7].

Sessional Paper of 2012 on Kenya Vision 2030 recognize that continued decline in investment and overall lack of competitiveness have constrained the manufacturing sector from realizing its potential contributions to the economy in terms of output, exports and employment (Republic of Kenya, 2012). Among the factors identified to cause the decline in investment is the limited access to capital. Figure 1.2 presents a plot of a cross country relationship between the manufacturing sector value addition as a percentage of GDP and domestic credit to private sector by banks as a percentage of GDP for lower middle-income

[7]Vision 2030 is implemented under medium term plan, the first ran between 2008 and 2012 but largely it did not achieve its target level of contribution of manufacturing sector to GDP.

countries. Lower middle-income economies as used here included selected countries to exclude outliers with a GNI per capita, calculated using the World Bank Atlas method, of between US $1,026 and US $4,035 per annum in 2016.

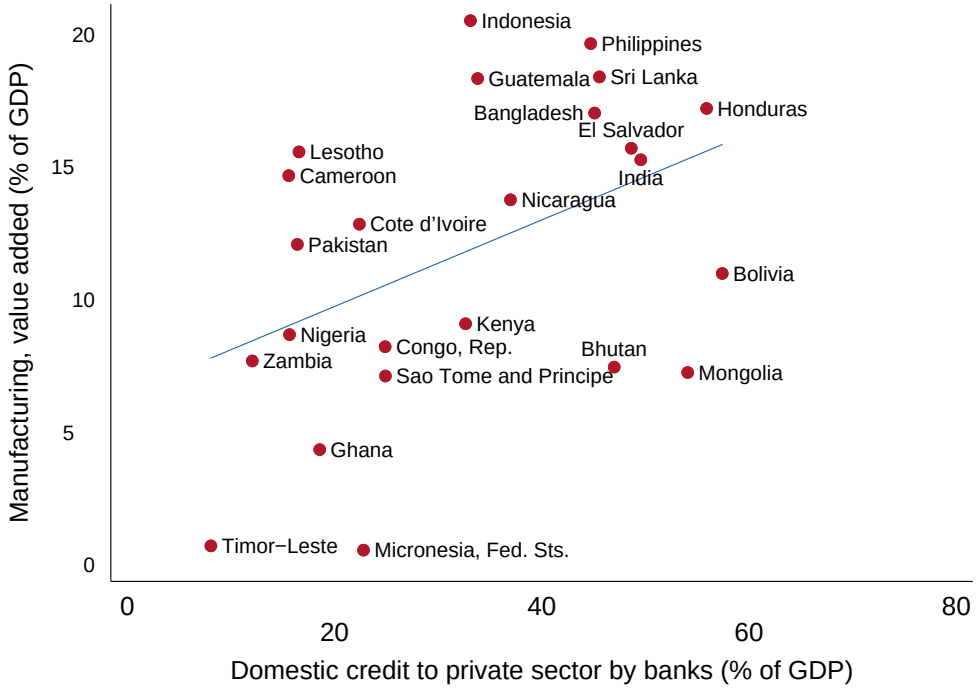

Figure 1.2: Domestic Credit to Private Sector and Manufacturing Sector
Source: World Bank, 2017

There is a positive relationship between the contribution of the manufacturing sector to GDP and the domestic credit to private sector by banks as a percentage of GDP. High domestic credit to private sector by banks is associated with high contribution of the manufacturing sector to GDP. One implication of this is that a robust financial sector that avails credit to the productive sectors of the economy with minimal or no supply constraints will lead to growth and hence significance of these sectors in the economy.

The contribution of the manufacturing sector to GDP in Kenya in 2016 was 9.1% while the domestic credit to private sector by banks was 32.6% of GDP. This

suggests that the low level of contribution of the manufacturing sector to GDP might be explained by the low levels of domestic credit to private sector by banks. Despite this, there is a dearth of evidence on how limited access to capital affects firm's real decisions in Kenya.

1.2 Statement of the Problem

If capital markets are perfect, then internal and external capital are perfect substitutes and therefore the observed corporate investment levels are optimal. However, under imperfect capital markets, financial constraints become a problem and the affected firms forgo some of the profitable investment opportunities resulting in suboptimal level of corporate investment. Constraints in access to capital is associated with low level of utilization of external capital which in turn results in low level of corporate investment relative to the optimal level of investment.

The growth in manufacturing sector fell below that of GDP leading to a decline in its contribution to GDP from 10.8 percent in 2008 (KNBS, 2012) to 9.5 percent in 2012 (KNBS, 2014) and further to 9.1 percent in 2016 (KNBS, 2018). Existing evidence shows that limited access to capital is one of the major constraints leading to low private investment and hence limiting expansion of the manufacturing sector in Kenya (Bigsten et al., 2010). Moreover, investment rate is lower by about 67 percent[8] for firms that do not use external capital in Kenya (Ngugi et al., 2009). Evidence of financial constraints among listed companies even in countries with advanced capital markets relative to Kenya such as USA, UK, Japan and emerging markets points to a higher likelihood of financial constraints among listed manufacturing firms in Kenya.

[8]Ngugi et al. (2009) found an investment rate of 0.157 for firms using external capital versus 0.051 for firms not using external capital

Constraints on access to external capital affect the mix of financing used in investment and other operations. This in turn, affects the capital structure of the firm. Specifically, financial constraints makes firms to bypass debt and issue equity (Brown et al., 2009), increasing the likelihood of violation of pecking order hypothesis. Previous studies have shown that pecking order hypothesis fail for the subsets of firms with huge informational problem and is stronger for the subset of firms with less informational problem (Fama & French, 2002; Frank & Goyal, 2003). This violates the prediction of pecking order theory.

A key element in examining the effects of financial constraints is a setting where some firms suffer from financial constraints and accurate identification of financially constrained firms. Manufacturing firms have specialized assets which are likely to have high sunk cost due to thin resale market and therefore are difficult to collateralize. Hence can be considered as relatively illiquid (Chirinko & Schaller, 1995). Consequently, some firms in the manufacturing sector are likely to be financially constrained. Identification of financially constrained firms in order to estimate the effects of financial constraints on firm's real decision is a challenge that is yet to be resolved (Farre-Mensa & Ljungqvist, 2015).

Classification of firms is complicated since the financial constraints faced by a firm cannot be observed and secondly, since the proxies of financial constraints are often correlated with key variables that affect real decisions in the presence of financial constraints. Previous studies have largely used proxies based on archival records and subjective measures in classification of firms. These proxies are likely to result in endogeneity problem, bias and errors in the classification of firms. In an attempt to overcome endogeneity problem and address static and dynamic misclassification problem, a number of studies have exploited exogenous shocks and endogenous switching regression models, respectively.

However, failure to take into consideration differences in financial constraint status across the shock groups might introduce bias. Moreover, it is difficult to distinguish the effects of the shocks from the effects of influential variables. If the response to the shock varies with financial constraint status, and the assignment of each firm into its respective financial constraint status is not random process but related to firm characteristics, then simple comparison of before-the-shock and after-the-shock outcome will be flawed. Lastly, evidence that the common linear combination of firm characteristics produce inconsistent sub-samples and therefore do not accurately measure financial constraints (Farre-Mensa & Ljungqvist, 2015) imply that endogenous switching regressions indices might not capture experienced financial constraints.

1.3 Research Questions

From a researcher's point of view, evidence of static and dynamic misclassification problem in the identification of financially constrained firms and its effect on the estimates of the effects of financial constraints on firm's real decision and evidence that financial constraints causes firms to bypass debt to issue equity (Brown et al., 2009) and reduce expenditures on: research and development (Brown et al., 2009; Campello et al., 2010), investment (Agca & Mozumdar, 2012; Bond & Meghir, 1994; Campello et al., 2010; Fazzari et al., 2000, 1988; Hoshi et al., 1991; Rauh, 2006) and employment (Benmelech et al., 2011; Campello et al., 2010) raises the following important questions about financing and investment behaviour of firms:

(a) Do measures of financial constraints capture experienced financial constraints?

(b) What are the effects of financial constraints on firm capital structure in Kenya?

(c) What are the effects of financial constraints on firm investment in Kenya?

Against this backdrop, this study examined firm capital structure and investment and analysed the role of financial constraints in this context in Kenya.

1.4 Objective of the Study

The overall objective of this study was to examine firm capital structure and investment and to analyse the role of financial constraints in this context in Kenya. Specifically, this study:

(a) Evaluated accuracy of measures of financial constraints.

(b) Determined the effects of financial constraints on firm capital structure in Kenya.

(c) Investigated the effects of financial constraints on firm investment in Kenya.

1.5 Significance of the Study

The findings of this thesis are important for eight reasons. First, determining whether information asymmetry has large effects on capital market is central in deepening our understanding and shaping our interpretation of the observed investment-cash flow sensitivities. Whether information asymmetry has large effects in practice or not, has implications on the interpretation of outcome in the literature. Knowing how information asymmetry affects real decisions is critical as interpretation of investment-cash flow relationship is contentious (Romer, 2012). Furthermore, determining the effects of financial constraints on firm's capital structure and hence the cost of external funds is important in shaping the interpretation of the observed investment-cash flow sensitivities.

Second, determining if information asymmetry has large effects in practice is important since the two major sources of financial constraints - information asymmetry and transaction cost - have different policy implications (Chirinko & Schaller, 1995). In particular, determining the form which financial constraints take is important in developing policies to alleviate constraints on access to external capital. Third, understanding how sensitive endogenous switching regression model's classification is to the choice of starting values and the specification of the outcome and regime selection equation is important in checking the robustness of endogenous switching regression results in financial constraints literature and other areas applying endogenous switching regressions.

Fourth, accuracy in sorting of each firm into its respective financial constraints state is important so as to capture the reality of firm's financial constraint status and generate valid estimates of the effects of financial constraints on firm's real decisions. Thus, the measures of financial constraints should be reliable and accurate. Moreover, accuracy in classification of firms minimizes classification errors and mitigates against the controversy in the interpretation of the results. Fifth, the findings of this thesis highlights the importance of supply side constraints, in particular, access-to-finance dimension of business environment on firm's investment.

The investment rate for firms that use external capital in Kenya is three times that of firms that do not use external capital (Ngugi et al., 2009) suggesting that firms under-invest possibly due to constraints in access to external capital. Underinvestment at micro-level has three effects. These three effects give three additional reasons why the findings of this thesis are important. Sixth, it is passed on, to the extent of the importance of financial constraints in the economy, to the aggregate level leading to lower aggregate investment. This leads to low private investment in the economy. Limited access to capital leads to low private

investment (Bigsten et al., 2010) and hence lower production capacity which in turn reduces the strength of future economic growth (Campello et al., 2010).

Seventh, underinvestment at micro-level generates distributional consequences. For instance, this can occur if financially unconstrained firms undertake investment foregone by financially constrained firms (Rauh, 2006). This distributional effects could lead to a shift in wealth from residents to foreigners if the control of listed financially unconstrained firms by multinationals is significantly large. Multinational companies are likely to face little or no financial constraints since parent company can mobilize resources from other subsidiaries or from less costly markets and direct it to high return investments. Last, reliance on internally generated funds by financially constrained firms implies high sensitivity of investment to cash flow which might act as an additional channel of propagation of shocks. Financial constraints amplify the shocks especially those affecting the cash flow. This is key in the assessment of the effectiveness of monetary policy and understanding fluctuation of investment at macro-economy level.

1.6 Contribution of the Study

This study makes a number of contributions. It may be considered as one of the first attempts to measure the severity of financial constraints among listed manufacturing firms in Kenya. In this respect, a new measure was constructed from dividend payout ratio, in addition to another measure based on a combination of size and age, to identify financial constraint status. Unlike Fazzari et al. (1988) who used dividend payout ratio, this study constructed a measure, the dividend payout measure, using distance from frontier method. This measure takes into consideration changes in financial constraint status over time. An evaluation of these two measures and the final classification values

of the endogenous switching regression against experienced financial constraints shows that only size-age measure is a good proxy of financial constraints.

This study also constitutes one of the first attempts to improve on the identification of financially constrained firms by evaluating various measures of financial constraints. This study departs from previous studies such as Campello et al. (2010), Hadlock and Pierce (2010) and Farre-Mensa and Ljungqvist (2015), which evaluated measures based on linear combination of firm characteristics or individual proxies of financial constraints by evaluating measures of financial constraints under endogenous switching regression framework. The paper closest to this study in this context is Farre-Mensa and Ljungqvist (2015). While Farre-Mensa and Ljungqvist considered Kaplan and Zingales (1997), Whited and Wu (2006) and Hadlock and Pierce (2010) indices in a single equation context, this study evaluated these indices in an endogenous switching regression context. This study posited that the results under endogenous switching regression do not depend on the starting values and the specification of the outcome and selection equations. The results from this study, however, contradicted this view. In addition, size-age based measure performed better than measures based on endogenous switching regression. The latter were found to be inefficient in the identification of financially constrained firms.

This study contributed methodologically in testing of pecking order theory in the presence of financially constrained regimes. The test for pecking order theory was implemented by interacting a dummy variable (a measure of financial constraint status) with the determinants of capital structure. The idea is to allow financially constrained regimes, a departure from earlier work such as Lemmon and Zender (2010). The introduction of financially constrained regimes in pecking order equation improved the fit of the pecking order equation and produced results that are consistent with pecking order prediction. This study

concluded that financial constraints and debt capacity constraints are important in aligning the results of pecking order model to those predicted by the pecking order theory. Moreover, this approach allowed this study to make a contribution to the literature by demonstrating the importance of financial constraints in explaining why data contradicts pecking order theory.

This study contributed to the literature by empirically analysing firm's investment response to shocks in the presence of financial constraints. Past studies have considered exogenous shocks such as cash windfall in corporate lawsuits (Blanchard, Lopez-de Silanes & Shleifer, 1994), capital expenditures of oil companies in their non-oil corporate segments (Lamont, 1997) and discontinuity in corporate pension funding obligations (Rauh, 2006). This study complements the work of these studies by showing that firm's response to shocks depended on financial constraint status. Financially constrained firms responded by not changing their investment expenditure while financially unconstrained firms' investment jumped up immediately after the shock.

The findings of how a financially constrained firm responds to a positive shock and indirect effects of cash flow, to the best of my knowledge, have not been documented before. The paper close to this study is Blanchard et al. (1994). They considered how firms uses cash windfall in corporate lawsuits in general; hence their results did not show the effects of cash windfall on investment under different financial constraints states. In addition, their sample was small. Thus, only negative shocks have been considered in the literature on the effects of financial constraints on investment.

Hitherto, cash flow was thought to directly affect investment in the presence of financial constraints. When financial constraints are binding the effects of cash flow depended on the current level of external capital. These contributions shade light on the importance of supply side constraints, in particular constraints on

access to capital among listed firms, in financing and investment decisions. It would also help policymakers to understand how financial constraints affect the expansion of the manufacturing sector, in particular, and private investment for non-financial firms, in general.

1.7 Conceptual Framework

This is a general model that applies to all the three essays. The basis of determining the impact of financial constraints is classification of firms into groups on the basis of differences in financial constraint status and, controlling for other relevant factors, estimate the differences in the outcome of interest between these groups. In the same spirit, this study develops a strategy for identifying financially constrained firms and estimating the differences in the outcome of interest.

In this theoretical model, the objective of the firm is to maximize the value of its risk neutral owners. Therefore, risk has no effect on the shareholder's required rate of return. The firm operates in a competitive product market but in an imperfect capital market characterized by information asymmetry. Assume information asymmetry imposes informational cost on equity such that equity-holders being residual claimants face a higher risk of loss and therefore demand a higher rate of return compared to debt-holders. Thus, debt and equity will not be perfect substitutes.

In addition, information asymmetry imposes informational cost or agency cost on the use of external capital and therefore internal and external funds are not perfect substitutes. Therefore, shareholders will prefer the firm to issue debt over equity once it exhaust internal funds and will only prefer issuance of equity once the firm exhaust its debt capacity. For simplicity, assume that the cost of internal

funds is zero so that what matters is the wedge between the cost of internal and external capital.

Let I_{jt1} be the outcome of firm j at time t in financially constrained state (financial constraint state 1), I_{jt0} be the outcome of firm j at time t in financially unconstrained state (financial constraint state 0) and is the first best solution and X_{jt} be the covariates of firm j at time t. In addition, let $FC = 1$ if the firm faces financial constraints, such that I_{jt1} is observed and let $FC = 0$ in the absences of financial constraints, such that I_{jt0} is observed. Thus, the outcomes conditional on X_{jt} are:

$$I_{jt1} = \beta_1 X_{jt} + \varepsilon_{jt1} \tag{1.1}$$

$$I_{jt0} = \beta_0 X_{jt} + \varepsilon_{jt0} \tag{1.2}$$

And the observed outcome is:

$$I_{jt} = FC \bullet I_{jt1} + (1 - FC) \bullet I_{jt0} \tag{1.3}$$

The financially constrained state to which the observed values of the outcome variable, I_{jt}, belong is unobservable. Thus, the sample separation is unknown.

Let the return on investment I be given by a production function $R(I)$, where $R'(I) > 0$ and $R''(I) < 0$. That is, R is continuous, twice differentiable and concave in its argument, I. Financial constraints reduce the outcome, hence $I_{jt1} < I_{jt0}$ and thus $R\left(I_{jt1}\right) < R\left(I_{jt0}\right)$. Financially constrained firms can decide to use internal finance only and get contented with I_{jt1}. Alternatively, they

can pay a higher cost of external funds relative to unconstrained firms (incur an additional cost of C_{jt} over and above the cost of internal finance) to obtain external funds and improve the outcome to I^c_{jt1}, where $I_{jt1} \leq I^c_{jt1} \leq I_{jt0}$. C_{jt} is the wedge between the cost of external capital and internal finance for firm j at time t and is assumed to be increasing with the severity of financial constraints. Furthermore, C_{jt} is the value a firm transfer to providers of external capital if it decides to use external capital in a constrained state.

It is rational to incur C_{jt} if $C_{jt} \leq R\left(I^c_{jt1}\right) - R\left(I_{jt1}\right)$ which is the range within which the effects of financial constraints can be mitigated. In the case where $C_{jt} > R\left(I^c_{jt1}\right) - R\left(I_{jt1}\right)$, financial constraints are binding and therefore it is not feasible for the affected firms to incur any extra cost in an attempt to reduce the severity of financial constraints. Thus, a constrained firm will use external capital until $R\left(I^c_{jt1}\right) - R\left(I_{jt1}\right) = C_{jt}$, that is, up to that level where the marginal return on external funds is equal to marginal cost of external funds[9]. The effects of financial constraints on investment, E^I_{jt}, on firm j at time t is given by $E^I_{jt} = \left(I^c_{jt1} - I_{jt0}\right)$ and on returns, E^R_{jt}, on firm j at time t is given by $E^R_{jt} = \left(R\left(I^c_{jt1}\right) - R\left(I_{jt0}\right) - C_{jt}\right)$. The reduction in the outcome from its first best level can, however, be mitigated by incurring an extra cost, C_{jt}. I^c_{jt1} is the outcome associated with C_{jt} and $I_{jt1} < I^c_{jt1}$ for $C_{jt} > 0$.

This theoretical model highlights the following key points. First, there is a threshold beyond which a firm switch from unconstrained to constrained regime. Although the switching equation is not explicitly stated, financial constraints has no effects on firm access to capital if $E^R_{jt} = 0$ and it is binding at different levels, if $E^R_{jt} < 0$, and this, respectively, determines whether the observed outcome, I_{jt}, belongs to either equation (1.2) or equation (1.1). Second, with a random

[9] C_{jt} is the incremental cost of using external capital.

assignment mechanism of firms into constrained and unconstrained groups, the average treatment effects (ATE) of financial constraints is given by:

$$ATE = I^{c}_{jt1} - I_{jt0} \tag{1.4}$$

where $ATE \leq 0$ and $I^{c}_{jt1} = I_{jt1}$ if $C_{jt} = 0$. The ATE estimates in equation (1.4) is invalid if the assignment mechanism is not random. Moreover, accurate estimations of ATE in equation (1.4) is complicated by unobservable financial constraint status or imperfect information on sample separation. Third, the relation between marginal cost or wedge, C_{jt}, and the marginal gain, $R\left(I^{c}_{jt1}\right) - R\left(I_{jt1}\right)$, determines whether a firm is financially constrained or not. If marginal gain reflects profitability of investment opportunities and holding the cost constant, then an increase in profitability due for instance to a favourable price shock in the foreign market for a net exporter will lead to a decrease in the severity of financial constraints, and vice versa. An unexpected implication of this interpretation is that severely financially constrained firms are likely to be financially distressed, and vice versa. Fourth, in the absence of informational problem, internal and external funds are perfect substitutes and thus $C_{jt} = 0$. Consequently, the observed value of I_{jt} will be the first best level of the outcome, I_{jt0}. On the other hand, information asymmetry ensures that $C_{jt} > 0$ and therefore internal and external funds are not perfect substitutes.

Lastly, the wedge between the cost of external and internal finance increases a firm's marginal cost of capital and the firm will be discounting successive investment opportunities at a higher rate than that of a comparable unconstrained firm. That is, attempt to reduce severity of financial constraint results in loss of some investment opportunities especially investments that are on the margin: investments with low or very low net present values (NPV). To see this, consider

a firm with i investments of equal initial outlays ranked in ascending order using NPV, where $i = 1,2,...,M,...,N$, where M to N investments are on the margin. Let I_0 be the investment outlay, $R(I)$ is the investment specific series of returns and r be unconstrained-firm's marginal cost of capital. Also let the NFC represent unconstrained firms and FC represent constrained firms. Thus, in the absence of financial constraints the net present value of each investment is:

$$NPV_{i,NFC} = \sum_{t=1}^{\infty} \left(\frac{R(I_t)}{(1+r_t)^t} \right) - I_0 \qquad \text{for } i = 1,2,...,M,...,N \tag{1.5}$$

Let the number of investments with $NPV \geq 0$ under equation (1.5) be N. Introducing financial constraints into the NPV equation implies that firms incur an additional non-negative cost of C_{jt} per unit of external capital used in investment. The NPV for each investment under financial constraints is given by:

$$NPV_{i,FC} = \sum_{t=1}^{\infty} \left(\frac{R(I_t)}{\left(1+r_t^{FC}\right)^t} \right) - I_0 \qquad \text{for } i = 1,2,...,M,...,N \tag{1.6}$$

where $\left(1+r_t^{FC}\right) = (1+r_t)\left(1+C_{jt}\right)$. The presence of C_{jt} in the discount rate imposes a penalty on the discounting of future cash inflows from the investment and therefore reduces their present values[10]. The reduction in the present values of future cash inflows with no change on the investment outlays, results in edging out of the projects on the margin from the set of viable projects. That is, presence of C_{jt} results in $N-M$ projects switching from a positive NPV to a negative NPV. Therefore, N investments have positive NPV under unconstrained state

[10]Rearranging equation (1.6) and using $\left(1+r_t^C\right) = (1+r_t)(1+C_{jt})$ gives $NPV_{i,C} = \sum_{t=1}^{\infty} \left(\frac{CF_t}{\left\{(1+r_t)\left(1+C_{jt}\right)\right\}^t} \right) - I_0$. Since $0 < C_{jt} < 1$ and hence $1/(1+C_{jt}) > 1$, then the discounted values of CF_t at time t will be discounted further by a factor of $1/(1+C_{jt})$.

while only M investments are viable under constrained state. High level of cash flow alleviate financial constraints and therefore the amount of investment forgone might be less than $N-M$.

The foregoing analysis has three implications. First, constrained firms forgo an investment expenditure of $(N-M)\times I_0$. Second, financially constrained firms, with investment expenditure limited to $M\times I_0$ and unconstrained firms with investment expenditure of $N\times I_0$ are not homogeneous, even if they are the same in all other aspects. Heterogeneity arises since firm's investment behaviour depends on the degree of financial constraints faced each firm. Therefore, the representative firm framework is not appropriate in this case. Lastly, there might be distributional consequences of unconstrained firms undertaking investments $((N-M)\times I_0)$ forgone by constrained firms.

1.8 Data and Data Sources

This study used panel data of annual observation for all manufacturing firms that were listed in Nairobi Securities Exchange between 1999 and 2016. The study period was limited by the availability of published annual financial statements while the study sample was limited to public companies due to differences in valuation of assets for public and private companies. For consistency, only one source of data was used. This ensures reliability of the data. The data was collected from published annual financial statements that companies filed at Capital Market Authority. Published financial statements have a balance sheet, income statement and cash flow statements. All these formed the principal sources of the data used in this study.

To avoid introducing sector related bias in investment behaviour, this study focused on manufacturing firms. Manufacturing firms have specialized assets which have high sunk cost and therefore are difficult to collateralize, hence

can be considered as relatively illiquid. Consequently, some firms in the manufacturing sector are likely to suffer from financial constraints. The effects of liquidity for the manufacturing vis-à-vis non-manufacturing firms were confirmed by Chirinko and Schaller (1995) who found a coefficient for the former to be twice as large. Therefore, combining manufacturing firms with non-manufacturing firms may introduce bias and complexities in modelling.

Furthermore, to avoid survival bias, data for listed manufacturing companies that entered or exited the NSE between 1999 and 2016, subject to availability of data, were all included. In addition, years without data on the variables of interest were deleted. Supplementary data on variables not reported in financial statements were obtained from NSE. These include market price of stocks and years the company have been listed in NSE. Data on real exchange rate and consumer price index for Kenya and its major trading partners were sourced from World Bank. The major trading partners chosen include USA, European Union, UK, India and China.

1.9 Organization of the Study

This study is made up of three essays. Chapter one introduces the study and the research problem to be tackled alongside the objectives of the study. Subsequent chapters present each of the three essays. Each essay addresses one specific objective and the corresponding research question. The first is on *"Do measures of financial constraints capture experienced financial constraints?"* and it evaluated the accuracy of measures of financial constraints.

The second paper on *"Financial constraints and firm capital structure in Kenya"* investigated the effects of financial constraints on firm capital structure and used it to explain violation of pecking order hypothesis. The last paper on *"Financial constraints and firm investment in Kenya"* investigated the effects of financial

constraints on firm investment. A real exchange rate shock relative improvement in competitiveness of exports conditional on financial constraint status was used to examine how investment respond to the shock and how the response differs across financial constraint status.

CHAPTER TWO

DO MEASURES OF FINANCIAL CONSTRAINTS CAPTURE EXPERIENCED FINANCIAL CONSTRAINTS?

2.1 Introduction

A key question in corporate finance is how financial constraints affect firm's real decisions. Addressing this question requires accurate identification of financially constrained firms (Farre-Mensa & Ljungqvist, 2015). Unfortunately, identifying financially constrained firms is a challenge that is yet to be resolved. It is complicated since the financial constraints faced by a firm cannot be observed and secondly, since the proxies of financial constraints such as dividend payout ratios are often correlated with key variables that affect real decisions in the presence of financial constraints such as cash flow. The former introduces errors in classification of firms, which water down the estimated effects of financial constraints and the latter cause endogeneity problem. As a result, out of the several measures that have been proposed, none has consistently performed well under all circumstances.

Archival records based firm characteristics is the most commonly used approach in classifying firms. These firm characteristics can be used either as individual characteristics such as dividend payout ratio, age of the firm, size of the firm, affiliation of the firm to financial institution(s) and Chief Executive Officers (CEOs) statements on financial difficulties or as a linear combination of characteristic such as Kaplan and Zingales (1997) index (henceforth, KZ Index),

Whited and Wu (2006) index (henceforth, WW Index) and Hadlock and Pierce (2010) index (henceforth, HP Index) to generate indices.

Indices summarize several firm characteristics into a single measure of financial constraint status of a firm. Kaplan and Zingales (1997) used cash flow, Tobin Q, debt, dividends, dividend restricted, unrestricted retained earnings, cash and unused line of credit as covariates to construct the KZ index. Whited and Wu (2006) index is based on firm characteristics such as the ratio of long term debt to total assets, cash dividend payment dummy and annual growth in sales, log of total assets, ratio of liquid assets to total assets and the ratio of cash flow to total assets while Hadlock and Pierce (2010) index is based on age, size and size squared.

The accuracy of proxies of financial constraints based on archival records is debatable. Indices developed by Kaplan and Zingales (1997) and Whited and Wu (2006) and their extensions have been criticized as inaccurate in classifying firms (see for instance: Hadlock & Pierce, 2010). In addition, KZ Index, WW Index and HP Index have been found to be inaccurate in measuring financial constraints (see for instance: Farre-Mensa & Ljungqvist, 2015). Indices are not the only measures that do not accurately measure financial constraints, individual firm characteristics such as size, affiliations, profitability, dividend payment and growth prospects have been found to be inaccurate in measuring self-reported financial constraints (Campello et al., 2010).

Self-reported measures of financial constraints are biased since they are measured with a lot of noise. Moreover, if proxies of financial constraints are affected by fluctuations in cash flows or macroeconomic conditions or taste and preferences (see for instance; Gertler & Gilchrist, 1991), then identification of financially constrained firms based on such proxies is likely to be flawed. An alternative to a priori classification of firms is the switching regression model

with unknown sample separation (Almeida & Campello, 2007; Hovakimian & Titman, 2006; Hu & Schiantarelli, 1998). Unlike the use of exogenously determined proxies and indices, sample separation under this approach is jointly estimated with the outcome equation, and this eliminates the need for ex ante sample separation.

However, evidence that covariates used to generate KZ index, WW index and HP index in a single equation context produce inconsistent sub-samples and therefore do not accurately measure financial constraints (Farre-Mensa & Ljungqvist, 2015) imply that endogenous switching regressions indices might be sensitive to the choice of the covariates used in the selection equation.Therefore, how sensitive endogenous switching regression model's classification is to the specification of regime selection equation is unknown.

Clearly, classification of firms is marred by a lot of controversy. Classification is inconsistent across different measures (see for instance: Farre-Mensa & Ljungqvist, 2015; Hadlock & Pierce, 2010). In addition, how sensitive endogenous switching regression model's classification is to the choice of starting values and the specification of the outcome and regime selection equation is unknown. Against this background, this study sought to address the question do measures of financial constraints capture experienced financial constraints? The idea is to determine the most accurate method of identifying financially constrained firms.

In view of the foregoing, this study evaluated the accuracy of measures of financial constraints. Specifically, this study:

(a) Constructed a priori measures of financial constraints in Kenya

(b) Evaluated sensitivity of the classification generated by endogenous switching regressions to the choice of the starting values and the specification of the outcome and selection equation

(c) Evaluated how well endogenous switching regressions final indices and a priori classification capture experienced financial constraints

(d) Estimated the severity of financial constraints among listed manufacturing firms in Kenya

Data from published financial statements of manufacturing firms that were listed on Nairobi Securities Exchange between 1999 and 2016 shows 67 percent of the firm-years were financially constrained with age and size as the main determinants of financial constraints. Experienced financial constrained puts severity of financial constraints at 50 percent. Moreover, the measure based on size and age performed better in identifying financially constrained firms and producing consistent results, and is the only measure that approximate experienced financial constraints well. The classification of firms under endogenous switching regression were found to be inefficient and is sensitive to the choice of the starting values of financial constraint variable and the specification of the outcome and regime selection equations.

The findings of this study are important in the following three ways. First, understanding factors that affect the results in an endogenous switching regression context is important in checking the robustness of endogenous switching regression results in financial constraints literature and other areas applying endogenous switching regressions. Second, there is no doubt that the measures of financial constraints should be reliable and accurate. Accurate measures of financial constraints capture the reality of firm's financial constraint status. Lastly, accurate measures of financial constraints improve the accuracy

of the estimated effects of financial constraints on firm's real decisions. More importantly, improving accuracy in the identification of financially constrained firm-years is key in generating reliable estimates of the effects of financial constraints on firm's real decision and minimizing classification errors related controversies in findings.

The contribution of this study is as follows. First, this study is related to the work of Campello et al. (2010); Hadlock and Pierce (2010) and Farre-Mensa and Ljungqvist (2015) who evaluated the accuracy of proxies or indices in the identification of financially constrained firm-years. In particular, this study is similar to the work of Farre-Mensa and Ljungqvist (2015), however, unlike their study which evaluated Kaplan and Zingales (1997), Whited and Wu (2006) and Hadlock and Pierce (2010) indices in a single equation context and therefore their criticism does not apply to classification of firms using endogenous switching regression, which simultaneously estimate the structural (for instance, investment) equations and sample separation equation. Thus this study departs from the work of Farre-Mensa and Ljungqvist (2015) by evaluating how well firm characteristics identified by Kaplan and Zingales (1997), Whited and Wu (2006) and Hadlock and Pierce (2010) determine the financial constraints in an endogenous switching regression environment.

Secondly, this study may be considered as one of the first attempts to develop a criteria for identifying financially constrained firms in Kenya. Few studies, if any, have attempted to construct a criteria for identifying financially constrained firms in Kenya. In a country where the likelihood of financial constraints is high, a criteria for identifying financially constrained firms is important in three ways. It provides the basis for: identification of financially constrained firm-years, estimation of the severity of financial constraint in Kenya and the design of interventions to mitigate constraints in financial constraints.

Capital markets in Kenya like in other developing countries are inefficient and illiquid (Ngugi et al., 2009), which increases the likelihood of financial constraints and thus providing a perfect setting for studying financial constraints and its effects. Financial constraints have been shown to affect listed companies in countries with advanced capital markets such as USA (see: Fazzari et al., 2000, 1988; Hadlock & Pierce, 2010; Kaplan & Zingales, 1997, 2000), UK (Bond & Meghir, 1994) and Japan (Hoshi et al., 1991). Compared to these countries, the level of development in capital markets in Kenya is lower and therefore the severity of financial constraints might be greater. Market statistics in Kenya shows that by 2016 there were only 18 companies that had issued corporate bonds (3 of which are not listed in Nairobi Securities Exchange), up from 5 in 2005, with a total value of 86.76 billion Kenya shillings (Capital Markets Authority, 2016). This is very low given that there were, on average, 62 listed companies during this period.

Firms in the sample considered in this study rarely issued equity after Initial Public Offer (IPO). For instance, between 1999 and 2016 only three manufacturing firms issued equity after IPO. In addition, credit to private sector by banks in Kenya averaged about 32.6 percent in 2016, which was slightly above the regional average of about 28.8 percent in sub-Saharan Africa. Other developing regions such as Eastern Europe and Central Asia (excluding high income countries), and Latin America and Caribbean (excluding high income countries) had an average of about 52.4 percent and 47.5 percent, respectively. The low level of use of corporate bonds and credit to private sector points to a high likelihood of financial constraints in Kenya. The essay proceeds as follows. Section 2.2 provides a review of literature. Section 2.3 discusses the methodology as well as the hypotheses to be tested and describes the data.

Section 2.4 analyses and discusses the empirical results. Section 2.5 concludes the essay.

2.2 Literature Review

In this section, theoretical and empirical literature relevant to this study was reviewed. The aim was to identify determinants of financial constraints and develop strategies for identifying financially constrained firms.

2.2.1 Theoretical Literature

This section presents the theoretical model for identification of financial constrained firm-years. There is dearth of theoretical work in this area and the only relevant model, presented here, is attributed to Whited and Wu (2006). In this model firms takes factor prices, output prices and interest rate as given. Firms maximizes the expected present discounted value of future dividends, which are given by:

$$V_{i0} = E_{i0} \sum_{t=0}^{\infty} M_{0,t} d_{it} \tag{2.1}$$

where V_{i0} is the value of firm i at time 0, E_{i0} is the expectations of firm i given the information set at time 0, $M_{0,t}$ is the stochastic discount factor from time 0 to t and d_{it} is the firm's dividend. The firm maximizes equation (2.1) subject to dividend identity given by:

$$d_{it} = \pi(K_{it}, v_{it}) - \psi(I_{it}, K_{it}) - I_{it} + B_{i,t+1} - (1 + r_t) B_{it} \tag{2.2}$$

where K_{it} is the beginning of period capital stock; I_{it} is the investment by firm i at time t; $\psi(I_{it}, K_{it})$ is the cost of adjustment associated with investments, with $\psi_I >$

0, $\psi_K < 0$ and $\psi_{II} > 0$; B_{it} is the beginning of the period debt; r_t is the coupon rate on debt, $\pi(K_{it}, v_{it})$ is the firm's profit function that follows a Markov process and its state is known to the firm at time t. The price of capital is normalized to unity and, for simplicity, taxes are omitted. The firm has maximized along other dimensions except investment. The firm also maximizes equation (2.1) subject to capital stock accumulation identity given by:

$$K_{i,t+1} = I_{it} + (1-\delta) K_{it} \tag{2.3}$$

where δ_{it} is the firm-specific constant rate of depreciation. The firm also faces two unobservable constraints: equity financing constraint and debt financing constraint. These constraints are given by:

$$d_{it} \geq d_{it}^* \tag{2.4}$$

$$B_{i,t+1} \leq B_{i,t+1}^* \tag{2.5}$$

where d_{it}^* is the firm- and time-varying lower limit on dividends, and B_{it}^* is the firm- and time-varying upper limit on the stock of debt. When $d_{it}^* < 0$, then the firm is able to raise outside equity finance. In the absence of taxes, negative dividends are equivalent to new share issues (for details, see Whited & Wu, 2006). With λ_{it} as the Lagrange multiplier for equation (2.4), the Euler equation for K_{it} is given by:

$$\psi_I(I_{it}, K_{it}) + 1 =$$
$$E_{it}\left(M_{t,t+1}\left(\frac{1+\lambda_{i,t+1}}{1+\lambda_{it}}\right)\left\{\pi_K(K_{i,t+1}, v_{i,t+1}) - \psi_K(I_{i,t+1}, K_{i,t+1})\right\}\right) +$$
$$c_5 E_{it}\left(M_{t,t+1}\left(\frac{1+\lambda_{i,t+1}}{1+\lambda_{it}}\right)(1-\delta_i)\left[\psi_I(I_{i,t+1}, K_{i,t+1}) + 1\right]\right) \quad (2.6)$$

Equation (2.6) states that the expected discounted cost of deferred investment equals the sum of the marginal adjustment cost and the purchasing cost of investment. The right hand side consists of marginal product of capital and the marginal reduction in the adjustment cost. If the outside equity constraints are not binding then the relative shadow cost of external capital is $\frac{1+\lambda_{i,t+1}}{1+\lambda_{it}} = 1$, otherwise $\frac{1+\lambda_{i,t+1}}{1+\lambda_{it}} \neq 1$. The shadow cost of external capital affect investment only if it is time varying, that is $\lambda_{i,t+1} \neq \lambda_{it}$.

Letting γ_{it} be the Lagrange multiplier for equation (2.5), then the Euler equation for B_{it} is:

$$(1+\lambda_{it}) = E_{it}\left[(1+\lambda_{i,t+1})(1+r_t)M_{t,t+1}\right] + \gamma_{it} \quad (2.7)$$

Equation (2.7) shows that a binding and time-varying debt constraint affects inter-temporal allocation of resources. Since λ_{it} and γ_{it} are not observable and are likely to be affected by the same factors, it is difficult to separate the two. Therefore, one can focus on either λ_{it} or γ_{it}. This study approached the study of financial constraints from the perspective of pecking order hierarchy and thus the focus is on γ_{it}.

2.2.2 Empirical Literature

Classification of firms for the purpose of estimating the effects of financial constraints date back to the work of Fazzari et al. (1988). They used dividend

payout as a proxy of financial constraints to classify firms into three classes of financial constraints. Subsequently, numerous proxies of financial constraints which include age of the firm, size of the firm, affiliation of the firm to financial institution(s), credit rating and CEOs statements on financial difficulties have been proposed. In addition, some studies have used indices to classify firms as well as validate the proxies of financial constraints (see for instance: Hadlock & Pierce, 2010; Kaplan & Zingales, 1997; Whited & Wu, 2006). These indices summarize several firm characteristics into a single measure of financial constraint status of a firm. Indices have been used for validation or as an alternative to the archival-record based measures of financial constraints due to the shortcomings of the latter.

Validation of archival-record based measures of financial constraints was first used by Fazzari et al. (1988) in their seminal work. They estimated a probit model for the probability that a firm is correctly included in class one using size, real growth in sales, Tobin Q, debt and standard deviation of earnings as explanatory variables. The probit classification was consistent with their classification based on retention ratio; however, their validation was incomplete. This study builds on the work of Fazzari et al. (1988). However, unlike their work, which is based on natural ordering of dividend payout, this study constructed distance from the frontier for the dividend payout ratio. Distance from the frontier is preferred over natural ordering in order to address concerns on stability of the measure across firms and over time (Whited & Wu, 2006) such as those arising from the variation in dividend payout ratio due to fluctuations in macroeconomic conditions[1].

[1]Distance from the frontier measures constructed for within financial constraints sub-samples would be more accurate.

Subsequently, a number of indices to measure financial constraints have been developed. Kaplan and Zingales (1997) estimated an ordered logit model and used it to verify that their classification scheme based on CEOs qualitative statements correctly classify firms into their respective financial constraint status. They used five ranked classes with financially unconstrained being the lowest state and financially constrained the highest. They used cash flow, Tobin Q, debt, dividends, dividend restricted, unrestricted retained earnings, cash and unused line of credit as independent variables. In general, the logit model provided a strong quantitative validation of their classification scheme; however, their classification is inconsistent with the results of Hadlock and Pierce (2010). In addition, Tobin Q is highly correlated with investment prospect.

Kaplan and Zingales (1997) study, like this study, used ordered measures of financial constraints. They used measures based on CEO's statement while this study used a measure based on a combination of age and size, and dividend payout to measure financial constraints. Kaplan and Zingales (1997) index has been applied for instance by Baker, Stein and Wurgler (2003), Lamont, Polk and Saá-Requejo (2001) and Almeida, Campello and Weisbach (2004). Baker et al. (2003) used a variant of this index with five determinants of constraints that included: cash flow, cash dividend, cash balances, leverage and Tobin Q, however, in their final estimation they dropped Q citing measurement problems and correlation with investment prospect which is proxied by dividend payment.

On the other hand, Lamont et al. (2001) and Almeida et al. (2004) constructed an index of financial constraints, using cash flow, Tobin Q, debt, dividend and cash, to classify firms in their sample. Hadlock and Pierce (2010) criticized the index-based measures of financial constraints, arguing that the indices developed by Kaplan and Zingales (1997) and Whited and Wu (2006) and their extensions could not correctly predict the candidate measure of financial constraint status

derived using qualitative manager's statements on financial constraints. They therefore suggested the use of size and age to identify financially constrained firms, a criteria first suggested by Blinder in 1988 in the comments to the seminal work of Fazzari et al. (1988).

Firm size was also discussed in Fazzari et al. (1988), however, they considered it inadequate. More specifically, Hadlock and Pierce (2010) proposed an index based on size, size squared and age as independent variables. Other measures of financial constraints that have been considered include ownership or affiliations (Hoshi et al., 1991). On the other hand, Farre-Mensa and Ljungqvist (2015) evaluated index based measures of financial constraints and found that Kaplan and Zingales (1997) index , Whited and Wu (2006) index and Hadlock and Pierce (2010) index did not measure financial constraints.

An alternative approach is attributable to Cleary (1999), who classified firms using an index similar to Altman's Z factor for predicting bankruptcy. The author classified firms into two mutually exclusive groups, those that increased dividend payment and those that reduced dividend payment the previous year. These correspond, respectively, to firms that are not likely to be financially constrained and that are likely to be financially constrained. Cleary (1999) then used multiple discriminant analysis including current ratio, debt ratio, fixed charge coverage, net income margin, sales growth, and slack/net fixed assets as regressors. These variables successfully predicted which firms will cut or increase their dividends. Their discriminant scores are likely to be biased due to exclusion of firms that do not change dividend payments in their discriminant analysis. In addition, Cleary (1999) approach cannot handle cases where the dependent variable takes more than two values.

Other studies have used approaches that endogenously determine the financial constraint status of a firm such as cluster analysis and endogenous switching

regression. La Rocca, Staglianò, La Rocca and Cariola (2015) adopted cluster analysis and found that their classification was inconsistent with traditional criteria used to identify financially constrained firms as discussed above. Some studies have used models where the probability of a firm facing financial constraints is endogenously determined. This approach requires specification of a switching regression where regimes or the probability of a firm's financial constraint status is jointly estimated with the outcome equation. Hu and Schiantarelli (1998) used an endogenous switching regression model of investment to address static and dynamic misclassification problem.

Following Hu and Schiantarelli (1998) a number of studies have adopted this approach. Hovakimian and Titman (2006), Almeida and Campello (2007), Bhaduri (2008) and Shen and Lin (2010) used endogenous switching regression to examine the effects of financial constraints on a firm's real decisions. These studies assumes that endogenous switching regression classifications results are independent of the choice of the starting values and the specification of the outcome and selection equations. Evidence that linear combination of firm characteristics yield inconsistent sub-samples suggests that endogenous switching regression final indices might be sensitive to the choice of starting values, outcome equation or selection equation.

The adequateness of proxies of financial constraints based on archival records is debatable. Campello et al. (2010) evaluated various measures of financial constraints which included: size, affiliations, credit rating, profitability, dividend payment and growth prospects and documented evidence that only credit rating predicted self-reported financial constraints. However, subjective measures of financial constraints such as those used by Campello et al. (2010) and Savignac (2008) were likely to be biased. Moreover, subjective measures of financial constraints are likely to be measured with a lot of noise.

2.2.3 Overview of Literature

Despite the pivotal role of identification strategy of financially constrained firms in estimation of the effects of financial constraints on real decisions, there is no consensus on which is the best approach. The main indices used in identifying financially constrained firms contradict each other. Endogenous switching regression models have been used in an attempt to address static and dynamic misclassification problem. However, the results under endogenous switching regression might be sensitive to the choice of the starting values and the specification of the outcome and regime selection equations and this introduces classification errors. In addition, there is dearth of empirical evidence on the severity of financial constraints among listed firms in developing countries, in general, and Kenya, in particular.

Finally, there is also concern on stability of the measure across firms and over time due to changes in macroeconomic conditions, when firm's response to shocks depend on financial constraint status. This study posits that final classification values generated by endogenous switching regression are sensitive to the choice of starting values and the specification of the outcome and regime selection equation. In an attempt to generate a stable measure of financial constraints, this study constructed a dividend payout measure using distance from frontier approach and by using data from listed manufacturing firm from Nairobi Securities exchange it contributed to the literature by providing evidence from developing countries.

2.3 Methodology

This section discusses the identification strategy of financially constrained firms in Kenya. First, the model to be used is presented followed by the procedure

for generating starting values of financial constraints. This essay argues that the starting measures of financial constraints and thus the severity of financial constraints are inefficient and endogenous switching regression will improve on these values to yield efficient measures of financial constraints statuses and hence severity of financial constraints. However, endogenous switching regressions might be sensitive to the choice of starting values and the specification of outcome and regime selection equations, and thus introduces classification errors.

2.3.1 Model Specification

The effects of financial constraints can be obtained by taking the differences between the estimates of the two equations derived under the conceptual framework on page 23 (which also form the theoretical model of this essay) and restated as equation (2.8) and equation (2.9) below:

$$I_{jt1} = \beta_1 X_{jt} + \varepsilon_{jt1} \tag{2.8}$$

$$I_{jt0} = \beta_0 X_{jt} + \varepsilon_{jt0} \tag{2.9}$$

However, this is possible if the financial constraint state of each firm-year is observable. In addition, the results are only valid if the assignment mechanism of firms into constrained and unconstrained statuses is random. The random assignment mechanism in experimental data ensures that those assigned to treatment and control groups are identical and hence reduce or eliminate the need to control for covariates in estimation of the treatment effects.

In the case of observational data, financial constraint status is not observed and is proxied using one or more observable firm characteristics. Therefore, firms in

financially constrained and unconstrained groups are likely to be different due to non-randomness in sample separation and self-selection. The non-randomness in sample separation mechanism and the unknown sample separation threshold, caused by unobservable financial constraints, makes it difficult to measure the severity of financial constraints and estimate its effects. These challenges can be overcome by introducing a third equation in the line of Maddala (1986) to determine the threshold that assign firms into sub-samples represented by equation (2.8) (unconstrained) and equation (2.9) (constrained). The third equation is called a switching or disequilibrium equation.

In determining the kind of switching equation to use, two key issues were taken into consideration. First, whether the regime is known a priori or not. In this study, the regime a firm belongs to is imperfectly known. Financial constraints faced by a firm are not observable. Second, whether the errors of the switching equation are correlated with the errors of the outcome equation(s) or not. The errors of equation assigning firms financial constraint status is likely to be correlated to the errors of the outcome equations such as investment equation. For example, financially constrained firms are likely to have lower investment expenditures than unconstrained firms. Thus, the errors of the outcome equation in this study might be correlated with the errors of the switching equation.

With imperfect information on sample separation and correlation in errors of switching and outcome equations, the most appropriate model is an endogenous switching regression model of the form given in equation (2.12) with equation (2.8) and equation (2.9) as outcome equation. Equation (2.8) and equation (2.9) are restated, in matrix form, as:

$$I_{jt1} = X_{jt}\beta_1 + \varepsilon_{jt1} \qquad if \quad FC = 1 \tag{2.10}$$

$$I_{jt0} = X_{jt}\beta_0 + \varepsilon_{jt0} \qquad if \quad FC = 0 \tag{2.11}$$

and a regime switching equation given by:

$$FC^*_{jt} = Z_{jt}\gamma + \varepsilon_{jt}, \qquad FC_{it} = \begin{cases} 1 & FC^*_{jt} > 0 \\ 0 & FC^*_{jt} \leq 0 \end{cases} \tag{2.12}$$

where FC_{it} is a dichotomous variable and as noted earlier I_{jt1} is observed if $FC_{it} = 1$ and I_{jt0} is observed if $FC_{it} = 0$. Z is a vector of firm characteristics that identify financial constraint status of a firm. Let IV_{jt} be the starting values of the unobserved financial constraints, FC^*_{jt}, such that:

$$IV_{jt} = \begin{cases} 1 & if \quad I_{jt} = I_{jt1} \\ 0 & if \quad I_{jt} = I_{jt0} \end{cases} \tag{2.13}$$

and

$$IV_{jt} = f\left(FC_{jt}, \omega_{jt}\right) \tag{2.14}$$

where ω_{jt} is the errors in measurement of FC_{jt}. Two starting values were used: (i) IV_{jt} equals zero if a firm is old and large, and one, otherwise and (ii) IV_{jt} equals one if a firm pays dividend below a threshold (measured in terms of distance from frontier) and zero, otherwise. IV_{jt}, required as dependent variable in equation (2.12), captures the initial measure of financial constraint status of each firm and is assumed to be measured with error[2]. Endogenous switching

[2]The implication of this is to take into consideration classification errors identified in a priori classification

regression improves on these starting values to yield an efficient measure of financial constraint status, FC. The performance of IV_{jt} against FC is given by a transition probability matrix:

	$FC_{jt}=1$	$FC_{jt}=0$
$IV_{jt}=1$	ρ_{11}	ρ_{10}
$IV_{jt}=0$	ρ_{01}	ρ_{00}

where $\rho_{lk} = Prob\left(FC_{jt}=k \mid IV_{jt}=l\right) \quad for\, l,k=0,1$ with a row sum of 1. IV perform better than FC if $\rho_{11}=\rho_{01}$ since the indicator FC do not contain any information about equations (2.10) and (2.11) (Lee & Porter, 1984). However, when $\rho_{11}\neq\rho_{01}$ then FC conveys some information on sample separation. When $\rho_{11}=\rho_{00}=1$ there is no efficiency gain in using FC as the sample separation produced by IV and FC are exactly identical. The goodness of fit of FC relative to IV was performed using the Chi-Square Test for Independence and Fisher's exact tests. These tests help in establishing whether FC distribution differs from IV distribution.

The model has one main drawback. It cannot determine the severity of financial constraints without the outcome equations: equation (2.10) and (2.11). In this regard, and in line with the overall objective of this thesis, two main outcomes: choice of financing mix and the investment measures were used to facilitate the estimation of severity of financial constraints. This provides a foretaste for in-depth analysis of financing and investment decisions in chapter three and four, respectively.

For the purpose of estimating severity of financial constraints, variables identified in Frank and Goyal (2003) as the determinants of the choice of source of funds were used. The authors considered financing deficit, tangibility of assets, size as measured by log of sales, ratio of market to book value and

profitability as covariates and leverage or changes in debt as the outcome variable in testing pecking order hypothesis. The empirical investment Euler equation variables include lagged investment rate, square of lagged investment rate, cash flow to capital ratio, sales to capital ratio and square of debt to capital ratio (e.g. Bond & Meghir, 1994). A detailed discussion of the choice of financing mix and the investment is postponed to chapter three and four.

The remaining part is the definition of the vector Z. Z is a vector of firm characteristics that identify financial constraint status of a firm. Z is defined as the right-hand side variables or firm characteristics that feature in the three most common index of measuring financial constraints, that is, Kaplan and Zingales (1997) index, Whited and Wu (2006) index and Hadlock and Pierce (2010) index. These indices were rigorously evaluated by Farre-Mensa and Ljungqvist (2015) who concluded that none of them measure financial constraints.

Farre-Mensa and Ljungqvist (2015) used a single equation to obtain a priori classification in their evaluation and therefore their criticism does not apply to studies using endogenous switching regression, which simultaneously estimate the structural (for instance, investment) equations and sample separation equation. This study fills this gap by evaluating how well firm characteristics identified by Kaplan and Zingales (1997), Whited and Wu (2006) and Hadlock and Pierce (2010) determine the financial constraints in an endogenous switching regression environment.

Hadlock and Pierce (2010) proposed an approach that has an advantage over other approaches, as much as it excludes financial variables which are likely to be correlated due to the nature of their constructions. Hadlock and Pierce (2010) index is based on size, size squared and age as independent variables. Thus, following Hadlock and Pierce (2010) equation (2.12) can be expressed as a function of age and size:

$$FC^{*}_{jt} = \alpha_0 - \alpha_1 size_{jt} + \alpha_2 size^{2}_{jt} - \alpha_3 age_{jt} + \xi_{jt} \tag{2.15}$$

where FC_{jt} is a binary variable measuring financial constraint status of firm j at time t, $size_{jt}$ is the size of firm j at time t as measured by the log of fixed assets and age_{jt} is the number of years a firm j at time t has been listed at Nairobi Securities Exchange (NSE). FC_{jt} equals one if firm j at time t is financially constrained and zero, otherwise. The expected sign are as indicated in equation (2.15). The model is fitted into the data using endogenous switching regression and then used for classification of firms.

This study uses a version of Kaplan and Zingales (1997) index employed by Lamont et al. (2001) and Almeida et al. (2004), which has cash flow ($\frac{C}{K}$), market to book ratio (MtB) (or Tobin Q (Q)), debt ($\frac{D}{K}$), dividend ($\frac{Div}{K}$) and cash ($\frac{CS}{K}$) as the regressors. Thus, the equation (2.12) is defined as follows:

$$FC^{*}_{jt} = \beta_0 - \beta_1 \left(\frac{C}{K}\right)_{jt} + \beta_2 MtB_{jt} + \beta_3 \left(\frac{D}{K}\right)_{jt} - \beta_4 \left(\frac{Div}{K}\right)_{jt} + \beta_5 \left(\frac{CS}{K}\right)_{jt} + c_5\beta_j + \beta_t + \varepsilon_{jt} \tag{2.16}$$

where ε is the error term, $\beta's$ are the coefficients to be estimated, β_j is the firm fixed effects, β_t is the year fixed effects and other variables are as defined earlier. The expected signs are as indicated in equation (2.16). KZ index is higher the severe the financial constraints.

Under Whited and Wu (2006) index, the starting point is a reduced form specification for the stochastic discount factor, $M_{t,t+1}$, using Fama and French (1993) three factor model given by

$$M_{t-1,t} = \alpha_0 + \alpha_1 MKT_t + \alpha_2 SMB_t + \alpha_3 HML_t \tag{2.17}$$

where MKT is the return on the market; SMB is the return on an arbitrage portfolio that is long small firms and short large firms; and HML is the return on an arbitrage portfolio that is long firms with high book to market ratios and short firms with low book to market ratios. The model to be used in place of equation (2.12) is:

$$FC^*_{jt} = \beta_0 + \beta_1 \left(\frac{D}{K}\right)_{jt} - \beta_2 Div_{jt} - \beta_3 \Delta S_{jt} - \beta_4 size_{jt} + \beta_5 \left(\frac{CS}{K}\right)_{jt} - c_5 \beta_6 \left(\frac{CF}{K}\right)_{jt} + \beta_7 M_{t-1,t} + \varepsilon_{jt} \tag{2.18}$$

where FC, under Whited and Wu (2006), is the shadow cost of raising equity, $\frac{D}{K}$ is the ratio of long term debt to total assets, Div equals one if the firm pays cash dividends and zero, otherwise, ΔS is the annual growth in sales, $size$ is the natural log of total assets, $\frac{CS}{K}$ is the ratio of liquid assets to total assets and $\frac{CF}{K}$ is the ratio of cash flow to total assets. $M_{t-1,t}$ is the stochastic discount factor as defined in equation (2.17).

There are two key issues in estimating equation (2.15), (2.16) and (2.18). First, an ordered discrete dependent variable such as in these equations violate Gauss-Markov assumptions and the use of linear regression in such a case can yield incorrect results. In addition, use of linear regression when the distance between ordered preferences is unknown leads to biased results (Long & Freese, 2006). Thus, the non-linear ordered logistic regression is more appropriate for ordered responses or preferences in the dependent variable. Secondly, financial constraints, FC, a firm face is not observable. This complicates the analysis of

the determinants of financial constraints, the identification strategy of financially constrained firms and estimations of switching regression model[3].

2.3.2 Proxies of Financial Constraints

The observable characteristics that are correlated with financial constraints are chosen as proxies in constructing a priori measures of financial constraints. Two approaches are used: dividend payout ratio and a measure based on a combination of age[4] and size. By using dividend payout ratio as a proxy, the first approach is closely related to Fazzari et al. (1988) approach. However, unlike Fazzari et al. (1988) this study used distance from frontier to construct dividend payout measure of financial constraints. This modification corrects for the effects of changes in macroeconomic conditions on financial constraint status, when firm's response to shocks vary with financial constraint status. Distance from the frontier was computed using $DF_{jt} = \left(Max_t - div_{jt}\right)/(Max_t - Min_t)$, where DF_{jt} is the distance from the frontier for firm j at time t, Max_t is the highest dividend payout ratio in year t, div_{jt} is the dividend payout by firm j at time t and Min_t is the lowest dividend payout in year t. Here, the dividend payout gives the financial constraint status.

The second approach uses age and size. Here, the distribution of size and age is used to identify the points at which to split the observations. Using distribution of a variable to identify the split points in the presence of bimodal distribution is equivalent to using finite mixture model (FMM). Where there are no clear break points in the distributions, age and size were broken down at the median

[3]Presence of natural ordering in the dependent variable of the regime switching equation implies that standard regression commands such as switchr in stata might not be appropriate. Thus, two step estimation process was used as well.

[4]Age is measured as the number of years a firm has been listed on the NSE. This measure is appropriate since what is important in this study is not how long a company has been in existence but how long has the company been exposed to publicly listed companies disclosure requirements. Equivalently, how long has the company been followed by analysts.

into two. Using the break points, firms were divided based on age and size. This was followed by classification of firms into three categories: (i) young and small; (ii) young and large or old and small, and (iii) old and large. Finally, a firm is classified as financially unconstrained if it is old and large, otherwise it is financially constrained. Mature and large firms face less informational problem and hence less severe financial constraints, since investors are able to gather information on larger firms with ease (B. Bernanke, Gertler & Gilchrist, 1996) and mature firms have well established track records (Schiantarelli, 1996).

To measure the experienced financial constraints, for every firm-year this study gleaned information on difficulty in financing operations and investment from financial statements, specifically the Chairman's statements. A firm-year was considered financially unconstrained if it indicated that it had a financing surplus (excess of cash flow over investment). A firm-year was also classified as unconstrained if it started paying dividend or it increased dividend payment. Therefore, financial unconstrained sub-sample is likely to be similar to those of Kaplan and Zingales (1997) and include only financially healthy firm-years with high profitability, high value of tangible assets, high cash and low debt. Any other firm-year that do not meet the criteria of financially unconstrained firm-years were classified under financially constrained sub-sample.

2.3.3 Definition and Measurement of Variables

The variables defined hereunder were used in this study.

Variables	Measurement	Expected sign	Literature source
Financial constraints (FC)	Is the dependent variable. It is a dummy variable for identifying financially constrained firms which takes the value of one if a firm is financially constrained and zero, otherwise. For details on how this variable is constructed see section 2.3.2 on page 51.	Not Applicable	Hadlock and Pierce (2010); Whited and Wu (2006); Fazzari et al. (1988)
Size	Log of the book value of assets	Size is negatively related to financial constraints	Hadlock and Pierce (2010); Whited and Wu (2006); Hubbard (1998)
Age	Number of years a company has been listed on NSE	Age is negatively related to financial constraints	Hadlock and Pierce (2010)
Dividend payout ratio	Is the ratio of dividend per share to the par value of the share.	Negatively related to financial constraints	Fazzari et al. (1988)
Dividend payout	$DF_{jt} = {(Max_t - div_{jt})}/{(Max_t - Min_t)}$, where DF_{jt} is the distance from the frontier for firm i at time t, Max_t is the highest dividend payout ratio in the entire sample, div_{jt} is the dividend payout by firm j at time t and Min_t is the lowest dividend payout in the entire sample.	Negatively related to financial constraints	Fazzari et al. (1988)
Foreign ownership	Percentage of firms owned by foreigners. 0% - no interest, 1-25% - investment, 26-50% - controlling interest and 51-100% - subsidiary	Higher percentage is associated with lower financial constraints	Hoshi et al. (1991)

Cash flow to Capital Stock	Ratio of cash flow book value of property, plant and equipment	Negative	Almeida et al. (2004); Lamont et al. (2001); Whited and Wu (2006)
Market to book values	Ratio of market value of assets to book value of assets. Market value = book value of assets + market value of equity - book value of equity	Positive	Almeida et al. (2004); Lamont et al. (2001)
Debt to Capital Ratio	Is the ratio of debt and long term borrowings to the book value of property, plant and equipment	Positive	Almeida et al. (2004); Lamont et al. (2001)
Dividend to Capital Ratio	Is the ratio of the total dividend paid to the book value of property, plant and equipment	Negative	Almeida et al. (2004); Lamont et al. (2001)
Cash to Capital Ratio	Is the cash and cash equivalents to the book value of property, plant and equipment	Positive	Almeida et al. (2004); Lamont et al. (2001)
Debt to Capital Ratio	Is the ratio of debt and long term borrowings to the book value of property, plant and equipment	Positive	Whited and Wu (2006)
Dividend dummy	Equals one if the firm pays cash dividends and zero, otherwise	Negative	Whited and Wu (2006)
Growth in sales	Is the annual percentage change in sales.	Negative	Whited and Wu (2006)
Financing deficit	Excess of change in working capital, net cash used in investing activities, current portion of long term debt and dividends over cash flow after interest and taxes[5]. It is scaled using net assets which is given by the sum of share capital and long term debt or borrowings	Financing deficit should have a one to one relationship with borrowed funds	Frank and Goyal (2003); Shyam-Sunder and Myers (1999)

[5]Financing deficit is defined as $DEF_{jt} = DIV_{jt} + NI_{jt} + \Delta W_{jt} + CD_{jt} - CF_{jt}$

Tangibility of assets	Ratio of fixed assets to total assets	Ambiguous	Frank and Goyal (2003); Rajan and Zingales (1995); Ramjee and Gwatidzo (2012)
Market to book values	Ratio of market value of assets to book value of assets. Market value = book value of assets + market value of equity - book value of equity	Increase in market to book ratio reduces the use of borrowed funds	Frank and Goyal (2003); Liu (2009); Rajan and Zingales (1995)
Profit	Ratio of operating income to book value of asset	Ambiguous	Frank and Goyal (2003); Rajan and Zingales (1995); Ramjee and Gwatidzo (2012)
Sales	Log of deflated sales	Large firms in terms of sales use more borrowed funds	Frank and Goyal (2003); Rajan and Zingales (1995)
Sales to Capital Stock	Is the ratio of total sales of a company to the book value of property, plant and equipment	Sales to Capital Stock is positive under imperfect competition and zero under perfect competition	Bond and Meghir (1994)
Cash flow to Capital Stock	Ratio of cash flow book value of property, plant and equipment	Negative in the absence of financial constraints and positive, otherwise.	Bond and Meghir (1994)
Debt to Capital Ratio	Is the ratio of debt and long term borrowings to the book value of property, plant and equipment	Zero if financing and investment decisions are independent and positive otherwise.	Bond and Meghir (1994)
Investment rate	Is the ratio of the purchase of property, plant and equipment to the capital stock, measured by the book value of property, plant and equipment in year t		Kaplan and Zingales (1997)
Change in debt	Is the total amount of debt and long term loans obtained by the firm in year t.		Frank and Goyal (2003); Shyam-Sunder and Myers (1999)

2.3.4 Data Sources and Description

This study used data of manufacturing firms that were listed on Nairobi Securities Exchange between 1999 and 2016. The data was collected from published financial statements that companies filed at Capital Markets Authority. Published financial statements consist of balance sheet, income statements and cash flow statements, and are the principal sources of the data used in this study. The sample consists of all (13) companies in the manufacturing sector that were listed on the Nairobi Securities Exchange (NSE). Supplementary data on variables not reported in financial statements were obtained from NSE. These included market prices of stocks and the year a company was listed at the NSE. Data on consumer price index were sourced from the World Bank.

2.4 Empirical Results

2.4.1 Introduction

This section presents the empirical results of this essay. First summary statistics of the firms studied is presented, followed by a priori classification and identification of firm's and the mean financial constraint status. Subsequently, endogenous switching regression was used to examine the efficiency of apriori measures in classification of firms and in estimating the severity of financial constraints.

2.4.2 Descriptive Statistics

Descriptive statistics including mean, 25^{th} percentile, median, 75^{th} percentile, standard deviation, minimum, maximum, kurtosis and skewness for the main variables used in empirical analysis are presented in Table 2.2 on page 57.

Table 2.2: Descriptive Statistics

Variables	Mean	25th Percentile	Median	75th Percentile	Standard Deviation	Min	Max	Kurtosis	Skewness
$\frac{Sales}{K}$	3.407	1.161	1.930	4.183	4.278	0.313	30.25	24.18	4.101
Debt Sq	0.0559	0	0.000386	0.0238	0.134	0	0.642	11.42	2.981
Investment Rate	0.137	0.0468	0.111	0.188	0.108	0.00275	0.493	3.926	1.082
Cash flow	0.444	0.253	0.459	0.698	0.662	-3.311	2.332	20.10	-2.899
Size	11.07	10.00	10.99	12.09	1.160	8.974	13.08	1.790	0.0568
Age	3.113	2.674	3.466	3.664	0.769	0.693	3.829	4.137	-1.383
$\frac{Debt}{K}$	0.115	0	0.000326	0.146	0.197	0	0.855	6.402	2.042
$\frac{Cashflows}{K}$	0.377	0.245	0.450	0.696	1.267	-13.20	3.943	74.89	-7.479
$\frac{Dividend}{K}$	0.138	0.0186	0.0774	0.213	0.184	0	1.641	24.72	3.633
$\frac{Cash}{K}$	0.200	0.0319	0.0878	0.235	0.411	0	4.193	63.01	7.015
$\frac{Debt}{TA}$	0.115	0	0.000326	0.146	0.197	0	0.855	6.402	2.042
Dividend Paid	0.658	0	1	1	0.475	0	1	1.444	-0.666
Growth in sales	0.0541	-0.0165	0.0752	0.149	0.241	-2.220	0.656	40.59	-4.336
Log of TA	11.07	10.00	10.99	12.09	1.163	8.873	13.29	1.807	0.0600
$\frac{Cash}{TA}$	0.909	0.0152	0.0340	0.0745	12.57	0	186.5	218.0	14.73
$\frac{Cashflows}{TA}$	1.223	0.104	0.183	0.297	15.27	-0.330	226.6	218.0	14.73

Continued on next page

Table 2.2 – *Continued from previous page*

Variables	**Mean**	**25th Percentile**	**Median**	**75th Percentile**	**Standard Deviation**	**Min**	**Max**	**Kurtosis**	**Skewness**
Foreign Ownership	29.35	8.280	23.36	31.07	26.12	0.890	77.20	2.261	0.882
Maximum Payout Ratio	0.916	0.500	0.652	0.885	0.770	0.457	3.746	10.48	2.823
Minimum Payout Ratio	0	0	0	0	0	0	0		
Average Payout Ratio	0.301	0.235	0.246	0.303	0.134	0.189	0.751	7.538	2.201
Median Payout Ratio	0.238	0.187	0.264	0.285	0.0682	0.103	0.328	2.364	-0.784
Dividend Payout	0.617	0.433	0.695	0.872	0.324	0	1	2.141	-0.556
Financing Deficit	0.330	-0.184	0.140	0.529	1.151	-1.618	4.220	6.324	1.563
ΔD	0.393	0	0	0.235	0.977	0	4.301	11.75	3.115
Tangibility	9.195	3.549	8.285	13.08	6.287	1.665	23.71	2.618	0.767
Sales	8.985	2.757	7.011	12.86	7.205	1.205	29.96	3.719	1.125
Market to Book	13.59	2.526	5.557	21.03	16.65	-0.0737	71.51	5.603	1.726
Profitability	1.737	0.270	1.081	2.788	2.111	-1.267	8.434	4.640	1.309

Sources: Author's Computation.

The size ranges from 8.974 to 13.08 with a mean of 11.07 which is slightly higher than the median of 10.99. Compared to size, log of age is more dispersed. Log of age ranges from 0.693 to 3.829 with the mean and median of 3.113 and 3.466, respectively. 75 percent of the firms are clustered between 3.664 and 3.829. Since 3.466 is higher than half of the maximum age, then this indicate that majority of the firms in our sample are mature. Distance from the frontier for dividend payout ranges from zero for high dividend payers to one for low dividend payout. The high concentration of the distance from frontier at values close to one, even for the median firm (0.695), implies that a large number of firms pay below average dividends. This is indicative of severe financial constraints.

The mean foreign ownership is 29.35 with the median of 23.36 and foreign control of the companies ranges from 0.89 to 77.20. Debt to capital ratio which is a measure of the proportion of capital financed by debt averaged 0.115. That is about 11.5 percent of total capital is financed by debt. The low value is indicative of financial constraints, as firms might not be able to issue debt. By making firms not to issue debt or to bypass debt to issue equity, financial constraints affect financing decisions and hence capital structure of the firm. Other indicators of financial constraints are low dividend payment and low cash holdings ratios. The mean of the ratio of dividend payment to capital stock is 0.138 while the mean of cash to capital stock is about 0.200, which suggest the sample might be financially constrained.

The mean of market to book value ratio is 13.59. The mean of sales to capital stock is 3.407 and it ranges from 0.313 to 30.25. Sales like assets is also a measure of size of the firm, however, unlike log of assets, the mean log of sales is 8.985 which is lower than the mean of log of assets of 11.07. The mean investment rate is 0.137 with values ranging from 0.00275 to 0.493. The mean

cash flow to capital stock of 0.377 is above the mean of investment rate and its values lie between -13.20 and 3.943. The mean ratio of profit to capital stock is 1.737 with the worst performance being a loss to capital stock ratio of -1.267 and the best performance being 8.434.

2.4.3 Identification of Constrained Firms Years in Kenya

In this section, a measure of experience financial constraints was constructed. In addition, two measures of financial constraints were generated using dividend payout approach[6] and a combination of age and size. These two measures formed the starting values for endogenous switching regressions. Experienced financial constraints classify 50 percent of the firm-years as financially constrained. Firms increased dividend payments or started paying dividend in 42 percent of firm-years while another 42 percent of the firm-years registered financing surplus; excess cash flow over investment.

The underlying statistical distribution of the data is critical in obtaining a valid measures of financial constraints. That is, the validity of the measure of financial constraints depends on how well the data generating process fits into the assumed statistical distribution. Figure 2.1 to Figure 2.3 plots the Kernel distribution and Histogram for age, size and dividend payout, respectively. For ease of comparison and interpretation, the two Kernel density and histogram have been presented side by side. Figure 2.1 plot kernel density function and histogram for age.

[6]This is based on distance from frontier approach described in section 2.3.2

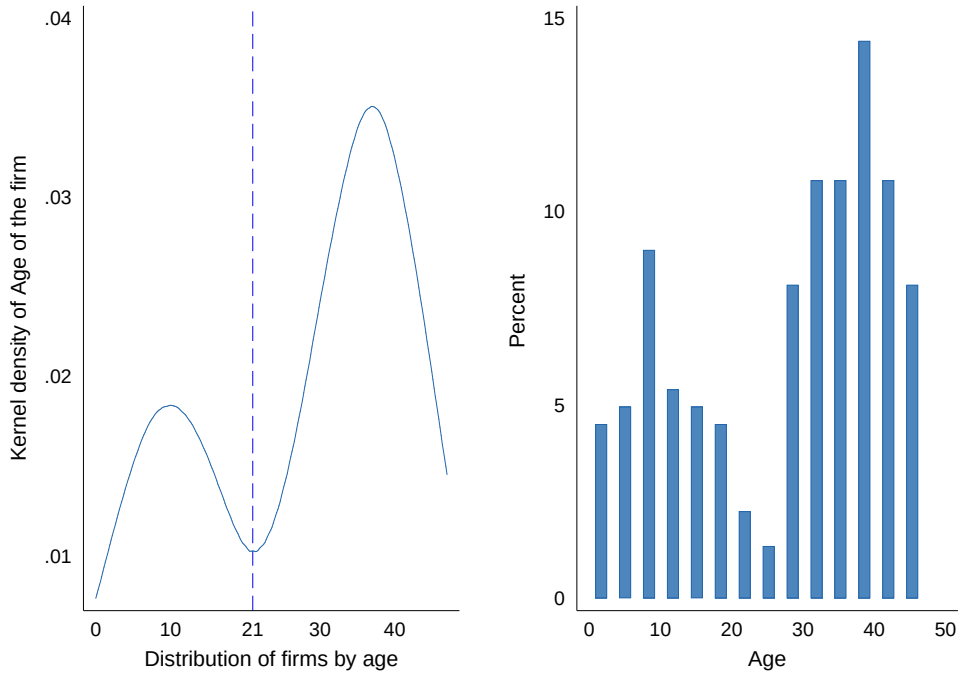

Figure 2.1: Distribution of Firms by Age (Kernel Density and Histogram)
Source: Author's calculation based on published company financial statements.

The age variable lies between 0 and 47 years. The first group of firms is clustered between the age of 21 years and 47 years while the ages for the other group of firms lies between 0 and 20 years. The number of firms with the age of 20 years or lower is small. Young firms are more dispersed compared to mature firms, and this generates a bimodal distribution with the mode for the young firms at about 10 years and 35 years for the mature firms. The break point for this bimodal distribution is 20.5, and it is represented by the dashed line in the Kernel density function graph. Thus, firms whose age is lower than 20.5 are considered young, otherwise they are mature or old. Following previous work in the literature, young firms are likely to be constrained than mature firms. Therefore, age is expected to be negatively related to financial constraints.

Figure 2.2 graphs Kernel density curve and histogram for size variable.

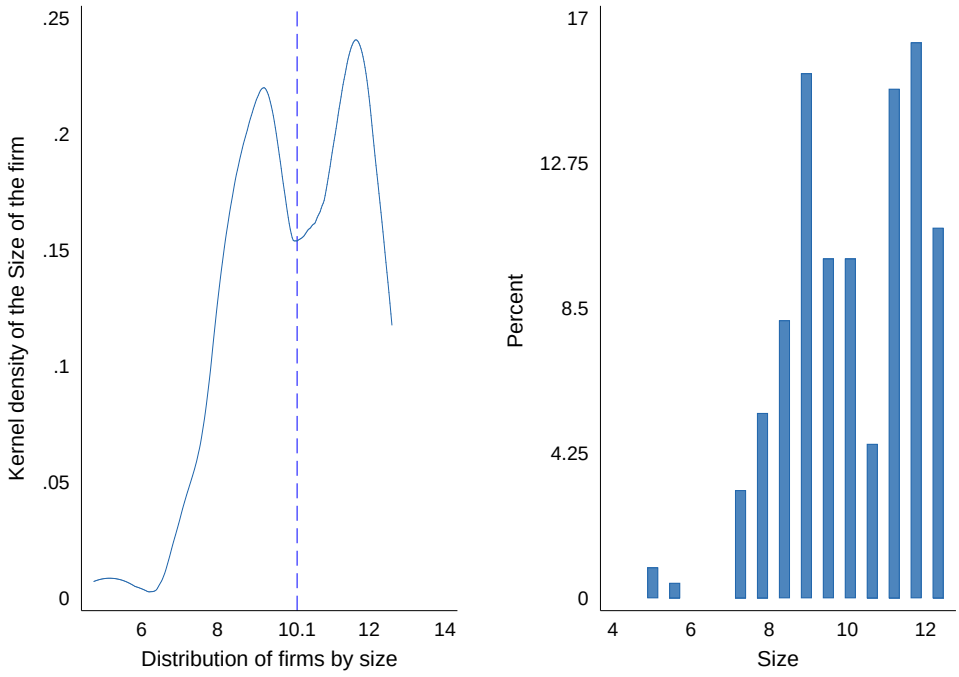

Figure 2.2: Distribution of Firms by Size (Kernel Density and Histogram)
Source: Author's calculation based on published company financial statements.

Size measured by the log of assets lies between 4.7 and 12.6. Like age, the distribution of size is also bimodal, with 10.2 as the value that separate the distributions. This is shown by the dashed line, which divides the distribution of firms by size into two groups: large and small. Splitting size at 10.2 and age at 20.5 years yields small and large firms on one side and young and mature, on the other. 49 percent of the firms are small and 36 percent of the firms are young. Grouping mature and large firms as financially unconstrained and any other firm as financially constrained puts the severity of financial constraints for listed manufacturing firms at 67 percent. That is, about two in every three listed manufacturing firms suffer from financial constraints.

To assess how well size-age measure identify financially constrained firms, another proxy of financial constraints based on dividend payment was constructed. The construction of this proxy entailed computing distance

from frontier based on yearly dividend payments by firms. That is, the yearly maximum and minimum values were used instead of the maximum and minimum values for the entire sample. This approach eliminates the effects of common shock that have disproportionate effects on financial constraint status of a firm. For instance, the effects of macroeconomic conditions on dividend payout and is appropriate due to movement of dividend payment over time. This yields a scaled variable, referred to as dividend payout measure, which range from 0 representing maximum dividend payout ratio to 1 representing minimum dividend payout ratio in any year. Figure 2.3 plots the Kernel distribution and histogram for the dividend payout.

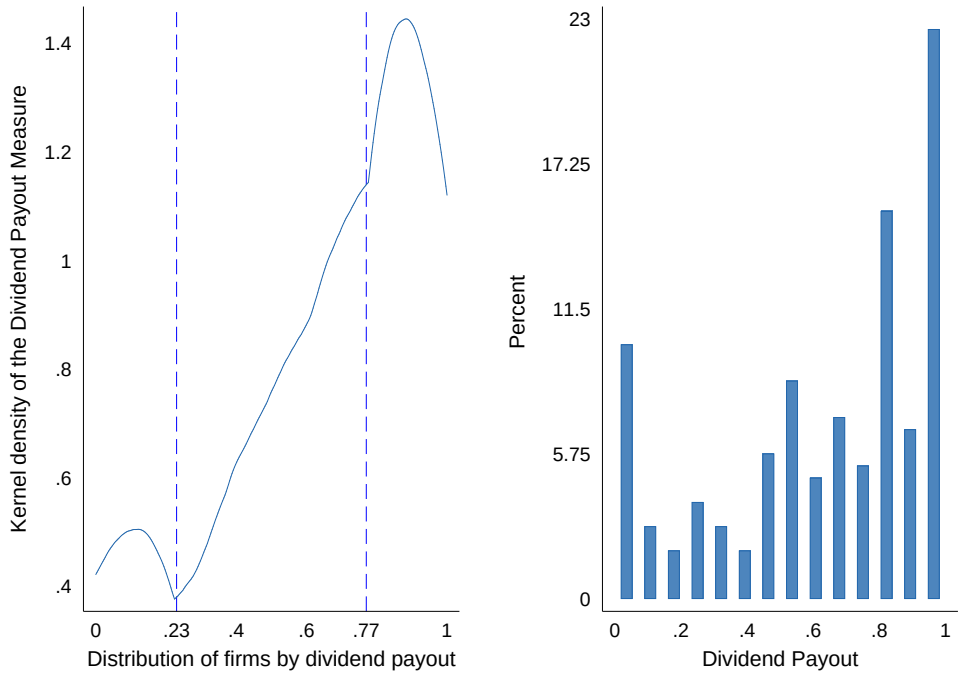

Figure 2.3: Distribution of Firms by Dividend Payout (Kernel Density and Histogram)
Source: Author's calculation based on published company financial statements.

Distance from frontier approach was used to construct dividend payout measure of financial constraints used in this section. Clearly, dividend payout lies closer

to one for the majority of the firms with the median of 0.70, suggesting most of the firms pay dividend close to the dividend payout of the lowest dividend payer. Dividend payment is zero in 8.4 percent of the firm-years and one in 18.4 percent of the firm-years. 91 percent of the firm-years have dividend payout measure of more than 0.235. The dividend payout is not a binary variable and hence represents the financial constraint status of each firm-year. Splitting the dividend payout measure at the median puts the severity of financial constraints at 33 percent. Subsequent subsections analyse the determinants of financial constraints and validate the measures of financial constraints developed in this section.

2.4.4 Evaluation of Financial Constraints Measures under Endogenous Switching Regression

In this section the regression results of endogenous switching regression are presented followed by an evaluation of the endogenous regression based classification against the starting measures generated in section 2.4.3. The idea was to assess the information content of Kaplan and Zingales (1997) index, Whited and Wu (2006) index and Hadlock and Pierce (2010) index about financial constraints and how endogenous switching regression used this information to improve on the starting values generated in section 2.4.3 to provide efficient measures of financial constraints[7]. Table 2.3 presents endogenous switching regression results of Hadlock and Pierce (2010) index

[7]Efficiency refers to classification that minimizes both the static and dynamic classification errors.

Table 2.3: Switching Regression with Hadlock and Pierce (2010) Regressors

	(1)	(2)	(3)	(4)
	Size-Age		Dividend Payout	
Variables	PoH	Investment	PoH	Investment
		Selection Regression		
Age	-1.6062***	-17.6169***	0.5232***	-5.2102***
	(0.000)	(0.000)	(0.000)	(0.000)
Size	4.2768***	48.5087***	2.3841***	-6.2372***
	(0.000)	(0.000)	(0.000)	(0.000)
Size sq.	-0.1309***	-2.0672***	-0.0488***	0.1233***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-29.0193***	-245.7641***	-19.2029***	58.8858***
	(0.000)	(0.000)	(0.000)	(0.000)
		First Regime Regression		
Financing Deficit	-0.0151		0.9641***	
	(0.410)		(0.000)	
Constant	0.0942*		-0.1170	
	(0.067)		(0.198)	
Cash flows		0.0111***		-0.0232***
		(0.000)		(0.000)
		Second Regime Regression		
Financing Deficit	1.0156***		0.0068	
	(0.000)		(0.271)	
Constant	-0.3170***		0.5079***	
	(0.005)		(0.000)	
Cash flows		-0.0048		-0.0074
		(0.192)		(0.621)
Observations	215	189	201	200
Adj. R-squared	0.99	0.9998	0.9508	0.9961
Mean Prob. vector	0.761	0.47	0.27	0.50

The levels of significance are: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. P-values are in parenthesis below the coefficients.

Source: Author's calculation based on published company financial statements.

The columns labelled 1 and 2 in Tables 2.3 presents the results generated using size-age measure as starting values while the columns labelled 3 and 4 presents the results generated using dividend payout measure of financial constraints as

starting values. The columns with subtitle PoH presents results of the outcome variable used in testing the impact of financial constraints on the validity of pecking order theory. The columns with subtitle Investment presents results of the outcome variable used in testing the impact of financial constraints on investment decisions. The first part of Tables 2.3 gives the selection equation while the second part, immediately below the first part, gives the regression results of the outcome equation under the first regime and the last part presents the regression results of the outcome equation under the second regime. A firm dummy and a year dummy[8] were included to remove firm-specific effects such firms meeting certain (listing) criteria self-selecting into a sample of listed firms and eliminate macro shocks, respectively.

To determine whether endogenous switching regression classification of firms are sensitive to the choice of the starting values and/or the specification of the selection and/or outcome equation, the regression results are compared across these dimensions. The classification of firms is sensitive to the choice of starting values if the coefficients and the mean probability vector varies with the choice of starting values for a given outcome and selection equations. Similarly, the classification is sensitive to the specification of the selection equation if the mean probability vector varies across Kaplan and Zingales (1997) index, Whited and Wu (2006) index and Hadlock and Pierce (2010) index for a given outcome equation and starting values. Lastly, the classification is sensitive to the specification of the outcome if for a given starting values and the specification of selection equation, the mean probability vector varies with the change in the outcome equation.

[8]Firm dummy and year dummy were included for each firm and year, respectively, and one dummy variable for each variable was dropped. Whichever dummy is dropped does not matter since this study is not interested in the effect of any particular firm or year dummy.

The results in Table 2.3 shows that the mean probability vector when outcome is PoH is 0.761 and 0.27, respectively, for size-age and dividend payout starting values. The mean probability for investment is 0.47 and 0.50 for size-age and dividend payout starting values, respectively. Similarly, the coefficients of the selection equation vary across the outcome due to changes in starting values. For, size-age starting values the mean probability vector 0.761 and 0.47 for PoH and Investment, respectively while for dividend payout starting values the mean probability vector is 0.27 and 0.50, respectively. These variations in mean probability vector provide evidence that the classification is sensitive to the choice of starting values and the specification of the outcome under the Hadlock and Pierce (2010) index.

In the absence of financial constraints, the coefficient of cash flow in the investment equation is hypothesized to be negative and vice versa in the presence of financial constraints. This hypothesis applies to the results in Tables 2.3, 2.4 and 2.5. The coefficients of cash flow in the second regime investment equations for the two starting values do not clearly indicate the financial constraint regimes they represent. It is, however, clear that the first regime investment equation under dividend payout starting values belongs to financially unconstrained regime while the first regime investment equation under size-age starting values belongs to financially constrained regime. Thus, the sub-samples generated in Table 2.3 are inconsistent across the starting values.

Table 2.4 presents endogenous switching regression results of Kaplan and Zingales (1997) index

Table 2.4: Switching Regression with Kaplan and Zingales (1997) Regressors

	(1)	(2)	(3)	(4)
	Size-Age		Dividend Payout	
Variables	PoH	Investment	PoH	Investment
		Selection Regression		
Cash flows	1.2546***	-0.8226***	1.6741***	1.0644***
	(0.000)	(0.000)	(0.000)	(0.000)
Market to Book	-0.0467***	-0.6216***	0.0173***	-0.0055
	(0.000)	(0.000)	(0.000)	(0.201)
Leverage	-5.0684***	-14.2337***	0.9644***	2.4894***
	(0.000)	(0.000)	(0.002)	(0.000)
Dividend	4.7063***	20.1936***	-4.2686***	-10.5987***
	(0.000)	(0.000)	(0.000)	(0.000)
Cash	2.5248***	-2.8275***	-0.6754***	0.6964***
	(0.000)	(0.000)	(0.007)	(0.000)
Constant	0.7715***	0.1165***	-1.1443***	1.1760***
	(0.000)	(0.002)	(0.000)	(0.000)
		First Regime Regression		
Financing Deficit	-0.0164		0.0058	
	(0.331)		(0.332)	
Constant	0.0597		0.0887**	
	(0.249)		(0.035)	
Cash flows		0.0136***		0.0579**
		(0.000)		(0.025)
		Second Regime Regression		
Financing Deficit	1.0208***		0.9624***	
	(0.000)		(0.000)	
Constant	-0.2756**		-0.2740**	
	(0.011)		(0.020)	
Cash flows		0.0056		-0.0178***
		(0.360)		(0.008)
Observations	221	207	214	201
Adj. R-squared	0.9966	0.9998	0.9630	0.9813
Mean of Prob. vector	0.74	0.46	0.70	0.46

The levels of significance are: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. P-values are in parenthesis below the coefficients.

Source: Author's calculation based on published company financial statements.

The mean probability vector in Table 2.4 when outcome is PoH is 0.74 and 0.70, respectively, for size-age and dividend payout starting values. For investment as the outcome variable, the mean probability is 0.46 and 0.46 for size-age and dividend payout starting values, respectively. Similarly, the coefficients of the selection equation vary across the outcome due to changes in starting values. Holding starting values constant and varying outcome variable gives the mean probability vector 0.74 and 0.46 for PoH and Investment, respectively for size-age starting values. The corresponding mean probability vector for dividend payout starting values is 0.70 and 0.46, respectively. These variations in mean probability vector provide evidence that the classification is sensitive to the choice of starting values and the specification of the outcome under the Kaplan and Zingales (1997) index.

The results in Table 2.4 are similar to those in Tables 2.3. The interpretation of coefficient of cash flow remain as above. The coefficients of cash flow for the first regime investment equations are positive and significant implying that the first regime under the two starting values represent financially constrained regimes. The coefficients of cash flow for the second regime investment equation suggest a financially unconstrained regime for dividend payout starting value and financial constraint regime under size-age starting values is ambiguous. Thus, the sub-samples generated in Table 2.4 are inconsistent across the starting values.

Table 2.5 presents endogenous switching regression results of Whited and Wu (2006) index

Table 2.5: Switching Regression with Whited and Wu (2006) Regressors

	(1)	(2)	(3)	(4)
	Size-Age		Dividend Payout	
Variables	PoH	Investment	PoH	Investment
		Selection Regression		
Leverage	-23.7250***	-25.8535***	-1.5602***	2.8309***
	(0.000)	(0.000)	(0.000)	(0.000)
Dividend	-4.6502***	8.8103***	-0.6434***	-0.2459*
	(0.000)	(0.000)	(0.000)	(0.059)
Growth in Sales	4.6403***	-13.5227***	-0.9679***	1.0537***
	(0.000)	(0.000)	(0.000)	(0.000)
Size	6.8608***	1.1872***	-0.9418***	-0.6752***
	(0.000)	(0.000)	(0.000)	(0.000)
Cash	16.1430***	4.6844***	3.3113***	-3.8562***
	(0.000)	(0.000)	(0.000)	(0.000)
Cash flow	-13.1045***	-3.8097***	-2.7683***	3.1537***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-79.3697***	-24.2745***	13.4504***	7.2158***
	(0.000)	(0.000)	(0.000)	(0.000)
		First Regime Regression		
Financing Deficit	0.0218		0.9895***	
	(0.201)		(0.000)	
Constant	0.0807		-0.1111	
	(0.271)		(0.322)	
Cash flows		0.0285**		-0.0076
		(0.015)		(0.263)
		Second Regime Regression		
Financing Deficit	0.9575***		0.0043	
	(0.000)		(0.457)	
Constant	-0.4342***		0.0826*	
	(0.000)		(0.094)	
Cash flows		-0.0009		0.0252**
		(0.851)		(0.031)
Observations	206	203	206	203
Adj. R-squared	0.9994	0.9995	0.9528	0.9763
Mean of Prob. vector	0.75	0.45	0.30	0.42

The levels of significance are: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. P-values are in parenthesis below the coefficients.

Source: Author's calculation based on published company financial statements.

The results in Table 2.5 are also similar to those in Tables 2.3 and 2.4. Table 2.5 shows that the mean probability vector when outcome is PoH is 0.75 and 0.30, respectively, for size-age and dividend payout starting values. For investment as the outcome variable, the mean probability is 0.45 and 0.42 for size-age and dividend payout starting values, respectively. Similarly, the coefficients of the selection equation vary across the outcome due to changes in starting values. Holding starting values constant and varying outcome variable gives the mean probability vector 0.75 and 0.45 for PoH and Investment, respectively for size-age starting values. The mean probability vector is 0.30 and 0.42, respectively for dividend payout starting values. These variations in mean probability vector show that the classification is sensitive to the choice of starting values and the specification of the outcome under the Whited and Wu (2006) index.

In Table 2.5, the positive and significant coefficient of cash flow in the first regime investment equation under size-age starting values suggest the presence of financial constraints. This is, however, inconsistent with the first regime investment equation under dividend payout starting values, which has an ambiguous financial constraint regime. The second regime investment equation has a positive coefficient of cash flow under dividend payout starting values implying that a financially constrained regime. The second regime investment equation has a negative but insignificant coefficient of cash flow under size-age starting values implying an ambiguous financial constraint regime. Thus, the sub-samples generated in Table 2.5 are inconsistent across the starting values.

To determine whether the classification is sensitive to the specification of the selection equation, this study compares results across the selection specification defined by Hadlock and Pierce (2010) index, Kaplan and Zingales (1997) index and Whited and Wu (2006) index as used in Table 2.3, 2.4 and 2.5, respectively. Holding starting values constant gives the mean probability vector of 0.76, 0.74,

0.75 under investment equation for Hadlock and Pierce (2010) index, Kaplan and Zingales (1997) index and Whited and Wu (2006) index, respectively and the mean probability vector of 0.47, 0.46, 0.45 under PoH equation for Hadlock and Pierce (2010) index, Kaplan and Zingales (1997) index and Whited and Wu (2006) index, respectively. Thus, size-age starting values give consistent mean probability vector, however, it varies across the outcome variable.

This is not the case with the dividend payout starting values. The mean probability vector under investment equation is 0.27, 0.70, 0.30 for Hadlock and Pierce (2010) index, Kaplan and Zingales (1997) index and Whited and Wu (2006) index, respectively and the mean probability vector of 0.50, 0.46, 0.42 under PoH equation for Hadlock and Pierce (2010) index, Kaplan and Zingales (1997) index and Whited and Wu (2006) index, respectively. Unlike size-age starting values, dividend payout starting values do not converge to the same mean probability vector. It is clear that size-age measure, unlike dividend payout, produce consistent sub-samples.

Ideally, the endogenous switching regression should improve on starting values, converging to the same classification of firms regardless of the choice of starting values, the specification of selection and the outcome equation. Thus, the regression results of an outcome equation should be independent of the starting values. Furthermore, the effects of financial constraints on firm's real decisions (dependent variable in the outcome equation) should be consistent for any given selection equation. These hypotheses, however, are not supported by the results in Tables 2.3, 2.4 and 2.5. The classification generated by endogenous switching regression was found to be sensitive to the choice of starting values, the specification of outcome and regime selection equation. In addition, the sub-samples generated by endogenous switching regression are inconsistent across the starting values.

Similar results on the inconsistency of measures of financial constraints were documented by Campello et al. (2010) and Farre-Mensa and Ljungqvist (2015). However, not in the context of endogenous switching regression as documented by this study. Endogenous switching regression should improve on the starting values to yield an efficient measure of financial constraint status. A measure of financial constraint status is more efficient the more the information it contains about financially constrained state to which the observed values of the outcome variable belong. An evaluation of the performance of the final values of the endogenous switching regression against the starting values gives the efficiency performance of the endogenous switching regression. Table 2.6 present the evaluation results for the final values of the endogenous regressions.

Table 2.6: Final Values of Switching Regression versus Initial Values

	A: Size-age combination											
	A1: PoH						A2: Investment					
Initial Values	**HP Index**		**KZ Index**		**WW Index**		**HP Index**		**KZ Index**		**WW Index**	
	0	1	0	1	0	1	0	1	0	1	0	1
0	0.07	0.93	0.08	0.92	0.09	0.91	0.33	0.67	0.21	0.79	0.30	0.70
1	0.30	0.70	0.32	0.68	0.28	0.72	0.55	0.45	0.64	0.36	0.59	0.41
Fisher's Exact p-value	0.000		0.000		0.001		0.002		0.000		0.000	
Chi2 p-value	0.000		0.000		0.001		0.002		0.000		0.000	
	B: Dividend payout											
	B1: PoH						B2: Investment					
Initial Values	**HP Index**		**KZ Index**		**WW Index**		**HP Index**		**KZ Index**		**WW Index**	
	0	1	0	1	0	1	0	1	0	1	0	1
0	0.49	0.51	1.0	0.0	1.0	0.0	0.49	0.51	1.0	0.0	1.0	0.0
1	0.27	0.73	0.0	1.0	0.0	1.0	0.27	0.73	0.0	1.0	0.0	1.0
Fisher's Exact p-value	0.002		0.000		0.000		0.002		0.000		0.000	
Chi2 p-value	0.002		0.000		0.000		0.002		0.000		0.000	

Sources: Author's Computation.

Column one present the starting values, with the first part (A) of the table giving the starting values of size-age measure and the second part (B) giving starting values for dividend payout. For each starting values there are two outcome variables: Pecking Order Hypothesis (PoH) and Investment, represented by A1 and A2 for size-age measure and B1 and B2 for dividend payout, respectively. Under each outcome variable KZ, WW and HP index are considered. Similar to the starting values, each final index takes a value for financial constrained state and zero, otherwise.

If the value at the intersection of 1 for each index with 0 for the starting value is equal to the value at the intersection of 1 for each index with 1 for the starting value, then the starting values identify financially constrained firms better than the index, otherwise the index performs better than the starting values. From Table 2.6 on page 74, the Chi-Square Test for Independence and Fisher's exact tests showed that there is no significant association between size-age starting values and the indices at 5% level of significance. The implication is that the final values are not significantly different from starting values.

The Chi-Square Test for Independence and Fisher's exact tests showed that there is no significant association between dividend payout starting values and all the indices at 5% level of significance. The implication is that the starting values identify financially constrained firms better than all indices regardless of the outcome variable. Furthermore, if the value at the intersection of the value of 1 for each index with the value of 1 for the starting values is equal to the value at the intersection of the value of 0 for each index with the value of 0 for the starting values, then there is no efficiency gain in using the index. In this case, the sample separation produced by starting values and index are exactly identical.

From the results in Table 2.6 on page 74, the dividend payout starting values and the KZ and WW Indices produces identical sub-samples regardless of the outcome variable. Thus, there is no efficiency gain in using KZ and WW Indices under the dividend payout starting values regardless of the outcome variable. Thus, size-age and dividend payout starting values outperform endogenous switching regression final indices implying that there is no efficiency gain in using endogenous switching regression final indices in classifying firms instead of starting values.

However, unlike size-age measure, dividend payout produced inconsistent sub-samples across the indices, which in turn, led to mixed results on the effects

of financial constraints across the sub-samples. Hence, size-age measure outperform dividend payout measure and thus, age and size are the major determinants of financial constraints in Kenya. This study documented evidence that the final values of HP index, KZ index and WW index generated by endogenous switching regression are sensitive to the choice of the starting values, and the specification of the outcome and selection equation, and therefore is awake up call for studies using endogenous switching regression without taking into consideration the possibility that their results might be sensitive to the choice of starting values and the specification of the outcome equation and the regime selection equation.

2.4.5 Severity of Financial Constraints

Based on the hypothesis that endogenous switching regression improves on these starting values to yield efficient measures of financial constraint status, the effects of financial constraints on investment, E^{I}_{jt}, developed in section 1.7 on page 22 was estimated for the main corporate decisions; financing and investment decisions and its performance in classification of firms gauged against the starting values. The regression results summarized in Tables 2.3, 2.4 and 2.5 clearly shows that the classifications based on endogenous switching regression are sensitive to the choice of starting values, the selection equation and the outcome equations.

Moreover, the mean probability vector ranges from about 0.27 to 0.76 depending on the starting values, outcome equation and selection equation used. That is the severity of financial constraints ranges from about 27 percent to 76 percent of firm-years. On the other hand, the severity of financial constraints for size-age starting values for listed manufacturing firms is 67 percent. That is, about two in every three listed manufacturing firms suffer some level of financial constraints.

This is slightly higher than the severity of financial constraints of 33 percent for the dividend payout measure. Experienced financial constraints, as measured by Chairman's statement on financial position of the company, put the severity of financial constraints at 50 percent of the firm-years.

In classification of financially constrained firms, size-age measure and dividend payout performs better than the endogenous switching regression indices. The regression results under dividend payout measure were, however, inconsistent across the outcome equation and the starting values. The correlation between the measure based on experienced financial constraints, on one hand, and size-age and dividend payout, on the other, is 0.78 and 0.17, respectively. Thus, size-age measure is a good proxy for experienced financial constraints and therefore measures financial constraints with reasonable accuracy. The results that the classification of firms vary across the different measures of financial constraints have been documented by a number of studies such as Campello et al. (2010); Farre-Mensa and Ljungqvist (2015); Hadlock and Pierce (2010).

2.5 Conclusion and Policy Implications

This essay evaluated the accuracy of measures of financial constraints. To this end, it identified financially constrained firm-years in Kenya, which formed the basis against which the classification of firms generated by switching regression model was evaluated. It also estimated the severity of financial constraints in Kenya. Endogenous switching regression was estimated with the right hand side variables in KZ, WW and HP indices as the selection equation and the pecking order test equation and investment equation as the outcome equations, and the a priori classification served as the starting values. A priori classification based on size-age measure was used and in addition, a new measure constructed from dividend payout ratio, using distance from frontier method, was used.

The dividend payout measure constructed took into consideration changes in financial constraint status of some firms over time as well as the dependence of firm response to shocks on financial constraint status. Endogenous switching regression model and two proxies of financial constraints were applied on a sample of 13 listed firms over the period 1999 to 2016. This essay hypothesized that the results under endogenous switching regression is not sensitive to the choice of the starting values and the specification of the outcome and selection equations. This hypothesis was rejected and it was found that the classification of firms generated by endogenous switching regression model were sensitive to the specification of regime selection and outcome equation, and the choice of the starting values. Furthermore, the sub-samples generated by endogenous switching regression model were found to be inconsistent across the starting values.

In order to determine the accuracy of the final classification generated by endogenous switching regression models, the performance of the final classification values were evaluated against the two a priori classification criteria: size-age and dividend payout. Specifically, a null hypothesis of no significant association between the starting values and the final classification values generated by endogenous switching regression was used to assess the performance of the final classification values. It was found that dividend payout and size-age starting values outperformed all the indices generated by endogenous switching regression model. The implication is that there is no efficiency gain in using endogenous switching regression indices since it did not improve on the starting values.

Unlike size-age measure, dividend payout produced inconsistent sub-samples across the indices, which in turn, led to mixed results on the effects of financial constraints across the sub-samples. The correlation coefficient between the

measure based on experienced financial constraints, on one hand, and size-age and dividend payout, on the other, is 0.78 and 0.17, respectively. Thus, size-age measure is the only measure that does a better job of identifying financially constrained firms, producing consistent results, and is the only measure that is a good proxy of experienced financial constraints. Hence, age and size are the major determinants of financial constraints in Kenya.

The severity of financial constraints ranges from 27 percent to 76 percent for measures of financial constraints generated using endogenous switching regression and is about 67 percent and 33 percent for size-age measure and dividend payout, respectively. The experienced financial constraints, which provides more accurate measure of financial constraints, puts severity of financial constraints in Kenya at 50 percent. That is, one in every two listed manufacturing firms suffer from financial constraints. However, size-age measure of financial constraints suggests that two in every three listed manufacturing firms suffer some level of financial constraints.

This study is one of the first studies to analyse financial constraints in Kenya and evaluate the efficiency of endogenous switching regression in sample separation. The evidence of sensitivity of endogenous switching regression classification to the choice of the starting values and the specification of the outcome and the regime selection equation points to the need for studies using endogenous switching regression to conduct sensitivity analysis and report the statistics as part of their results. Greater impact on reducing financial constraints can be achieved by targeting to ease constraints in access to capital for small and young firms.

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CHAPTER THREE

FINANCIAL CONSTRAINTS AND FIRM CAPITAL STRUCTURE IN KENYA

3.1 Introduction

Information asymmetry, which is taken as one of the sources of imperfections in capital and credit markets, has been very influential in explaining; differences in access to finance through quantity rationing (Stiglitz & Weiss, 1981) and price constraints (Bond & Meghir, 1994; Fazzari et al., 1988), and the choice of the source of finance (Myers, 1984; Myers & Majluf, 1984). The former provide evidence of the importance of information asymmetry, besides transaction cost (Chirinko & Schaller, 1995), in explaining financial constraints. In the latter, information asymmetry introduces additional cost which vary with the source of funds and thus generates financing hierarchy such as pecking order theory where firms prefer internal finances to external capital, and in case internal finances are inadequate prefer debt to equity. And this hierarchy is more apparent in the presence of huge informational problem.

Empirical evidence suggests that capital structure varies across firms facing different levels of information asymmetry (Brown et al., 2009), however, this evidence contradict the prediction of pecking order hypothesis. It is stronger for the subset of firms with less informational problem and vice versa. Specifically, pecking order hypothesis predicts financing behaviour of large firms (Frank & Goyal, 2003) and fails for small low-leverage growth firms (Fama & French, 2002). Attempts to reconcile the theory to empirical findings have considered

debt capacity constraints[1] documenting evidence that debt capacity constrained firms tend to issue equity whenever the need for external capital arises. But even with no debt capacity constraints, small high growth firms do not follow pecking order hypothesis (Fama & French, 2002). Consequently, it is natural to ask: what explains the reversal of predictions of pecking order theory for firms under different levels of information asymmetry and that are not debt capacity constrained[2]?

In view of the foregoing, this study investigated the effects of financial constraints on firm capital structure in Kenya. Specifically, this study:

(a) Investigated the effects of financial constraints on pecking order hypothesis

(b) Determined the role of financial constraints in the reversal of predictions of pecking order theory for small firms

Whether financial constraints affect firm's financing decision or not, provides candidate explanation to two key questions in corporate finance. These questions are: First, what causes violation of pecking order theory? Second, why small high growth firms do not issue debt even when they are not debt capacity constrained?

Most of the studies documenting the reversal of predictions of pecking order theory have used size or proxies of information asymmetry that are related to size. Though size has strong links with information asymmetry, there is ample evidence linking size to financial constraints (Hadlock & Pierce, 2010; Hubbard, 1998) and to the wedge between the cost of internal finance and external capital

[1]Debt capacity constraints can arise if firms do not have pledge-able assets.

[2]Debt capacity constraints is inferred from excess capacity (over and above existing debt contracts) in terms of uncommitted future cash flows or tangible assets that a firm can pledge as security to obtain debt.

(Hennessy & Whited, 2007). Furthermore, small firms which have been found to exhibit the reversal of predictions of pecking order theory (Fama & French, 2002) are more likely to be financially constrained than large firms (Brown et al., 2009; Hadlock & Pierce, 2010; Schiffer & Weder, 2001). According to the pecking order theory, credit or debt should precede equity as a source of external capital. However, if financial constraints are binding, firms might not fully utilize credit or debt as predicted by pecking order theory, even if they have excess capacity, in terms of uncommitted future cash flows or tangible assets, to borrow[3]. Thus, financial constraint is an impediment in access to credit or debt.

Kenya provides a perfect setting for investigating the effects of financial constraints on capital structure. Financial constraints are likely to be greater given its level of financial development. Empirical evidence show that listed companies even in countries with advanced capital markets such as USA (see: Fazzari et al., 2000, 1988; Hadlock & Pierce, 2010; Kaplan & Zingales, 1997, 2000), UK (see: Bond & Meghir, 1994; Guariglia, 2008) and Japan (Goyal & Yamada, 2001; Hoshi et al., 1991) face financial constraints. Given the level of financial development in Kenya is not as advanced as in USA, UK or Japan, financial constraints in Kenya are likely to be severe.

Moreover, capital and credit markets are thin and illiquid. For example, the number of firms issuing corporate bonds increased from 1 in every 11 firms in 2005 to 18 out of 62 listed firms with a total value of 86.76 billion Kenya shillings in 2016 (Capital Markets Authority, 2016). On the other hand, equity is no better. Although it is the main security listed and traded in the Kenyan capital markets

[3]If a firm cannot borrow or issue debt due to financial constraints, then alternative sources of funds such as equity might take precedence in external capital usage. In this way, financial constraints affect changes and hence accumulation of debt or credit which, in turn, has implication on capital structure. Thus, financial constraints are likely to be behind the observed behaviour of small high growth firms, however, whether it can validly explain this behaviour or not has not been verified empirically.

with a market capitalization of about 1.998 trillion Kenya shillings in 2016, equity is rarely issued as a source of funds after initial public offer. Over the period 1999 to 2016, there were only three instances where listed manufacturing firms issued equity after initial public offer. Furthermore, domestic credit to private sector in Kenya averaged about 32.6 percent in 2016, which is slightly above the regional average of about 28.8 percent in sub-Saharan Africa. Other developing regions such as Europe and Central Asia (excluding high income countries), and Latin America and Caribbean (excluding high income countries) each had an average of about 52.4 percent and 47.5 percent, respectively, in 2016 (World Bank, 2017). This, in combination, acts to increase the likelihood of financial constraints.

This study exploited the differences in pecking order prediction among firms of different sizes and growth, and used the link between financial constraints and capital structure to explain the reversal of predictions of pecking order theory. The key assumption here is that any effects of information asymmetry on capital market should manifest itself in the wedge between the cost of internal and external capital, and between the various components of external capital and ultimately in a firm's capital structure. Hence, pecking order prediction is hypothesized to depend on the extent of financial constraints. Constrained firms was found to use less internal funds and more external funds than unconstrained firms. In addition, unconstrained firms relative to constrained firms have more cash. Financing behaviour varies with financial constraint status. The wedge between the cost of debt and the opportunity cost of internal funds is the main cause of the reversal of predictions of pecking order theory.

The findings of this study are important for two reasons. First, determining the effects of financial constraints on firm capital structure and hence the cost of external funds is important in shaping the interpretation of the observed

investment-cash flow sensitivity. Second, determining the form which financial constraints take is important in developing policies to alleviate constraints on access to external capital. This study makes two key contributions. First, it contributed methodologically in testing of pecking order theory in the presence of regimes. An approach which interact the regime variable with the right-hand side variables of a pecking order equation was employed to test pecking order theory; a departure from earlier work such as Lemmon and Zender (2010). Allowing financial constraint regimes in pecking order equation improved the fit of the pecking order equation and produced results that are consistent with pecking order prediction.

Second, this study is related to emerging literature on explaining the reversal of predictions of pecking order theory such as Lemmon and Zender (2010) and Yang (2014). However, unlike Lemmon and Zender (2010) who used debt capacity constraints to augment capital structure equation and Yang (2014) who studied financial constraints and capital structure in a more general form[4], this study explicitly introduces financial constraint regimes in pecking order equation. This study is similar in spirit to the work of Lemmon and Zender (2010), however, instead of augmenting the pecking order equation, this study allowed for financial constraint regimes and relied on the marginal effects to test for the existence and the effects of financial constraints on financing behaviour. The rest of the essay is organized as follows. Section 3.2 provides a review of literature. Section 3.3 discusses the methodology as well as the hypotheses to be tested and describes the data. Section 3.4 analyses and discusses the empirical results. Section 3.5 concludes the essay.

[4]Yang (2014) approach is general that it cannot be interpreted in the context of pecking order theory

3.2 Literature Review

This section presents theoretical and empirical literature on information asymmetry and firm's financing decisions. First, theoretical literature is presented followed by empirical literature.

3.2.1 Review of Theoretical Literature

Theoretical analysis of capital structure began with Modigliani and Miller (1958) capital structure irrelevance theory. This theory states that in a perfect capital market, the cost of capital remains constant as debt to equity ratio changes. The cost of capital does not change when leverage changes since any gain accruing to the firm from the use of relatively cheaper debt will be offset by the increase in the cost of equity. Thus, the cost of capital and hence the value of the firm is independent of capital structure of the firm. This model is derived under the assumption of perfect capital markets; however, capital markets are likely to be imperfect due to presence of taxes, imperfect information among other factors. As a result taxes were introduced into the model in 1963 by Modigliani and Miller (1963).

With the introduction of taxes, the model predicts that firms should use 100 percent debt financing due to interest tax shield. However, in practice firms used a mixture of debt and equity. At the core of this was the question, what prevents firms from using a 100 percent debt capital. This question was addressed by trade-off theory of capital structure. The trade-off theory of capital structure argues that the interest tax shield of debt is offset by cost of financial distress and the interactions of these two generate an optimal capital structure (Myers, 1977).

All these models assume perfect information; hence they are not suitable for the analysis of capital structure under information asymmetry. In addition, these

theoretical models explain the level of debt and equity in a firm's capital structure and often do not discuss the evolution of capital structure[5], and hence cannot be interpreted as models of financing behaviour. Models of capital structure based on information asymmetry emerged in late 1970s (see for instance: Jensen & Meckling, 1976; Ross, 1977) and early 1980s (see for instance: Myers, 1984; Myers & Majluf, 1984).

The most influential of these models is the pecking order hypothesis due to Myers and Majluf (1984) and Myers (1984). This model emphasized asymmetric information between managers and less informed outside investors, which causes outside investors to discount new and existing risky securities when firms attempt to issue risky securities. Asymmetric information causes firms to prefer internal finances to external capital, and in case internal finances are inadequate to prefer low risk debt to high-risk debt, and to prefer high-risk debt to equity. Financial hierarchy arises where internal finances are used first and low risk debt issued once internal finances are exhausted, high risk debt and then equity will only be issued if a firm exhaust its capacity to issue low risk debt.

This hierarchy arises because informational cost is higher for equity than for debt, and comparatively debt is relatively expensive when compared with internal funds. The cumulative hierarchical financing over time generates the capital structure and hence the firm has no optimal capital structure (Myers & Majluf, 1984). If informational problem looms large for some firms, then pecking order predicted values should differ across firms grouped using informational asymmetry status. This, in addition to the interpretation of this model as one of financing behaviour, informed the choice of this model

[5]Trade-off theory, however, considers whether there is a target leverage and if firms' capital structure tends to evolve towards this target leverage level

for evaluation of the impact of information asymmetry and hence financial constraints on firm capital structure decision.

3.2.2 Review of Empirical Literature

This study builds on literature on capital structure that has considered information asymmetry. Of primary interest in this study are the differences in the financing behaviour of firms under different levels of information asymmetry. Research interest on financing decisions and investment decisions date back to as early as 1930s. However, systematic analysis began in 1950s with the work of Modigliani and Miller (1958). One of the conclusions of Modigliani and Miller (1958), the independence of financing and investment decisions in a perfect capital market, has motivated this study. Whether financing and investment decisions are independent or not, depends on the level of capital market imperfections the firm faces. Capital market will be imperfect if informational problem looms large and therefore financing and investment decisions cannot be independent.

In assessing the impact of financial constraints on firm investment, Bond and Meghir (1994) used Euler investment equation that captures the independence of financing and investment decisions. Independence of financing and investment decisions means absence of imperfections in capital markets. Based on this, firms can be dichotomized into two groups; where investment and financing decisions are independent on one hand and where they are not, on the other. In this regard, firms under the two regimes should behave differently in terms of financing and investment. Despite this possibility and evidence from financial constraints literature that firms facing different levels of information asymmetry behave differently, much of the literature on capital structure use representative firm framework.

Brown et al. (2009) documented evidence that young firms in Research and Development (R&D) sector bypass debt to issue equity once they exhaust internal finances. Therefore, these firms have a financing hierarchy that consists almost entirely of internal finance and equity finance. The inclusion of age (young) in their work needs to be emphasized. Age has been used as a proxy of information asymmetry or financial constraints; therefore, it stresses how differences in information asymmetry affect firm financing behaviour. This study differs from the work of Brown et al. (2009) in two respects; the latter focused only on young firms in the R&D sector while this study considers firms in the manufacturing sector regardless of age. Second, they sought to identify financial factors that drive growth in R&D sector. In contrast, this study examines the effects of information asymmetry and hence financial constraints on capital structure.

Similar evidence of violation of pecking order prediction were documented by Fama and French (2002) and Frank and Goyal (2003). Using data on publicly traded American firms for 1971 to 1998, Frank and Goyal (2003) found that net equity issues track the financing deficit more closely than do net debt issues, however, when they separated their sample based on size; they found that pecking order only hold for a subset of their sample constituting of large firms. Similar evidence was documented by Fama and French (2002) who observed large equity issues among small low-leverage growth firms. According to Fama and French (2002) these firms preserve low-risk debt capacity to finance future growth by issuing equity instead of debt thereby violating the pecking order theory.

These findings are in sharp contrast to the pecking order theory which predicts that debt issues should track financing deficit and this relationship should be stronger for small firms than for large ones. Unlike large established firms, small

firms face more informational problem and hence equity is more expensive than debt for these firms. Thus far, age and size have emerged as important factors in firm financing behaviour. This is in line with earlier evidence such as Hennessy and Whited (2007), who argued that size of the firm and the wedge between the cost of internal finance and external capital is linked.

This study complements earlier attempts to reconcile the theory to empirical findings which include Lemmon and Zender (2010) and Yang (2014). Lemmon and Zender (2010) divided firms using debt capacity constraints into two; those with debt rating are debt capacity unconstrained and those without debt rating are debt capacity constrained. They found evidence in support of pecking order hypothesis with a large coefficient of financing deficit for firms facing no debt capacity constraints than for firms facing debt capacity constraints. They also provided evidence that debt capacity constrained firms use equity to finance their deficits.

Yang (2014) examined the relationship between financial constraints and capital structure, although in a more general form that cannot be interpreted in the context of pecking order theory. In addition, Yang (2014) explicitly modelled debt capacity and equity constraints effectively leaving out the role of internal markets (see Lamont, 1997, for the importance of internal capital markets). Hence, this model like that of Lemmon and Zender (2010) cannot account for small high growth firms that do not issue debt, even when they are not debt capacity constrained.

This study also relates methodologically to the literature on pecking order hypothesis (Myers, 1984; Myers & Majluf, 1984). Shyam-Sunder and Myers (1999) developed testable predictions for pecking order hypothesis. The prediction is that use of external capital is driven by internal financing deficit, that is, investment less internally generated cash flows. They applied it to 157 firms

over the period 1971 to 1989 and found strong evidence in support of pecking order hypothesis, however, with low statistical power.

This approach was, however, criticized by Chirinko and Singha (2000) who argued that the approach could be unable to detect violations to the pecking order hypothesis such as those identified by Brown et al. (2009). As a result Frank and Goyal (2003) used a nested model, which combines Shyam-Sunder and Myers (1999) model and conventional factors proposed by Rajan and Zingales (1995) to test the pecking order hypothesis. If pecking order hypothesis holds, then conventional variables should not matter. In contrast, their finding showed that financing deficit does not wipe out the effects of conventional factors for their entire sample.

Shyam-Sunder and Myers (1999), unlike this study, used representative firm framework. This study is similar to Frank and Goyal (2003) in the use of conventional variables and separation of the sample using proxies of informational problem. But, unlike Frank and Goyal (2003) who focused on the differences in capital structure across firms in different size groups, this study focuses on examining the differences in capital structure for firms facing different degrees of financial constraints.

This study also relates methodologically to the work of Fama and French (2002) that used leverage prediction to test simple and complex version of the pecking order theory. Under complex version of pecking order hypothesis, firms with larger expected investments are pushed towards keeping more low-risk debt capacity to finance future investment. Thus, Fama and French (2002) approach is used to complement Shyam-Sunder and Myers (1999) approach.

Other studies similar to this one include Elsas, Flannery and Garfinkel (2014) and Grullon, Hund and Weston (2014). Elsas et al. (2014) focused on how the

financing of large investments affect leverage. They found evidence in support of trade-off theory and market timing hypothesis, and very little support for pecking order hypothesis. Their study did not have a comparison group; therefore, whether pecking order theory is supported for firms with small investment in their sample is unknown. In addition, there is no evidence in their study linking the size of investment undertaken by a firm to information asymmetry or agency problem.

Grullon et al. (2014) followed Frank and Goyal (2003) procedure and documented evidence that the largest investing firms finance their investment spending differently from other firms. They found that the largest investors' financing behaviour follows the pecking order hypothesis. However, they argue that this pattern vanished rapidly as the sample size increases to include firms with small investments. By increasing their sample to include smaller firms, their analysis was converging towards a representative firm framework.

Hence the failure in capital structure model to predict firm behaviour may be partly attributed to representative firm framework. In terms of interpretation, Grullon et al. (2014) results are consistent with those of Fama and French (2002), Frank and Goyal (2003) and Brown et al. (2009) and they arise due to information asymmetry. However, the results in Lemmon and Zender (2010) is attributed to debt capacity constraints. Grullon et al. (2014) focused on determining whether the top largest 100 investors behaved differently while this study seeks to estimate the effects of financial constraints on firm financing behaviour.

Other studies examining other theories of capital structure have shown that heterogeneity in firm characteristics or in the characteristics of source of capital have implications in the estimates. Rauh and Sufi (2010) found that ignoring debt heterogeneity lead to substantial loss in capital structure variation. By dividing

firms based on credit quality, the authors found that low quality credit firms have a capital structure made up of secured bank debt with restrictive covenants and subordinated non-bank debt with loose covenants.

Shivdasani and Stefanescu (2009) documented evidence that pension assets and liabilities affect capital structure decisions. They explored the effects on leverage of lowering firm's marginal corporate tax rates of pension contributions. Pension contributions tax shields, which they found to be about a third of those from interest payments, result in leverage ratios which is about 35 percent higher.

Similarly, Faulkender and Petersen (2006) factored in the effects of market frictions on both capital availability and the source of capital, and found that having a debt rating increases a firm's debt usage by about 35 percent, even after controlling for differences in firm characteristics that determine capital structure and endogeneity. These studies show that the cost of debt is an important factor in determining leverage and by extension any factors that affect leverage such as market frictions or financial constraints will drive financing decisions.

Korajczyk and Levy (2003) classified firms into constrained and unconstrained sub-samples and examined their capital structure decisions under different macroeconomic conditions. They found a counter-cyclical target leverage for unconstrained firms and a pro-cyclical target leverage for constrained firms. In addition, the issue choice and timing was found to be more sensitive to macroeconomic conditions for unconstrained firms than for constrained firms.

The studies by Shivdasani and Stefanescu (2009), Faulkender and Petersen (2006) and Korajczyk and Levy (2003) provide evidence of how heterogeneity leads to variation in capital structure, however, they offer little evidence on whether firm heterogeneity, in particular those arising from financial constraints, cause reversal in the prediction of pecking order theory. Moreover, the measures

of firm heterogeneity used in these studies do not strictly match the measure of financial constraints as used in the literature and in this study.

3.2.3 Overview of Literature

Two important messages emerged from the literature. First, in some cases pecking order theory fails in a representative firm framework. However, when the same firms are classified into groups based on differences in information asymmetry, the theory holds for a subset of firms. Second, the support of pecking order theory varies across dimensions such as size, debt rating and credit quality; which are related to information asymmetry and hence financial constraints. Most of the studies that have used these dimensions have come to a common conclusion that pecking order hypothesis does not hold for the subset of firms with severe informational problem and is in fact strongly supported for firms facing a lesser informational problem. This conclusion contradicts pecking order hypothesis. Pecking order prediction should be stronger for firms whose informational problems loom large. Evidence suggests that use of representative firm framework or failure to accurately identify financially constrained firms produce biased estimates of capital structure. Thus, this study posits that financial constraints affects pecking order financing hierarchy and therefore explain the reversal of predictions of pecking order theory.

3.3 Methodology

This section presents the methodology adopted to implement the objective of this essay. The theoretical framework, the model to be estimated and lastly, the definition of data and variables to be used are presented. Differences in the prediction of pecking order hypothesis across the subset of firms generated in Essay one (Chapter Two) was used to investigate the effects of financial constraints on firm capital structure in Kenya. The idea here is that higher

informational cost is associated with a higher wedge between internal and external capital and this leads to financial constraints. A higher wedge between internal and external capital, in turn, generate pecking order financing hierarchy.

3.3.1 Pecking Order Theory and Financial Constraints

Two versions of pecking order theory have been considered in previous literature: simple and complex. The level of debt is determined by accumulated differences between retained earnings and investment in the simple version while firms with larger expected investments preserve more low-risk debt capacity to finance future investment in the complex version of the theory (see, Fama & French, 2002, for a detailed discussion). The simple version implies that pecking order hypothesis holds if the level of debt (the changes in debt) is positively related to the accumulated differences between retained earnings and investment (financing deficit), with a coefficient that is not significantly different from one. On the other hand, investments or expected investments are negatively related to leverage if complex pecking order hypothesis holds.

The evaluation of the impact of financial constraints on firm pecking order financing hierarchy requires comparing the predictions of pecking order theory for firms under different degrees of financial constraints. Taking presence of financial constraints as a treatment, this entails comparing the pecking order prediction under financial constraints with its counter-factual. Counterfactual, in this context, is what would have been the prediction of pecking order hypothesis in the absence of financial constraints. However, counterfactual cannot be observed. In addition, comparing pecking order predictions for firms under different degrees of financial constraints is misleading due to selection bias. Including regressors that determine financial constraint status reduces or eliminate selection bias. This is the approach adopted in this study.

In the context of pecking order theory, the most effective way to use this approach is to allow for the slope and the intercept to vary across the determinants of firm's financial constraint status and capital structure. Applied econometricians have used interaction terms and the dummy to allow for the intercept and slope to vary across sub-samples. This study started with a simple model of PoH with no financial constraint regime and extended it to factor in financial constraint regimes.

3.3.2 Model Specification

Pecking order hypothesis is based on the argument that firms prefer internal finances to external capital, and in case internal finances are inadequate, prefer low risk debt to high risk debt, and high risk debt to equity. Thus, in the case of simple pecking order theory any financing deficit should be funded by debt. The model that implements this was proposed by Shyam-Sunder and Myers (1999) and extended by Frank and Goyal (2003). This model can be interpreted as a model of financing behaviour and the cumulative financing over time yields the capital structure. The financing deficit can be expressed as:

$$DEF_{it} = DIV_{it} + NI_{it} + \Delta W_{it} + CD_{it} - CF_{it} \tag{3.1}$$

where DIV_{it} is dividend payments for firm i in year t, NI_{it} is the net investment for firm i in year t, ΔW_{it} is the net change in working capital for firm i in year t, CD_{it} is current portion of long-term debt for firm i at the beginning of the year t and CF_{it} is the operating cash flows after interest and taxes for firm i in year t. Aggregation in equation (3.1) involves restricting the coefficients of the various components of financing deficit to one. If this is not the case, then the most

appropriate pattern of coefficients should be used. The pecking order hypothesis to be tested is:

$$\Delta D_{it} = \alpha + \beta DEF_{it} + \varepsilon_{it} \tag{3.2}$$

where ΔD_{it} is the amount of debt issued by firm i at time t and DEF_{it} is the financing deficit for firm i at time t. The pecking order hypothesis holds if the constant, α, is equal to zero and the pecking order coefficient, β, is equal to one. Thus, this study takes α and β as the parameters that determine the strength of pecking order prediction.

The financing hierarchy for the financially constrained firms is likely to violate the key empirical prediction of pecking order hypothesis and the test based on equation (3.2) are unable to detect such violations (Chirinko & Singha, 2000). To address this shortcoming, Frank and Goyal (2003) modified equation (3.2) by including conventional variables that drive capital structure. Moreover, following Lemmon and Zender (2010) and Agca and Mozumdar (2004) the square of financing deficit is included in equation (3.2) and (3.3) to capture the concave relationship between changes in debt and financing deficit in the presence of debt capacity constraints as shown by Chirinko and Singha (2000). The modified model with the expected sign is expressed as follows;

$$\Delta D_{it} = \alpha_0 + \beta DEF_{it} + \gamma DEF_{it}^2 + \alpha_1 \Delta T_{it} - \alpha_2 \Delta MtB_{it} + \alpha_3 \Delta s_{it} - \alpha_4 \Delta P_{it} + \varepsilon_{it} \tag{3.3}$$

where ΔD_{it} is the amount of debt issued by firm i at time t, DEF_{it} is the financing deficit for firm i at time t, ΔT_{it} stands for change in tangibility of assets for firm i at time t, ΔMtB_{it} is the change in market-to-book ratio of firm i at time t, Δs_{it} is

the change in log of sales for firm i at time t and ΔP_{it} is the change in profitability for firm i at time t. Other variables are as defined earlier. $\alpha's$, β and γ are the parameters to be estimated while ε is the error term.

The coefficient of market-to-book ratio is negative while that of sales is positive. The coefficient of profitability and tangibility are ambiguous. Due to information asymmetry, profitable firms are predicted to have higher leverage. On the other hand, highly profitable firms with few investments, as measured by market to book value, have little debt (Fama & French, 2002). Tangible assets act as collateral hence causing firms with high collateral to have high debt. The coefficient γ in equation 3.3 should be zero or positive if financial constraints are not binding, otherwise it is negative.

To determine whether financial constraint regimes are important in capital structure, equation 3.3 was extended by adding the determinants of financial constraints as regressors. This gives:

$$\Delta D_{it} = \alpha_0 + \beta DEF_{it} + \gamma DEF_{it}^2 + b_2 Z_{it} + \alpha_1 \Delta T_{it} - \alpha_2 \Delta MtB_{it} + \alpha_3 \Delta s_{it} - \alpha_4 \Delta P_{it} + \varepsilon_{it} \tag{3.4}$$

where Z_{it} is a vector of variables for firm i at time t that determine financial constraint status. $\alpha's$ and the vector b_2 are the parameters to be estimated. Other variables are as defined earlier. A coefficient vector b_2 that is statistically different from zero implies financial constraints plays a pivotal role in corporate capital structure. However, if Z_{it} is correlated with the determinants of capital structure, then the coefficients of Z_{it} might be biased. This problem was mitigated by dropping Z_{it} from regression equation and instead interacting all the right hand side variables with the financial constraint regimes variable. This gives:

$$\Delta D_{it} = \alpha_0 + \beta DEF_{it} + \gamma\left(DEF_{it}^2\right) + \alpha_1 \Delta T_{it} - \alpha_2 \Delta MtB_{it} + \alpha_3 \Delta s_{it} - \alpha_4 \Delta P_{it} + b_3 C_{it} + b_4 \left(C_{it} \times DEF_{it}\right) + b_5 \left(C_{it} \times DEF_{it}^2\right) + b_6 \left(C_{it} \times \Delta T_{it}\right) - b_7 \left(C_{it} \times \Delta MtB_{it}\right) + b_8 \left(C_{it} \times \Delta s_{it}\right) - b_9 \left(C_{it} \times \Delta P_{it}\right) + \varepsilon_{it} \quad (3.5)$$

where C_{it} is a dummy that equals one if firm i is financially constrained in time t and zero, otherwise. $\alpha's$ and $b's$ are the parameters to be estimated. Other variables are as defined earlier. The coefficients of interest are b_3 and b_4. A positive coefficient of b_4 significantly not different from one and an insignificant value of b_3 imply that the prediction of pecking order model is stronger for financially constrained firms. If the subset of firms defined by C equals to 1 is financially constrained, then the coefficient b_5 should be negative. In this way, this study makes a contribution by introducing a new way of testing for the effects of financial constraints on pecking order prediction.

The complex version of pecking order theory was implemented using partial adjustment model. In this model, the change in book leverage, $\frac{L_{it}}{A_{it}}$, partially absorbs the difference between target leverage, $\frac{TL_{it}}{A_{it}}$, and lagged leverage, $\frac{L_{it-1}}{A_{it-1}}$ (Fama & French, 2002). The pecking order hypothesis to be tested is given as:

$$\frac{L_{it}}{A_{it}} - \frac{L_{it-1}}{A_{it-1}} = \tau_0 + \tau_1 C_{it} + \tau_2 \left(C_{it} \times \left\{ \frac{TL_{it}}{A_{it}} - \frac{L_{it-1}}{A_{it-1}} \right\} \right) + \tau_3 F_{it} + \xi_{it} \quad (3.6)$$

where F_{it} is a vector of current and past investments and profits for firm i at fiscal year t and C_{it} is a dummy that equals one if a firm is financially constrained and zero, otherwise. Profitability has a negative effect on change in leverage while market to book value ratio (proxy for investment opportunities) has a positive effect on book leverage and a negative effect on market leverage.

The pecking order theory predicts that dividend payments do not change in the short run and therefore short term variation in investment and profitability will be absorbed by leverage. If the effect on market leverage of market to book value ratio is negative, then the complex pecking order holds. On the other hand, $\tau_2 = 0$ if simple pecking order theory hold. The model was estimated separately for the constrained and unconstrained sub-samples.

The effects of financial constraints on capital structure was also evaluated by including a full interaction of variables that determine capital structure and a dummy which takes the value of one in the presence of financial constraints and zero, elsewhere. $\frac{TL_t}{A_t}$ is proxied by the fitted values of the following equation;

$$\frac{L_{it}}{A_{it}} = c_o + c_1\frac{V_{it-1}}{A_{it-1}} + c_2\frac{EBIT_{it-1}}{A_{it-1}} + c_3\frac{Dp_{it-1}}{A_{it-1}} + c_4 RDD_{it-1} + c_5 ln\left(A_{it-1}\right) + c_6 TP_{it} + e_{it} \tag{3.7}$$

where $\frac{V_{it-1}}{A_{it-1}}$ is the ratio of market to book value of assets for firm i at the end of fiscal year $t-1$, $\frac{EBIT_{it-1}}{A_{it-1}}$ is the ratio of earnings before interest and taxes for firm i in fiscal year $t-1$ to book value of assets at the end of fiscal year $t-1$, $\frac{Dp_{it-1}}{A_{it-1}}$ is the ratio of depreciation expense for firm i in fiscal year $t-1$ to book value of assets at the end of fiscal year $t-1$, $ln\left(A_{it-1}\right)$ is the natural log of book value of asset at the end of fiscal year $t-1$, and TP_{it} is the target dividend payout ratio for firm i in fiscal year t. The target dividend payout is given by the fitted values of the following equation:

$$TD_{it} = TP \times Y_{it} \tag{3.8}$$

where TD is the total dividend paid by firm i at time t and Y is the total income attributable to ordinary shareholders.

Estimating equation (3.3), (3.4), (3.5), (3.6) and (3.7) requires determining whether the company and/or time variables on one hand are correlated to independent variables on the other. In this case, fixed effects are preferred, otherwise random effect model produce more efficient estimators. Fixed effects always give consistent results, but it is not as efficient as the random effect model. This study used least squares dummy variable (LSDV) in estimation.

The first objective was implemented using equation (3.4), (3.5) and (3.6), first with interacted variables and second without interacted variables. By interacting the right hand variables with financial constraint status, this study aimed to determine differences in the pecking order theory of capital structure for each financial constraint status. In this case if the increase in F arising from inclusion of interacted right hand variables is significant, then the pecking order prediction depends on the degree of financial constraints. The second objective attempts to replicate the analysis in the first objective with a different interaction dummy. The interaction term in this case takes the value of one if firm is a small-high growth and zero, otherwise. However, since financially constrained firms were not statistically different from small-high growth firms then the same dummy was used for the first and the second objective. Further tests were conducted to determine the link between small-high growth and financial constraint status.

3.3.3 Definition and Measurement of Variables

The variables defined hereunder were used in this study.

Variables	Measurement	Expected sign	Literature source
Change in debt (ΔD) or leverage	Is the dependent variable in pecking order hypothesis. ΔD is the total amount of debt and long term loans obtained by the firm in year t.	Not Applicable. It is the dependent variable	Frank and Goyal (2003); Shyam-Sunder and Myers (1999)
$(\frac{L_{it}}{A_{it}} - \frac{L_{it-1}}{A_{it-1}})$	Is the dependent variable in pecking order hypothesis. $\frac{L_{it}}{A_{it}} - \frac{L_{it-1}}{A_{it-1}}$ is the change in book (market) leverage measured by the change in the ratio of book (market) value of debt to book value of assets.	Not Applicable. It is the dependent variable	Fama and French (2002)
Financial constraints (FC)	Is a dummy variable for identifying financially constrained firms which takes one if a firm is financially constrained and zero, otherwise. For details on this variable see section 2.3.2 on page 51.	Financial constraints limit the use of external capital.	Hadlock and Pierce (2010)
Net investment	Equals capital expenditure + increase in investments + acquisition + other uses of funds - sales of investment - property, plant and equipment		Frank and Goyal (2003); Shyam-Sunder and Myers (1999)
Change in working capital	Change in operating working capital +change in cash and cash equivalents		Frank and Goyal (2003); Shyam-Sunder and Myers (1999)

Cash flow after interest and taxes	Income before extraordinary items + depreciation and amortization + extra-ordinary items and discontinued operations + deferred taxes + equity in net loss - earnings + other funds from operations + gain(loss) on sales of investment		Frank and Goyal (2003); Shyam-Sunder and Myers (1999)
Current portion of debt	Current portion of long term debt (falling due) in time t.		Frank and Goyal (2003); Shyam-Sunder and Myers (1999)
Change in equity	Value of net equity issued in time t.		Frank and Goyal (2003); Shyam-Sunder and Myers (1999)
Financing deficit	Excess of change in working capital, net cash used in investing activities, current portion of long term debt and dividends over cash flows after interest and taxes (see the definition in equation (3.1)). It is scaled using net assets which is given by the sum of share capital and long term debt or borrowings	Financing deficit should have a one to one relationship with borrowed funds	Frank and Goyal (2003); Shyam-Sunder and Myers (1999)
Size	Log of the deflated book value of assets	Size is negative related to financial constraints	Hadlock and Pierce (2010); Hennessy and Whited (2007); Hubbard (1998); Ramjee and Gwatidzo (2012)
Age	Number of years a company has been listed in NSE	Age is negatively related to financial constraints	Hadlock and Pierce (2010)
Tangibility of assets	Ratio of fixed assets to total assets	Ambiguous	Frank and Goyal (2003); Rajan and Zingales (1995); Ramjee and Gwatidzo (2012)

Market to book values	Ratio of market value of assets to book value of assets. Market value = book value of assets + market value of equity - book value of equity	Increase in market to book ratio reduces the use of borrowed funds	Frank and Goyal (2003); Liu (2009); Rajan and Zingales (1995)
Profit	Ratio of operating income to book value of asset	Ambiguous	Frank and Goyal (2003); Rajan and Zingales (1995); Ramjee and Gwatidzo (2012)
Sales	Log of deflated sales	Large firms in terms of sales use more borrowed funds	Frank and Goyal (2003); Rajan and Zingales (1995)
$\frac{EBIT}{A}$	Ratio of earnings before interest and taxes to book value of assets	Negative	Fama and French (2002)
$\frac{EAT}{A}$	Ratio of earnings after tax to book value of assets	Negative	Fama and French (2002)
$\frac{Dp}{A}$	Ratio of depreciation expense to book value of assets	Ambiguous	Fama and French (2002)

3.3.4 Data Sources and Description

This study used data from a sample of firms listed in Kenya covering the period 1999 to 2016. The data was collected from published financial statements that companies file at Capital Markets Authority. Published financial statements consist of balance sheet, income statement and cash flow statements, which are the principal sources of the data used in this study. The sample consists of all the (13) companies in the manufacturing sector that are listed in the Nairobi Securities Exchange (NSE). Supplementary data on variables not reported in financial statements were obtained from NSE. These include market prices of stocks and the year the company was listed in the NSE. Data on consumer price index for Kenya were sourced from the World Bank.

To avoid introducing sector related bias in investment behaviour, this study focused on studying firms in the manufacturing sector. Manufacturing firms have specialized assets which have high sunk cost and therefore are difficult to collateralize, hence can be considered as relatively illiquid. Consequently, firms in the manufacturing sector are likely to suffer from financial constraints. The effects of liquidity for the manufacturing vis-à-vis non-manufacturing firms were confirmed by Chirinko and Schaller (1995) who found the coefficient for the former to be twice as large. Combining manufacturing firms with non-manufacturing firms may introduce complexities in modelling. Furthermore, to avoid survival bias, data for listed manufacturing companies that entered or exited the NSE between 1999 and 2016, were all included. Companies with missing values on financial constraints, size, age, internal finance and financing deficit were excluded. All figures are expressed in 2010 constant prices. All variables are winsorized at the 1st and 99th percentiles to remove outliers.

3.4 Empirical Results

This section presents the empirical results of this essay. The analysis was carried out using annual panel data set spanning the sample period and it includes listed manufacturing firms in Table A1. An overview of the sample characteristics of the firms studied is presented, followed by results of the pecking order hypothesis.

3.4.1 Descriptive Statistics

Proxies of financial constraints used in this study classifies firms into two degrees of financial constraints. Table 3.2 summarizes these characteristics.

Table 3.2: Summary Statistics

	Entire	**Constrained Status**	
Variables	**All Obs**	**NFC**	**FC**
ΔD	0.3942	0.1759	0.5011
	0.9771	0.5715	1.1098
	222	73	149
FC Status	0.6710	0.0000	1.0000
	0.4709	0.0000	0.0000
	231	76	155
Age	3.1131	3.6011	2.8555
	0.7689	0.1411	0.8376
	220	76	144
Size	11.0488	12.1865	10.4839
	1.1794	0.6082	0.9673
	220	73	147
Sales	8.9855	11.1270	7.9363
	7.2052	7.2456	6.9722
	222	73	149
Profitability	1.7372	2.5995	1.3147
	2.1110	2.6677	1.6265
	222	73	149
Tangibility	9.1949	9.9124	8.8433
	6.2874	6.6462	6.0962

Continued on next page

Table 3.2 – *Continued from previous page*

	Entire	Constrained Status	
Variables	**All Obs**	**NFC**	**FC**
	222	73	149
Market to Book	13.6292	20.9968	10.0196
	15.7097	19.1724	12.2398
	222	73	149
Financing Deficit	0.3299	0.0198	0.4819
	1.1531	0.6566	1.3057
	222	73	149
Log of Assets	10.1455	11.5697	9.4431
	1.5876	0.6148	1.4433
	221	73	148

Sources: Author's Computation

For each variable, the first row presents the mean, the second row the standard deviation and the last row presents the number of observations used.

Clearly, firms facing different degrees of financial constraint have different characteristics. About 67 percent of the firms report some level of financial constraints. External capital in the form of debt issues for financially constrained firms is more than twice the level for unconstrained firms. This suggests that the financial constraints in the sample considered here is not due to quantity rationing. Quantity constraints results in lower debt issues for financially constrained firms relative to unconstrained firms. On the other hand, price constraints increases the cost of funds since the firms face high risk premium[6], and hence do not lock firms out of the capital market. This results in a wider wedge between the opportunity cost of internal funds and the cost of debt and the wider wedge the higher the value the firm will transfer to debt-holders if it decides to use debt.

Constrained firms are young and small, on average, compared to their unconstrained counterparts. They are small in terms of tangible assets and

[6]This might arise if subsequent debts do not rank pari passu with debt issued earlier or because of negative pledges, both of which results in increased risk .

sales as well as profitability. The lower value of tangible assets and sales among the constrained firms' points to a possibility that constrained firms unlike unconstrained ones have under-invested over time, hence accumulating less assets than their unconstrained counterparts which generates lower sales and hence lower profitability. In addition, lower value of tangible assets implies lower collateral value and hence reduced ability to borrow. This entirely acts to reduce finances available for investment hence constraining current and future investment, if the firm remains financially constrained.

A surprising result is that despite accounting for less than 30 percent of debt issued, unconstrained firms hold more than half of the tangible assets that can be pledged as security against borrowings. This suggests that the decision to issue debt is driven by the value the firm will transfer to debt-holders if it decides to use debt, which is higher the higher the wedge between the cost of internal funds and the cost of debt. Thus, the lower level of debt issue by unconstrained firms cannot be due to financial constraints since these firms have more tangible assets that they can pledge as security for more debt. Moreover, market to book value of assets for unconstrained firms is about twice that of constrained firms. This implies that unconstrained firms have low sunk cost than constrained firms, which is most likely to arise from differences in 'currency of technology' content in assets or more generally the quality of assets.

Furthermore, financially constrained firms have higher level of financing deficit compared to the unconstrained counterparts. High financing deficit is linked to high debt issue among financially constrained firms. Similarly, lower financing deficit for unconstrained firms explain the lower level of debt issue. It also explains why these firms have higher tangible assets yet they have low level of debt issue. Higher profitability seems to result in higher level of cash flow, which reduces the financing gap for financially unconstrained firms. On the other hand,

an average constrained firm has a level of profitability which is almost half that of unconstrained firms. Thus, high profitability and hence high level of cash flow reduce reliance on debt and hence ease financial constraints.

3.4.2 Financing Behaviour of Firms of Different Size-growth Classes

Dividing firms based on proxies of financial constraints, such as size, into classes, then further divide each class into subclasses, this time using growth rates in sales allows for examination of how well the financing behaviour of small-high growth firms fits into pecking order description. Small-high growth firms do not issue debt even when they are not debt capacity constrained (Fama & French, 2002). The idea here is that debt should wholly finance any excess of investment over internal finance if pecking order hypothesis holds and financial constraints are not binding. These predictions should be stronger for small firms than for large firms. But if financial constraints are binding, which is likely to be the case for small firms, then the prediction of pecking order hypothesis might be violated.

Two classes and subclasses were used, giving a hierarchical structure with small and large as classes, and high growth and non-high growth as subclasses under each class. Growth is measured by the growth rate in sales while size is the log of tangible assets. Size and growth are broken down at the mean[7] to generate small vs large firms, and high-growth vs non-high-growth firms.

Table 3.3 summarizes how manufacturing firms listed on Nairobi Securities Exchange finance their activities.

[7]The mean size was 11.05 and the mean growth rate for sales was 5.4 percent. 53 percent of the firms are high growth and 51 percent are large.

Table 3.3: Differences in Financing Patterns by Firms across Size and Growth Groups

	Small		Large	
Variables	High Growth	Non-high Growth	High Growth	Non-high Growth
Internal	84.92	90.87	95.77	98.16
Debt	5.60	3.35	1.69	0.74
Loan	3.45	2.13	0.84	0.39
Equity	6.03 †	3.65	1.70	0.72

† There is a negative equity value representing money loaned to the trustees of Employee share options plan by Athi River Mining in 2007. The outstanding balance at exercise price was Sh 90,825,000.

Source: Author's calculation based on published company financial statements.

Large firms, on average, use more internal finance than small firms in financing their activities. Small-high growth firms use the least internal finance compared to any other category of firms, followed by small-non-high growth firms. Small firms are likely to have lower level of cash flow relative to their financing needs for investment and operations, hence the relatively higher use of external capital relative to larger firms. Moreover, high growth firms might be having more investment opportunities relative to their internally generated funds. The implication is a high propensity to use external capital. Thus, financial constraints might manifest itself more in high growth firms than in non-high growth firms, even when in reality the firms face the same obstacle in access to capital[8].

A closer look at Table 3.3 reveals that capital spending is financed almost entirely with internal funds. The contribution of external capital in investment spending is very small. To examine further how firms finance their capital expenditure financing deficit (the excess of capital expenditure over internal funds) it was necessary to determine the contribution of each source of external capital; equity

[8]This arise if wedge between internal and external capital rises with the use of external funds.

or debt towards the capital expenditure financing deficit. That is, do average contribution of each source of funds point to a pecking order financing hierarchy or not? and do pecking order financing hierarchy varies across classes of firms?

Answering these questions require rewriting Table 3.3 so as to show the percentage each source of external capital (i.e. debt and equity) contributes towards bridging the capital expenditure financing deficit. Table 3.4 presents the contribution of debt[9] and equity to the total external capital obtained. The idea in Table 3.4 is to analyse the use of external versus internal finance, then debt versus equity within external capital.

Table 3.4: Pecking Order for Firms Facing Different Levels of Financial Constraints

		Internal finances	External finances	
			Debt & Loan	Equity
Small	High-growth	84.92	60	40
	Non-high-growth	90.87	60	40
Large	High-growth	95.77	59.85	40.15
	Non-high-growth	98.16	60.94	39.06

Source: Author's calculation based on published company financial statements.

Clearly, firms sampled in this study exhibit a financing hierarchy that is similar to the prediction of pecking order hypothesis. If internal finance cannot fully cover the planned capital expenditure, then the need for external capital arises, the bulk of which comes from debt. For instance, 84.92 percent of capital expenditure by small-high growth firms is financed by internally generated funds, implying that the balance (100 percent less 84.92 percent) comes from external sources; of which 60 percent is debt and loans and 40 percent is equity finance. The financing patterns especially with regard to internal finance vary slightly across sub-groups.

[9]Debt is broadly defined to include long term loans in subsequent analysis in this section.

In contrast, there is no variation across subgroups in the composition of external capital used. All firms tend to use more debt (about 60 percent) whenever they are in need of external capital. The use of more debt whenever firms need external capital has been shown to fit strongly into the predictions of pecking order theory (see for instance: Shyam-Sunder & Myers, 1999). The use of equity finance which average about 40 percent suggests that financial constraints might be important for the sample of firms used in this study. Thus, this is a suitable dataset for investigating how pecking order hypothesis and financial constraints interact, and how these interactions relate to the reversal of predictions of pecking order theory.

Drawing from the theoretical model developed in section 1.7 and the financial constraints literature argument that the wedge between the cost of internal and external capital increases with the use of external funds (for theoretical discussion, see: Kaplan & Zingales, 1997), then one can infer from the foregoing analysis (earlier analysis & table 3.4) that smaller firms have a higher likelihood of financial constraints since they face a higher need for external capital. Moreover, existing evidence suggest that financially constrained firms are small (Hadlock & Pierce, 2010; Hennessy & Whited, 2007) and young (Hadlock & Pierce, 2010), and hence the link between size and the wedge between the cost of external and internal finance (Hennessy & Whited, 2007).

In summary, the wedge between the cost of external and internal finance implies that internal and external capital are not perfect substitutes, and it has effects on the composition of financing over time and hence the capital structure. For instance, if financial constraints limit how much debt a firm can issue, then such a firm will use equity once it exhausts its debt capacity. In this way, financial constraints affect accumulation of debt and hence leverage which, in turn, has implication on pecking order hypothesis.

3.4.3 Financing Pattern and Pecking Order

Pecking order predicts that firms prefer internal finance over external capital and in case internal funds are inadequate they prefer low risk debt (then high risk debt) over equity funds. This prediction was examined in four ways. First, by use of kernel density graphs. Second, by use of Q-Q plot. Third, non-parametric tests were used to examine differences in the distribution of firms' financing of capital expenditure across the various sources of funds: internal funds and financing of funds flow deficit using debt funds and equity funds. Lastly, the prediction was examined by estimating the pecking order model and the determinants of financial constraints and a dummy, which takes one if financially constrained and zero otherwise, was used to examine the importance of financial constraints on capital structure. This dummy is the measure of financial constraints in this analysis and it divides the sample into two sub-samples: constrained and unconstrained sub-samples.

Figure 3.1 summarizes the distribution of firms in different levels of usage of internal finances.

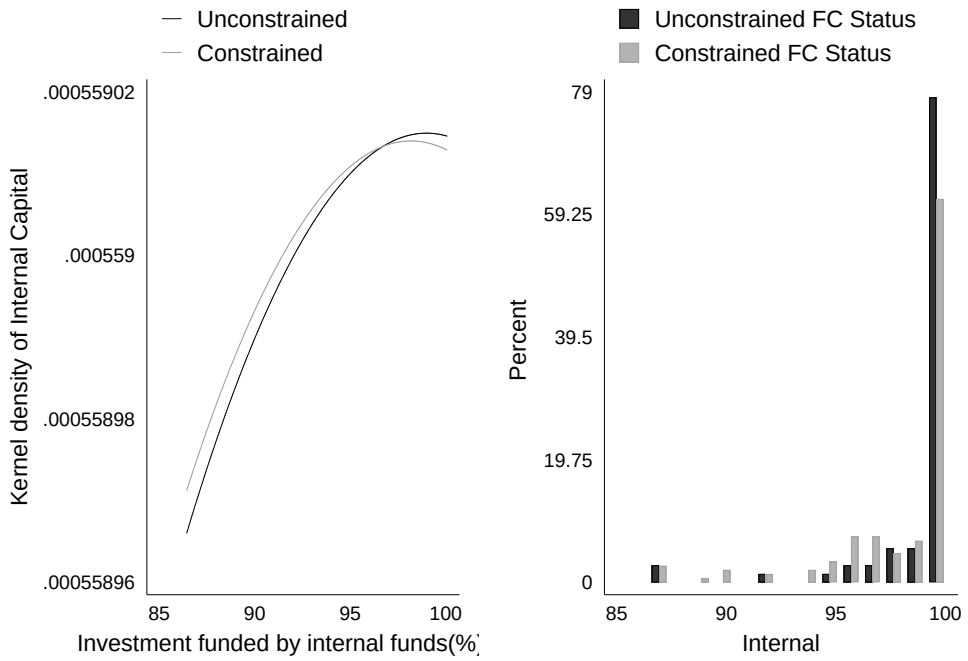


Figure 3.1: Distribution of use of Internal Funds by Financial Constraint Status
Source: Author's calculation based on published company financial statements.

Over 85 percent of finances for capital expenditure comes from internal finance and majority of the firms use less than 5 percent of external capital. The number of financially unconstrained firms that uses less than 5 percent of external capital are higher than their constrained counterparts. Thus, relative to unconstrained firms, financially constrained firms need more external capital but due to financial constraints their financing deficit might not be fully covered.

Figure 3.2 summarizes the distribution of firms in different levels of usage of debt and loans

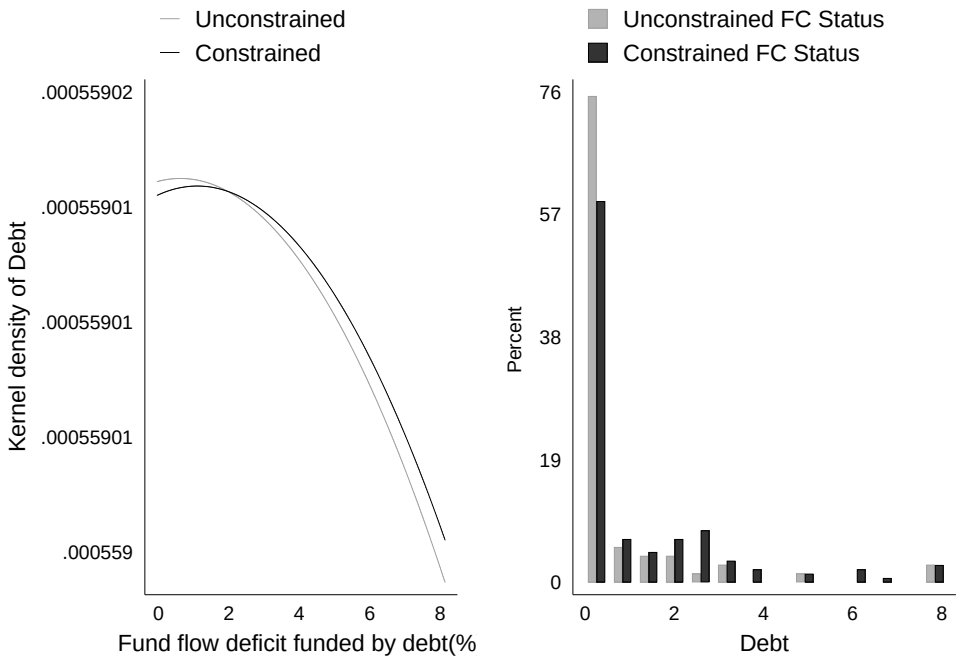
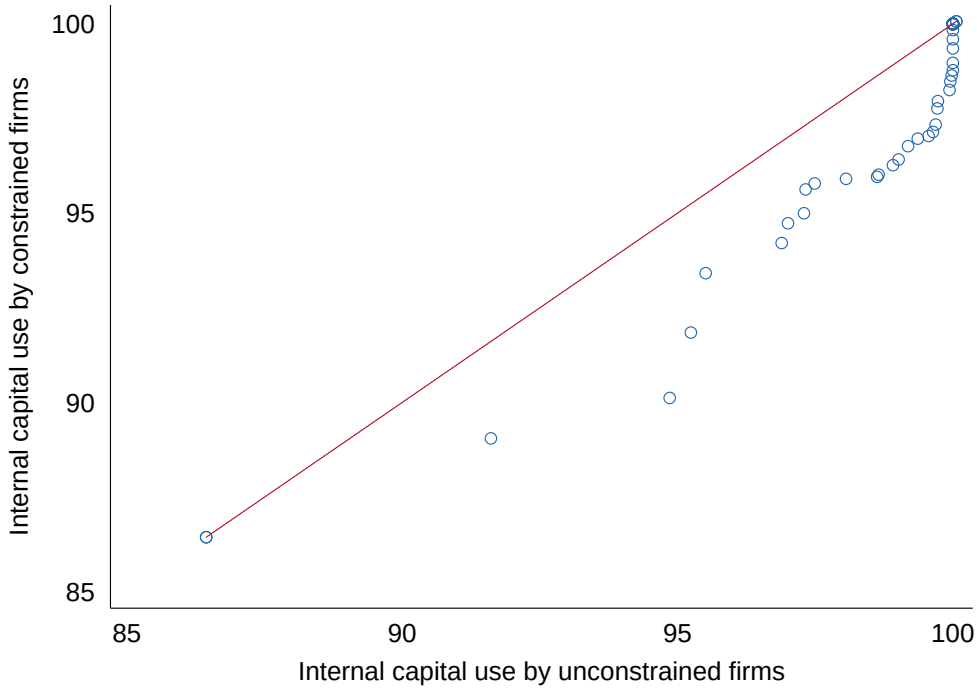


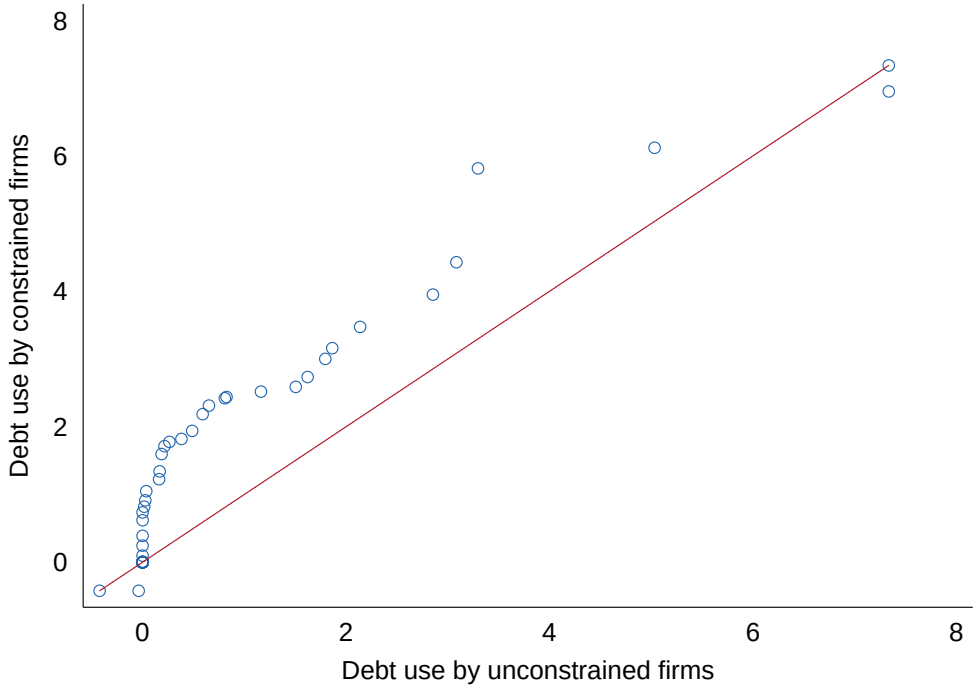
Figure 3.2: Distribution of use of Debt and Loans by Financial Constraint Status
Source: Author's calculation based on published company financial statements.

External capital contributes less than 5 percent with the majority coming from debt[10]. Despite most of the external funding coming from debt, the use of debt rarely went above 10 percent of capital expenditure. Use of debt is more popular among financially constrained firms. Overall, these results suggest that financially constrained firms follow a financing hierarchy where debt is used once internal funds are exhausted. These results of firm financing behaviour under different levels of financial constraints is more apparent in quantile-quantile plots. Quantile-quantile (Q-Q) plots is a graphical technique for determining if two data sets come from a population with a common distribution. If the data comes from a population with a common distribution, then the data-points should lie close to the 45^0 diagonal line from origin. Figure 3.3a and 3.3b plot the Q-Q plot for internal and debt capital, respectively.

[10]There were only three share issues for the entire sample.



(a) Internal Capital use by Constrained and Unconstrained Firms



(b) Debt use by Constrained and Unconstrained Firms

Figure 3.3: Financing Pattern and Financial Constraint Status
Source: Author's calculation based on published company financial statements.

Overall the Q-Q graphs show that constrained and unconstrained firms exhibit differences in the use of debt and internal funds. Furthermore, the clustering suggests the presence of outliers but the outlier problem is not severe. The Q-Q plot for internal funds and debt depicts differences in the use of internal and debt funds. The Q-Q plots for internal finance are skewed to the right. That is, constrained firms relative to unconstrained firms use less internal finance in their capital expenditure. On the other hand, the Q-Q plot for debt is skewed to the left implying that constrained firms relative to unconstrained firms are biased towards using more debt funds whenever they use external capital. Pecking order models predict that if capital expenditure exceeds internal funds, then the resulting fund flow deficit should be funded by debt due to cost advantage[11]. Financially constrained firms exhibit financing pattern that conforms to pecking order theory than do financially unconstrained firms.

Non-parametric Wilcoxon-Mann-Whitney test showed a significant difference between the underlying distributions of the internal and debt funds of constrained firms and the internal and debt funds of unconstrained firms (z = 2.173, Prob > |z| = 0.0298 for internal funds and z = -2.170, Prob > |z| = 0.0300 for debt funds). Thus, this statistically significant result gives evidence of significant differences between financing behaviour of financially constrained firms and financially unconstrained firms. The performance of prediction of pecking order hypothesis for the sample considered in this study is examined in the subsequent sub-sections.

Table 3.5 reports the estimation results for the pecking order model for the basic and extended models under the assumptions of no financial constraint regime.

[11]Lower informational cost and tax shield benefits reduces the cost of debt relative to equity.

Table 3.5: Baseline Pecking Order Estimation Results

	(1)	(2)	(3)	(4)
	Shyam-Sunder and Myers		Frank and Goyal	
Variables	Basic	Extended	Basic	Extended
Financing Deficit	0.4833**	0.1625**	0.4812**	0.1387*
	(0.023)	(0.045)	(0.024)	(0.058)
Sales			-0.0298*	-0.0134
			(0.084)	(0.292)
Profitability			-0.0212	-0.0693
			(0.795)	(0.256)
Tangibility			0.0338	-0.0005
			(0.300)	(0.978)
Market to Book			0.0068	0.0085*
			(0.186)	(0.073)
Financing Deficit sq.		0.1526***		0.1615***
		(0.000)		(0.000)
Constant	0.0014	-0.0161	-0.0301	0.1272
	(0.993)	(0.866)	(0.874)	(0.235)
Observations	222	222	222	222
R-squared	0.45	0.64	0.46	0.65
Number of Firms	13	13	13	13
PoH test	16.45	78.39	7.27	156.44

The levels of significance are: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

P-values are in parenthesis below the coefficients. The test for pecking order hypothesis was implemented by $F - test$ and the results for this test are presented in the last row; under POH test.

Source: Author's calculation based on published company financial statements.

The baseline model presents the estimation results for the pecking order model under the assumptions of no financial constraint regime. Hausman test recommended the use of fixed effect model and hence least squares dummy variables estimation approach was used. The basic model reports the results of the original models of Shyam-Sunder and Myers (1999) and Frank and Goyal (2003) while the extended model includes financing deficit squared to capture debt capacity constraints. The criticism of Chirinko and Singha (2000) on Shyam-Sunder and Myers (1999) approach does not apply to the results of this

study since equity funds were rarely used by firms in the sample used in this study. In particular, there were only three occurrences of equity issuance[12]. In addition, the criticism does not affect the substantial conclusion of this study since the study aimed at identifying differences in financing behaviour of financially constrained firms and financially unconstrained firms as opposed to testing competing capital structure theories.

The results conform, to a great extent, to the expectations in terms of sign (see for instance: Frank & Goyal, 2003). With the exception of the coefficient of sales and market to book, all the coefficients have the expected signs. Under Shyam-Sunder and Myers's specification, the pecking order hypothesis was rejected. This also apply to Frank and Goyal's specification. The positive and significant coefficient of financing deficit squared suggests presence of debt capacity constraints. The coefficient of financing deficit squared capture the concave relationship between changes in debt and financing deficit in the presence of debt capacity constraints. To examine the effects of financial constraints on the pecking order prediction, determinants of financial constraints were included alongside the determinants of capital structure. If financial constraints have no effects on capital structure decisions, then the additional variables should be insignificant. Table 3.6 presents results for the tests of the effects of financial constraints.

[12]Excluding these equity issues does not affect the results.

Table 3.6: Pecking Order Estimation Results in the Presence of Financial Constraints

	(1)	(2)	(3)	(4)
	Shyam-Sunder and Myers		Frank and Goyal	
Variables	Basic	Extended	Basic	Extended
Financing Deficit	0.4324***	0.1494***	0.4383***	0.1216**
	(0.000)	(0.004)	(0.000)	(0.026)
Sales			-0.0075	0.0020
			(0.747)	(0.916)
Profitability			-0.0121	-0.0642
			(0.844)	(0.207)
Tangibility			0.0071	-0.0167
			(0.734)	(0.334)
Market to Book			0.0056	0.0081
			(0.409)	(0.144)
Age	-0.1331	0.0399	-0.1057	0.0192
	(0.504)	(0.810)	(0.614)	(0.911)
Size	0.3649***	0.2018**	0.3380***	0.2108**
	(0.000)	(0.015)	(0.003)	(0.024)
Financing Deficit sq.		0.1448***		0.1559***
		(0.000)		(0.000)
Constant	-3.7212***	-2.3579**	-3.4944**	-2.2527**
	(0.002)	(0.018)	(0.012)	(0.048)
Observations	215	215	215	215
R-squared	0.49	0.65	0.49	0.66
Number of Firms	13	13	13	13
PoH test	65.99	136.19	59.11	132.34

The levels of significance are: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.
P-values are in parenthesis below the coefficients. The test for pecking order hypothesis was implemented by $F - test$ and the results for this test are presented in the last row; under POH test. Age was dropped since it is time invariant.
Source: Author's calculation based on published company financial statements.

The results of the baseline model and the model with financial constraints variables are similar. Unlike in the baseline model, the effects of conventional variables are entirely wiped out by the effects of financing deficit. Furthermore, pecking order theory was rejected in all cases. Size is significant, which suggests that financial constraints are important in capital structure decisions. The results

in Table 3.6 is likely to be biased since size might be correlated with variables such as tangibility, sales and profitability. In addition, the significant intercept suggests misspecification of the models.

The problems highlighted above were addressed by allowing financial constraint regimes in the pecking order test equation. This was done by introducing a dummy, C, which took the value of one if a firm was financially constrained and zero, otherwise and then interacting it with the right hand side variables of the pecking order equation. This definition of the dummy ensured that the first six coefficients were the coefficients of financially unconstrained firms; the sub-sample under which pecking order hypothesis should be less strong, if it holds. And, the next six coefficients gave the differences in coefficients on each variable arising from differences in financial constraints. The financial constraints dummy variable was used to determine the existence of financial constraint regimes. Table 3.7 reports estimates for pecking order model under different financial constraint regimes.

Table 3.7: Extended Pecking Order in the Presence of Financial Constraints

	(1)	(2)	(3)	(4)
	Shyam-Sunder and Myers		Frank and Goyal	
Variable	Basic	Extended	Basic	Extended
Financing Deficit	0.0714	0.0986	0.0653	0.0845
	(0.456)	(0.218)	(0.522)	(0.319)
Sales			-0.0353	-0.0307
			(0.216)	(0.214)
Profitability			-0.0127	-0.0219
			(0.869)	(0.730)
Tangibility			0.0308	0.0307
			(0.338)	(0.278)
Market to Book			0.0012	0.0018
			(0.886)	(0.799)

Continued on next page

Table 3.7 – *Continued from previous page*

Variables	(1) Basic	(2) Extended	(3) Basic	(4) Extended
Financing Deficit sq.		-0.0101		-0.0255
		(0.821)		(0.592)
CxFinancing Deficit	0.5057***	0.0014	0.5149***	0.0091
	(0.000)	(0.989)	(0.000)	(0.932)
CxSales			-0.0191	0.0059
			(0.472)	(0.796)
CxProfitability			-0.0043	-0.0569
			(0.964)	(0.465)
CxTangibility			0.0118	-0.0409
			(0.765)	(0.237)
CxMarket to Book			0.0193*	0.0107
			(0.094)	(0.266)
CxFinancing Deficit sq.		0.1866***		0.2117***
		(0.000)		(0.000)
Unconstrained	-0.2205	-0.1884	-0.0351	0.0808
	(0.206)	(0.208)	(0.882)	(0.684)
Constant	0.2496	0.3057	0.2404	0.2435
	(0.310)	(0.142)	(0.356)	(0.262)
Observations	222	222	222	222
Number of Firms	13	13	13	13
PoH test for NFC	96.22	43.20	84.98	43.23
PoH test for FC	73.17	57.05	67.63	58.23
Interacted	23.92	15.26	30.04	5.22

The levels of significance are: * p<0.1; ** p<0.05; *** p<0.01. P-values are in parenthesis below the coefficients. F-test was used to test for pecking order hypothesis under different degrees of financial constraints. POH test for NFC presents the results for this test for unconstrained firms while POH test for FC presents the results for financially constrained.

Sources: Author's calculation based on published company financial statements.

Like in the preceding tables, Table 3.7 present the results of the basic model and the extended model augmented with proxy for debt capacity constraints for

each approach. As hypothesized, the effects of all conventional factors is almost wiped out entirely. Only CxMarket to Book is significant at 10 percent level of significance when the measure of debt capacity constraints variable and its interaction term are excluded. This disappears when debt capacity constraints variable and its interaction term are included. CxFinancing Deficit is significant at 1 percent when debt capacity constraints variable and its interaction term are excluded. CxFinancing Deficit sq. is positive and significant at 5 percent implying that financially constrained firms are debt capacity constrained. In contrast, unconstrained firms are not debt capacity constrained.

The joint significance test of the interacted right hand side variables of the pecking order equations test for the existence of financial constraint regimes in firm capital structure. The test statistics are 23.92 and 30.04 for the basic model under Shyam-Sunder and Myers (1999) and Frank and Goyal (2003) model, respectively. These are statistically significant at 1 percent. When the proxy for debt capacity constraints is included, the test statistics are 15.26 and 5.22 under Shyam-Sunder and Myers (1999) and Frank and Goyal (2003) model, respectively and are significant at 1 percent and 10 percent, respectively. Thus, the inclusion of debt capacity constraints do not eliminate the need to take into consideration financial constraints, and therefore the results of Lemmon and Zender (2010) does not fully account for financial constraints.

The coefficient of financing deficit rises slightly when the debt capacity constraints variable and its interaction term were included. In contrast it is lower when it is excluded. The derivative of the dependent variable with respect to financing deficit shows that the coefficients of financing deficit for financially constrained firms is different from that of financially unconstrained firms. The test for the differences in coefficients of financing deficit for financially constrained and unconstrained firms using the results in column labelled (1)

and (3) gives Chi-square statistics of 23.81 and 10.17, respectively. These are statistically significant at 1% and it shows that the coefficients for financing deficit vary with financial constraint status. On the other hand, a similar test for the columns labelled (2) and (4) gives a chi square statistics of 21.58 and 11.88, respectively. These results are statistically significant and these indicate that when debt capacity constraints are controlled for, the coefficients for financing deficit remain different across financial constraint regimes. Thus, financial constraints are different from debt capacity constraints.

Pecking order hypothesis is rejected for all specification and for both constrained and unconstrained firms. When debt capacity constraints variable and its interaction term are omitted and judging by the size[13] of the pecking order test statistics, $\text{Chi}-\text{Squared}$ statistics, pecking order prediction is stronger for financially unconstrained firms than for financially constrained firms. However, the sizes of $\text{Chi}-\text{Squared}$ statistics for the test of pecking order hypothesis are reversed when debt capacity constraints variable and its interaction term are included. Given that financially constrained firms consist of firms whose informational problems looms large, then this leads to the conclusion that pecking order theory is stronger where it should not and weaker where it should not when debt capacity constraints are not factored in.

This conclusion is similar to that of Frank and Goyal (2003) and Fama and French (2002). However, introducing debt capacity constraints variable and its interaction term reverses these results and conclusion. Hence, the explanation for reversal of prediction of pecking order theory could be due to debt capacity constraints and financial constraint regimes. This study attributes these results

[13] If the size of $Chi-Sq statistics$ reflects the deviation of observed relationship from expected relationship for pecking order hypothesis to hold, then a higher value would mean a substantial deviation. Since the specification of the model and therefore the degrees of freedom are the same, it is reasonable to compare the $Chi-Sq statistics$ of the not constrained and constrained sub-samples.

to the wedge between the cost of internal and external funds in particular debt. The higher the wedge between the cost of internal funds and the cost of debt, the higher the value the firm will transfer to debt-holders if it decides to use debt funds and the more severe financial constraints is. Since the goal of the firm is to maximize value for its shareholders, then it is unlikely to issue debt in such a case. Debt will only be issued by firms as a last resort. But, do financial constraints explain pecking order reversal for small-high growth firms?

The average size of financially constrained firms in the sample used in this study is 9.4 compared to 11.6 for unconstrained firms. The growth rate of turnover for financially constrained firms is about 6.1 percent compared to 3.8 percent for financially unconstrained firms. Thus, financially constrained firms are small and exhibit high growth. Therefore, the violation of pecking order prediction by small high growth firms in Fama and French (2002) sample arose due to failure to control for debt capacity constraints and financial constraint regimes. Although firms can have excess debt capacity, the cost of debt relative to the cost of internal funds is important and therefore drives financing decisions.

Evidence from this study shows that the higher the wedge between the cost of debt and the opportunity cost of internal funds the higher the value that the firm will transfer to debt-holders if it issues debt and this reduces the value of the firm. Thus, price constraints are more important to all firms while quantity constraints also affect financially constrained firms. This explains debt issues and financial constraint status of the firms studied. Similar evidence has been documented by Faulkender and Petersen (2006) who found that the cost of debt drives financing decisions. Unlike this study which looked at the cost of debt relative to the cost of internal funds, their study considered cost of debt.

These results not only explain the financing behaviour of small-high growth firms; they also explain why pecking order hypothesis fails where it should

not. Controlling for debt capacity constraints and taking into consideration financial constraints, gives results that are consistent with the prediction of pecking order hypothesis. That is, evidence from this study is consistent with the view that constrained firms face higher informational cost and hence higher cost of debt (relative to the opportunity cost of internal funds). As a result, the firm management would not want to transfer substantial value to debt-holders and consequently do not issue debt even when they are not debt capacity constrained as observed by Fama and French (2002).

3.5 Conclusion and Policy Implications

This essay investigated the effects of financial constraints on firm capital structure in Kenya. This was implemented by interacting a financial constraints dummy with the right-hand side variables of pecking order test equation. This approach allows for financial constraint regimes and investigation of the effects of financial constraints on capital structure. Constrained firms relative to unconstrained firms are small in terms of size and have lower values of assets, sales and profitability. They are also young relative to their unconstrained counterparts. In summary, the results show that constrained firms use less internal funds and more external funds than unconstrained firms. This could arise if internal funds are insufficient to cover capital expenditure in the case of constrained firms. Unconstrained firms relative to constrained firms have more cash and hence need little external funds to supplement corporate investment. Complex pecking order theory was not supported. Neither was simple pecking order even when financial constraint regimes were allowed. Financing behaviour varies with financial constraint status.

Constrained firms in this study are similar to small high growth firms of Fama and French (2002) whose financing behaviour contradicts the pecking order

prediction, and more interestingly, even with excess debt capacity. Earlier attempts seeking to uncover why pecking order fail where it should not have been made. However, unlike Lemmon and Zender (2010) who studied the effects of debt capacity constraints on capital structure and Yang (2014) who studied financial constraints and capital structure in a more general form[14], this study shows that the explanation for reversal of prediction of pecking order theory lies in controlling for debt capacity constraints and allowing for financial constraint regimes. Thus, if financial constraints are severe the wider the wedge between the cost of debt and the opportunity cost of internal funds, then the wedge is the main reason why pecking order hypothesis does not hold for small high growth firms yet it does for their counterparts who are perceived to have less informational problems.

Unlike their unconstrained counterparts, constrained firms are small high-growth firms with high potential to generate substantial investments and jobs. Thus, there is need to improve access to capital for these firms in order to fully exploit its potential contribution to the economy. In this regard, policy should be geared towards reducing the wedge between the cost of external funds and the opportunity cost of internal funds. This can be achieved by instituting policies to reduce costs associated with verification of the quality of assets, private information, and contract execution and enforcement including legal charge such as by creation of a central depository for collateral.

[14] Yang (2014) approach is general that it cannot be interpreted in the context of pecking order theory

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CHAPTER FOUR

FINANCIAL CONSTRAINTS AND FIRM INVESTMENT IN KENYA

4.1 Introduction

Neoclassical models of investment predict that firm's management chooses a path of investment that maximizes shareholder's wealth. This prediction is based on the assumption of a perfect capital market where internal and external capital are perfect substitutes. If external capital is more costly than internal finance due for instance to information asymmetry or agency cost, then financing and investment decisions will not be independent. As a result, Tobin Q will not be the only factor relevant in investment decisions. Financial factors will matter as well. Following this line of argument, Fazzari et al. (1988) and subsequently several studies have challenged the neoclassical assumption of perfect capital markets.

The standard approach adopted in the literature to examine the validity of neoclassical assumptions entails: dividing the firms using proxies of financial constraints, fitting the investment equations augmented with financial factors such as cash flow and comparing the coefficients of financial factors across the sub-samples. Implicit in this analysis is the assumption that imperfections raise the cost of external capital relative to the cost of internal funds resulting in difficulties in access to external capital. Impediments in access to external capital make firms to rely wholly or largely on internal financial resources for investment. Therefore, the sensitivity of investment to cash flow or proxy

of liquidity should be higher for financially constrained firms than for the unconstrained firms.

Although several studies have found that financial variable(s) matter in investment equation (Fazzari et al., 2000, 1988; Kaplan & Zingales, 1997, 2000), the interpretations of these results are contentious. Higher coefficient of cash flow in an investment equation for financially constrained firms is attributed to imperfections in the capital markets. However, ambiguity in this interpretation arises when investment is highly sensitive to cash flow for financially unconstrained firms, a result first shown by Kaplan and Zingales (1997). The results, however, have largely been in support of imperfect capital market hypothesis (see for instance: Ağca & Mozumdar, 2008; Bond & Meghir, 1994; Fazzari et al., 1988; Hoshi et al., 1991), although there are a number of other studies contradicting this evidence (see for instance: Cleary, 2006; Cummins et al., 2006; Erickson & Whited, 2000; Kaplan & Zingales, 1997). Errors in the classification of firms and inappropriateness of investment-cash flow sensitivity approach (Kaplan & Zingales, 1997, 2000) have been identified as the main culprit.

Attempts to resolve this controversy include exploiting exogenous shocks that have disproportionate effects on firms' cash flows to study changes in firms' investment behaviour. These include receipt of cash windfall in corporate lawsuits (Blanchard et al., 1994); the 1986 oil price decline for non-oil segments of oils firms (Lamont, 1997) and the discontinuity in corporate pension funding obligations (Rauh, 2006). Although these studies rely solely on exogenous shocks to cash flows, they have consistently demonstrated that capital market imperfection is important. However, with the exception of Rauh (2006), their results are likely to be biased due to failure to classify or to accurately classify firms based on financial constraints.

Specifically, bias arises if the responses of firms' investment to shocks differ with the degree of financial constraints. For instance, constrained firms planned deeper cuts in investment than their unconstrained counterparts in response to the 2008 financial crises (Campello et al., 2010). Campello et al. (2010) avoided this bias by using survey to directly obtain the expected change in outcome due to shock for both constrained and unconstrained firms. However, the expected change in outcome due to shock is not readily available for secondary data from financial statements which form the basis of a large number of studies. A closer look at the results of Campello et al. (2010) reveals that the effects of shocks on firms under different degrees of financial constraints is asymmetrical. If the occurrences of financial constraints among shock's group and the no-shock's group is random and the effects of shocks is the same across all firms, then one can safely ignore financial constraints.

Unfortunately, this condition fails suggesting that ignoring financial constraints introduces bias in the estimates. Financial constraints tend to vary with firm characteristics such as age, nature of assets, affiliation and size. Hence self-selection cannot be ruled out. Furthermore, the effects of shocks vary with the degree of financial constraints. These combinations of relationships make it difficult to rule out biased results for a growing number of studies that have used exogenous shocks to cash flows to study the effects of changes in cash flow on investment while ignoring financial constraints.

This study addressed two main concerns that may affect validity of the results: endogeneity and the fact that firms might prioritise the reduction of costly high-risk debt over investment. First, it applied a difference in differences approach to a real exchange rate shock, which minimizes or eliminates bias in the estimation of the effects of imperfection in capital market on firm investment. Besides shocks to the cash flows (Blanchard et al., 1994; Campello et al., 2010; Lamont,

1997; Rauh, 2006), activities that tie a lot of cash and vary across firms offers an ideal setting for tackling the question at hand. The idea is that such activities affect cash flow without affecting investment function. A good example is exports which tie a lot of resources and vary across firms. The time taken to export (the difference between the time of export and the time of receipt of payment) can be high, and during this period a lot of cash is tied up.

Consequently, firms especially financially constrained ones, are likely to face a trade-off between investment and exports on whether to cut investment and ride on excess capacity to increase exports or in the absence of excess capacity, cut exports in order to increase investment. However, in the long run firms are likely to adjust resources to support their optimal level of exports and investments. This implies an independent relationship between investment and the observed level of exports. In the absence of fluctuations, this relationship is likely to persist.

Fluctuations such as in real exchange rate are likely to cause changes in the resource requirement for optimal level of exports and imported capital goods. For instance, real exchange rate depreciation improves competitiveness of domestic exports thereby generating new profitable opportunities, which call for expansion and more resources to be invested in exports and in production of import substitutes. Second, real exchange rate depreciation makes investment expensive if capital goods are imported. In this case, more resources will be needed for both investment and export purposes. In a perfect capital market firms are able to borrow to fully exploit these opportunities; however, expansion is limited in the presence of financial constraints.

In a similar (but opposite) way, real exchange rate appreciation works to lower investment opportunities and therefore reduce the resources required for investment and export. Therefore, real exchange rate fluctuation, in particular, real exchange rate depreciation can achieve the same results as the shocks

considered in previous studies. Fluctuations in exchange rate was first suggested by Lamont (1997) as an instrument of cash flow for evaluating imperfections in capital markets, however very few studies, if any, have heeded to this call. Against this backdrop, this study used fluctuations in exchange rate to examine listed manufacturing firm's investment as a basis for analysing the role of financial constraints in this context in Kenya.

The amount of resources held up in exports is a function of the value of exports per unit of time and the time required to export. According to The World Bank (2014), the time to export starts from the moment it is initiated and runs until it is completed and includes waiting time between procedures. The time to export of about 40 days in Kenya implies a huge amount of resources is tied up in exports and hence might crowd out investment. In 2014, the lead time to export was about 2 days while it took about 12 days to clear exports through customs and 26 days to export.

Real exchange rate in Kenya has appreciated for over three decades (see for instance; Musyoki, Pokhariyal & Pundo, 2012). Between 1999 and 2016, the US dollars, EU Euro, UK Sterling Pound, Chinese Yuan and Indian Rupees bilateral real exchange rate[1], on average, depreciated against the Kenya shillings. This implied an appreciation of Kenya shillings in real terms. Figure 4.1 summarizes the trend of real exchange rate movements.

[1]Following Ellis (2001), the real exchange rate between foreign country i and the home country at time t is computed as:

$$rer_{i,t} = s_{i,t} \times \frac{p_t}{p^*_{i,t}}$$

where *rer* is the bilateral real exchange rate (unweighted), expressed as the price of domestic currency in terms of foreign currency, s is the bilateral nominal exchange rate, expressed as the price of domestic currency in terms of foreign currency, p is the domestic price level and p^* is the foreign price level.

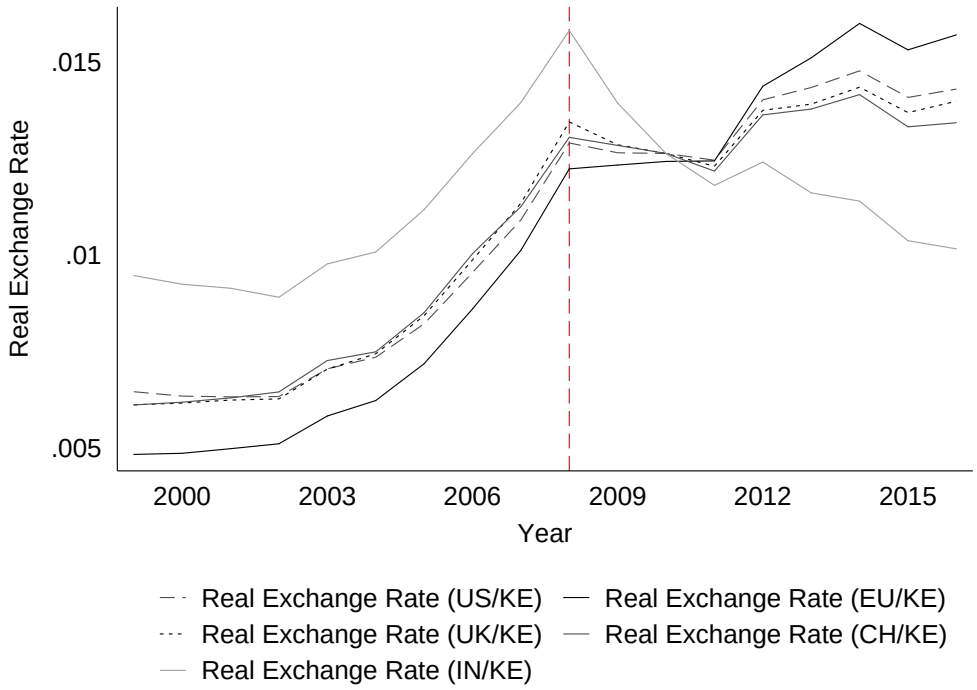


Figure 4.1: Real Exchange Rate Fluctuations
Source: Author's calculation based on data from World Bank.

Although there were periods of real exchange rate stability, real exchange rate appreciation dominated. Real exchange rate has recorded sharp appreciation in two periods. Between 2003 and 2007, real exchange rate appreciated sharply. It strengthened by about 103 percent, 115 percent and 140 percent against the US dollar, UK Sterling Pound and EU Euro, respectively. Sharp appreciation picked up again after 2011. The real exchange rate for the three major currencies, however, remained almost constant against Kenya shillings in two periods: between 1999 and 2002, and between 2008 and 2011. For the period 2008 to 2011, Kenya shillings slightly depreciated against the Pound and the dollar.

Real exchange rate appreciation affects the competitiveness of traded goods. It reduces the domestic price of imports while raising foreign price of exports. Holding other conditions constant, this would acts to lower investment opportunities of domestic producers by making exports less competitive and

imported substitutes of local produce cheaper. A period of sharp change in real exchange rate trend like in 2008 offers relief as it is followed by a relative improvement in competitiveness of domestic produce and hence investment opportunities. It is relative improvement since Kenya shillings depreciated against the currencies of its major trading partners[2]. If capital markets are perfect, all firms will fully adjust; otherwise some firms will not or will adjust partially. The discontinuity in real exchange rate in 2008 provides an ideal setting for examining how imperfections in capital markets affect investment. Unanticipated real exchange rate shock implies there is no similar discontinuity in the investment function and the real exchange rate function and therefore the results are valid.

Second, how do financially constrained firms smooth investment caused by fluctuations in cash flows when external capital is costly? Do increase (decrease) in cash flows for financially constrained firms always result in increase (decrease) in investment rate? Or do constrained firms use additional cash flows to reduce costly high-risk debt? Firms which are likely to be financially distressed are likely to prioritise the reduction of costly high-risk debt. Hence, depending on the likelihood of financial distress firms respond differently to fluctuations in cash flows; some firms adjust investment while others adjust costly high-risk debt. Thus, fluctuations in cash flows simultaneously affect investment and external capital and this relationship depends on the cost of external capital.

Previous attempts to resolve the investment-cash flow sensitivity did not pay much attention, if any, to the simultaneous effects on investment and external capital of the interaction of fluctuations in internal finance and the cost of external capital. If internal finance fluctuates and the cost disadvantage of external capital is small, then firms will use external capital to smoothen investment (Fazzari

[2]Kenya did not, however, depreciate against Euro in 2008.

et al., 1988). However, with a large cost disadvantage of external capital, the adjustment might be incomplete leading to suboptimal investment. This is likely to be the case if investment exceeds cash flow, during which unconstrained firms accumulate external capital such as debt or equity. Unlike their unconstrained counterparts, constrained firms are likely to accumulate lower debt, if any, due to financial constraints.

In contrast, during periods of excess cash flow (over investments), uncertainty might drive firms to reduce outstanding external capital in order to create and reserve external financing capacity for future use as well as reduce the risk of insolvency for firms in financial distress. External financing capacity can be in the form of unpledged tangible assets. Existing evidence shows a negative relationship between external financing and cash flow (López-Gracia & Sogorb-Mira, 2014). It is not clear whether this relationship arises due to firms, with high level of cash flow, accumulating less external capital or because firms use excess cash flows to retire external capital.

On the other hand, constrained firms are likely to have less debt and are therefore likely to hoard cash. Constrained firms compared to their unconstrained counterparts increases cash savings when cash flow increases (Almeida et al., 2004) and also when cash flow volatility increases (Han & Qiu, 2007), and vice versa. Moreover, the higher the cash holdings, the higher the levels of investment for both constrained and unconstrained firms, with a higher marginal value for constrained firms (Denis & Sibilkov, 2009). In this case, if external financing capacity and cash stocks are used to smoothen investment, then the standard investment-cash flow analysis might be flawed. This occurs since cash flow are likely to affect investment directly and indirectly through dependence on external capital and cash stocks, with indirect effects being increasing dependence on external capital and cash stocks.

Although the common view is that listed companies have access to various sources of finance and therefore face little or no difficulties in accessing capital; empirical evidence, however, show that listed companies even in countries with advanced capital markets such as USA (Almeida & Campello, 2007; Fazzari et al., 1988; Hadlock & Pierce, 2010; Kaplan & Zingales, 1997), UK (Bond & Meghir, 1994), Japan (Goyal & Yamada, 2001; Hoshi et al., 1991) and emerging markets (Blalock et al., 2008) face financial constraints. Given the level of financial development in Kenya is low relative to that of USA, UK and Japan, financial constraints problem is likely to be severe in Kenya. Despite the potential impact of constraining aggregate investment, employment and economic growth, there is a dearth of evidence on the effects of financial constraints in Kenya.

Due to its central role in industrial development, the manufacturing sector has received a lot of attention in the financial constraints literature. Manufacturing firms have specialized assets which are likely to have high sunk cost and therefore are difficult to collateralize, hence can be considered as relatively illiquid (Chirinko & Schaller, 1995). Consequently, firms in the manufacturing sector are likely to suffer more from financial constraints. Moreover, various development blueprints such as Kenya Vision 2030 identify investment climate and manufacturing as key in attaining the targeted rate of economic growth. It is hoped that a robust, diversified and competitive manufacturing sector will deliver the sector's potential contribution to GDP, exports and employment. However, the sector has recorded little progress since 1960s, with its contribution to GDP oscillating between 9.1 percent and 14 percent.

The first medium term plan for Kenya, covering the period 2008 to 2012, fell short of its manufacturing sector contribution to GDP target[3]. Instead, the growth in the manufacturing sector fell below that of GDP leading to a decline in its contribution from 10.8 percent in 2008 (KNBS, 2012) to 9.5 percent in 2012 (KNBS, 2014) and further to 9.1 percent in 2016 (KNBS, 2018). As a result, manufacturing sector importance, in terms of contribution to GDP, fell from the second place to the fourth place over the same period. Low private and public investment in Kenya has constrained the expansion of the manufacturing sector (Bigsten et al., 2010). Low private investment seems to emanate from financial constraints which limit access and use of external capital in investment. Moreover, investment rate is lower by about two-third for firms that do not make use of external capital in Kenya (Ngugi et al., 2009)[4].

Substantial research effort has been directed towards understanding the role of imperfections in capital markets on firm investment. However, the inconsistency in results and controversy in its interpretation have caused some studies to explore exogenous shocks to cash flows (Blanchard et al., 1994; Campello et al., 2010; Lamont, 1997; Rauh, 2006). Although this approach reduces or eliminates endogeneity problem in estimation, the measured effects are likely to be biased when financial constraints are ignored or when classification errors occur. If financial constraints are endogenous and the effects of the shock vary with it, then failure to control for it introduces bias.

Moreover, there are very few studies, if any, in sub-Saharan Africa linking financial constraints, exports and investment despite the fact that the region has one of the longest time to export and therefore a higher likelihood of financial

[3]Vision 2030 is implemented under medium term plan, the first ran between 2008- to 2012 but largely it did not achieve its target level of contribution of manufacturing sector to GDP.

[4]Ngugi et al. (2009) found an investment rate of 0.157 for firms using external capital versus 0.051 for firms not using external capital, however, their study did not attribute the non-use of external capital to financial constraints.

constraints. Thus, this study investigated the effects of financial constraints on firm investment. Specifically, this study:

(a) Examined how financial constraints affect investment

(b) Estimated the effect of dependence on external capital on investment

(c) Analysed firm's investment response to shocks in the presence of financial constraints

The analysis of firm's investment response to shocks was done by exploiting an exogenous favourable real exchange rate shock, which affects firms cash flows.

The findings of this study are important for three reasons. First, widespread underinvestment in the economy leads to a lower investment rate than potential at macroeconomic level, which if it persists for a longer period results in low productive capacity and hence reduces the future rate of economic growth. Second, estimates of the effect of cash flow on investment provide information that enhances modelling of fluctuations of investment at macroeconomic level. Lastly, it highlights the importance of supply side constraints, in particular, access-to-finance dimension of business environment on firm's investment.

This study made two contributions. Methodologically, this study demonstrated that focusing on exogenous shocks and ignoring financial constraints results in biased estimates. In this study, difference in differences was used. Second, this study contributed to the literature by empirically analysing firm's investment response to shocks in the presence of financial constraints. The rest of this essay is organized as follows: section 4.2 presents both theoretical and empirical literature; section 4.3 develops the methodology for addressing the objectives of this study; section 4.4 presents empirical results and section 4.5 concludes.

4.2 Literature Review

In this section, theoretical and empirical literature on capital market imperfection and firm investment were reviewed.

4.2.1 Review of Theoretical Literature

This section presents the relevant theoretical models on financial constraints and explains its link to firm investment. The theoretical models explain the gap between the cost of external capital and internal finance. In these models, information asymmetry causes providers of external capital to charge 'lemon' premium (Fazzari et al., 1988; Hubbard, 1998) which increases the cost of external capital. This concept of costly external capital is in contrast to the perfect capital markets approach underlying conventional models of investment, which emphasize net present values of future cash flows as the key determinant of investment.

Several theoretical models have been proposed, the most common ones that fit well into the context of this study include Froot, Scharfstein and Stein (1993) and Kaplan and Zingales (1997). In Froot et al. (1993) model a firm with internal funds, w, in period one faces a two period investment and financing decisions. In the first period the firm chooses investment level and external financing needs. In the second period the output is realized and the providers of external capital are repaid. The net present value of investment, $F(I)$, is given by:

$$F(I) = f(I) - I \tag{4.1}$$

where I is the investment expenditure and $f(I)$ is a concave function defining the expected level of output. Where $I > w$, the firm will raise from external

investors an amount equal to $I - w = e$ to finance the deficit in investment expenditures. Since discount rate is assumed to be zero, the expected repayment of external capital equals the amount initially raised. There are, however, additional cost, $^{C}/_{e}$, per unit of external capital arising, for instance, from information asymmetries or agency cost and this cost is increasing in external capital, e.

The model is solved backwards starting with firm's investment decisions in the first period. The firm maximizes the expected profit, $P(w)$, by choosing the level of investment and hence external financing.

$$P(w) = \max_{I} f(I) - I - C(e) \tag{4.2}$$

The first order conditions is $f_I - C_e = 1$. In the absence of additional cost of external capital, the first order condition for the maximization problem (4.2), which is the first best level, is $f_I = 1$. This shows that the wedge between the cost of external and internal finance leads to underinvestment. If internal finance fluctuates and the cost disadvantage of external capital is small, the firms will use external capital to smoothen investment (Fazzari et al., 1988). In addition to external capital, Froot et al. (1993) introduced hedging as an additional way of smoothing internal funds and hence investment. In this model, at period zero the firm chooses its hedging policy to maximize expected profit. The second order derivative of equation (4.2) evaluated at optimal level of investment I^* gives:

$$P_{ww} = f_{II}\left(\frac{dI^*}{dw}\right)^2 - C_{ee}\left(\frac{dI^*}{dw} - 1\right)^2 \tag{4.3}$$

which can be rewritten, by using the implicit function theorem on the first order condition, as:

$$P_{ww} = f_{II}\frac{dI^*}{dw} \tag{4.4}$$

According to equation (4.4), one of the conditions for hedging to be beneficial is that the level of internal finances must have a positive impact on optimal investment. Two important conclusions emerge from this model: first, the wedge between cost of external and internal finances leads to underinvestment and second, this wedge causes internal finances and investment to be positively related.

In the theoretical model proposed by Kaplan and Zingales (1997), the return to investment, I, is given by a concave function, $F(I)$. Like in the previous model, if $I > w$, the firm will raise from external investors an amount equals to $I - w = e$ to finance the deficit in investment expenditures. The opportunity cost of internal funds is set to 1. Information, agency and risk aversion problems generate deadweight cost to any firm using external capital. The cost is given by the function $C(e, \kappa)$ which is convex in e and increasing in both e and κ, where κ is the wedge between the cost of internal and external capital. Choosing I and hence e, allows the firms to maximize:

$$\max_I F(I) - I - C(e, \kappa) \tag{4.5}$$

Differentiating the first order condition, $F_I = 1 + C_I(I - w, \kappa)$, with respect to w and κ yields two fundamental equations of this theoretical model[5]:

[5] while taking into consideration $I = w + e$ and $I = f(\kappa)$

$$\frac{dI}{dw} = \frac{C_{II}}{C_{II} - F_{II}} \tag{4.6}$$

$$\frac{dI}{d\kappa} = \frac{-C_{I\kappa}}{C_{II} - F_{II}} \tag{4.7}$$

Equation (4.6) shows that the effects of internal funds on investment is positive while equation (4.7) states that the sensitivity of investment to the wedge between the cost of internal and external capital is negative if the marginal cost of raising external capital is increasing such that $C_{I\kappa} > 0$. This study draws two important implications from this theoretical model: a positive relationship between cash flow and investment, and a negative relationship between investment and the wedge between the cost of internal and external capital. In summary, these two models do not suggest that financially constrained firms should have higher investment-cash flow sensitivity as is commonly applied in empirical literature[6]. This inconsistency between theoretical models and empirical results has generated a lot of controversy in general and, in particular, in the interpretation of the results.

4.2.2 Review of Empirical Literature

Beginning with the work of Fazzari et al. (1988) a large pool of empirical literature has examined the impact on firm investment of capital market imperfection, in general, and financial constraints, in particular. The literature can be grouped into two strands. The first strand divides their samples using proxies constructed from archival records or obtained through a survey and the second group exploits exogenous shocks to cash flows to examine the impact of capital market imperfection on corporate investment.

[6]Kaplan and Zingales (1997) demonstrated that the relationship between investment and cash flow is not monotonic in the degree of financial constraints

Financial Constraints and Investment

Fazzari et al. (1988) classified firms into three classes using dividend payout ratio, and investigated the sensitivity of investment to cash flow for each of the three groups. They found that investment was more sensitive to cash flow for financially constrained firms and that the sensitivity was monotonic on the degree of financial constraint. Providing empirical evidence that contrast these findings, Kaplan and Zingales (1997) argued that there is no theoretical basis for investment-cash flow sensitivity to be monotonic on the degree of financial constraint.

Kaplan and Zingales (1997) focused on 49 low dividend payout firms studied by Fazzari et al. (1988) and argued that investment can be sensitive to cash flow for financially unconstrained firms and thus investment-cash flow sensitivity is not monotonic on the degree of financial constraints. They argued that changes in the operating environment that might affect investment overtime, for instance changes in investment regime and changes in cash reserves, might be important. Both studies used data from manufacturing firms in the USA and documented evidence that investment responds to changes in cash flow, however, they disagree over which subset of firms have higher investment-cash flow sensitivity and whether investment-cash flow sensitivity is monotonic in the degree of financial constraint.

Non-monotonicity of investment-cash flow sensitivity on the degrees of financial constraints has been documented by a number of studies such as Almeida and Campello (2007), Lyandres (2007) and Cleary, Povel and Raith (2007). Cleary et al. (2007) documented evidence that the relationship between investment-cash flow sensitivity and the degrees of financial constraints is U-shaped; large investment increases monotonically with internal funds while it decreases

monotonically with cash flow, if investment is very low. Similarly Lyandres (2007) found that investment-cash flow sensitivity is non-monotonic in the cost of external capital; decreasing when the cost is relatively low and increasing when it is high.

Hoshi et al. (1991) using data from Japan compared the importance of liquidity as a determinant of corporate investment across two sets of firms; those with close financial ties with large banks, which provide external capital in case of need, and those with weaker links to a main bank. They found evidence that information and incentive problems in the capital market affect investment. Simply put, investment is more sensitive to liquidity for the firms with weaker ties than for the firms with closer link. Although Hoshi et al. (1991) acknowledge the measurement errors in Tobin q they assumed it away by arguing that it cancels out since it is likely to be randomly distributed across the two groups. Erickson and Whited (2000) and Cummins et al. (2006) took care to minimize or eliminate measurement errors in Tobin q using different approaches and arrived at a similar conclusion.

Cummins et al. (2006) found that investment responds significantly to Tobin q constructed using earnings forecasts (obtained from securities analysts) to capture neoclassical fundamentals relevant to investment. The estimated q fully controlled for the important fundamentals in investment spending, wiping out the effects of cash flow. They found investment to be insensitive to cash flow, even for the financially constrained firms. Thus, their findings are consistent with the neoclassical model of investment, which imply that cash flow is irrelevant in investment decisions for all firms.

Agca and Mozumdar (2012) criticized Cummins et al. findings asserting that the stock market based q is superior to the measure of q constructed by Cummins et al. (2006) due to errors in their data and estimation. Measurement of marginal q

is difficult because it cannot be observed and its approximation using average q has been controversial due to measurement errors. Although measurement error remedies have been developed, misspecification of the estimators can lead to biased estimates (Erickson & Whited, 2012).

This strand of literature is marred with a lot of controversy due measurement errors in q and correlation between cash flows and firm expectations of future profits. Therefore, the coefficient of cash flow might be biased. Furthermore, in light of the difficulty in identifying constrained firms, it is not clear whether the differences in the sensitivities of investment to cash flow across different degrees of financial constraints is sufficient statistic for the impact of capital market imperfection on corporate investment.

Another approach that has received considerable attention is Euler equation approach. Euler equation models have been applied (for instance: Bond & Meghir, 1994; Hubbard & Kashyap, 1992; Petrick, 2005) as a walk around to measurement errors in Tobin q. Others include accelerator models (B. Bernanke et al., 1996). Most of these studies have documented evidence that financial constraints affect investment.

Some studies have used other methods such as structural equations. Hennessy and Whited (2007) used a structural equation and found that external capital is costly and as a result firms invest sub-optimally. They also documented evidence that cash flow is a poor proxy for the cost of external capital and size is a better indicator. Chowdhury, Kumar and Shome (2011) explored policy changes that are likely to decrease and increase information asymmetry and found that increase in disclosure requirements leads to a reduction in investment-cash flow sensitivity while deregulation lead to increase in investment-cash flow sensitivity. Ascioglu, Hegde and McDermott (2008) using a direct measure of financial

constraints derived from market micro-structure found that high information asymmetry lowers investment and increases investment-cash flow sensitivity.

Carpenter and Guariglia (2008) avoided measurement errors in *Tobin Q* by using contracted investment. They found that the inclusion of contracted investment in the investment equation significantly reduced the sensitivity of investment to cash flow for large firms but not for small firms. Thus, their results confirm that the investment-cash flow sensitivity stems from financial constraints.

Financial Constraints, Shocks to Cash Flow and Investment

A number of studies have used innovative approaches to avoid classification bias and endogeneity problem. These studies use differences in exogenous shocks to examine investment-cash flow sensitivity across the groups. Since exogenous shocks are rare, very few studies have used this approach. Blanchard et al. (1994) examined a small sample of firms that received cash windfall in corporate lawsuits and how they used them. The documented evidence that is inconsistent with the perfect capital markets model. Lamont (1997) examined the capital expenditures of oil companies in their non-oil corporate segments and found that investment by oil companies in their non-oil subsidiaries significantly declined relative to median investment following the 1986 oil price decline.

Rauh (2006) explored discontinuity in corporate pension funding obligations and found that increase in the amount of mandatory contributions which in turn reduces cash flows causing investment declines. Campello et al. (2010) who focused on the 2008 financial crises provided similar evidence. They used a survey based measure of financial constraint and found that constrained firms planned deeper cuts in employment, investment and tech spending. The results of these studies are unlikely to suffer from endogeneity of cash flows. Ascioglu et al. (2008) using direct measures of financial constraints derived from the market

micro-structure, documented evidence that firm investment is on average lower and the sensitivity of investment expenditures to fluctuations in internal funds is higher for financially constrained firms.

4.2.3 Overview of Literature

Theoretical literature show that internal funds have positive effects on investment, however, it is silent on whether this relationship is monotonic on the degree of financial constraints as asserted in the empirical literature. This, in addition to the appropriateness of cash flow as a proxy of capital market imperfections; measurement errors in Tobin q; and the identification strategy of financially constrained firms, has generated a lot of debate, particularly on the interpretation of the results. Consequently, it is not clear whether investment-cash flow sensitivities indicate imperfection in the capital market and if this relationship is monotonic on the degree of financial constraints. This study investigated the effects of imperfection in the capital market using Euler equation hence is not affected by measurement errors in Tobin q. Second, by using an exogenous real exchange rate shock, this study avoided the possible endogeneity problem in investment-cash flow sensitivity approach. Finally, the use of general method of moments with fixed effects control for endogeneity problem in cash flow.

4.3 Methodology

4.3.1 Introduction

This section presents the methodology employed to implement the objectives of this study. The first objective was to examine the effects of financial constraints on firm investment. The presence of financial constraint regimes in investment behaviour was examined by interacting the right hand variables of Euler equation

with a dummy for financial constraint status which equals one in the presence of financial constraints and zero, otherwise. The second objective was to estimate the effects of dependence on external capital on investment. To this end, cash flow and Tobin Q were interacted with a measure of dependence on external capital.

The third objective used discontinuity in real exchange rate to investigate firm's investment response to shocks in the presence of financial constraints. In a perfect capital market firms are able to borrow and adjust to any changes in the resource requirements for both investments and exports. Regression discontinuity design was used to examine how changes in resource requirements for both investment and exports affect investment behaviour.

Introducing financial constraints dimension to the discontinuity in real exchange rate allows this study to use difference in difference approach, which controls for biases that arise when investment and firm's investment response to shocks depend on the degree of financial constraints. This entails exploiting the kinks in real exchange rate to estimate firm's investment response to shocks in the presence of financial constraints. The rest of this section is organized as follows. First, theoretical framework is outlined followed by the model specification and the model to be estimated then the diagnostic tests and the definition of data and variables to be used and lastly, the source of the data used is outlined.

4.3.2 Theoretical Framework

In a perfect capital market external and internal finances are perfect substitutes, however, due to agency or informational problems, external capital is more costly than internal finance. Therefore, a firm facing agency or informational problems is likely to have a higher cost of capital, for a given mix of external and internal finance, than a similar firm facing few or no informational problems. This

differences in hurdle rate causes differences in the investment opportunities set (i.e. investments with positive net present values). If the value of the firm is the sum of discounted cash flows as asserted by Modigliani and Miller (1958), then the lower the cost of capital the higher the value of the firm. In the remaining part of this section, this study develops a theoretical model to explain these differences in investments opportunities and show how they bias the conventional Tobin Q. Euler equation is then derived.

The analysis is based on the following simplifying assumptions. First, firms issue securities to the providers of external capital in perpetuity, for instance by reissuing debt to retire maturing debt or by issuing non-redeemable equity stocks. In addition, the firm does not pay periodical interest or dividend, but instead interest is paid on maturity and dividends are realized as capital gains upon sale by the stock-holders. Second, due to informational problems firms follow pecking order in their financing and face exogenous cost of funds.

Third, firms have already optimized in other dimensions and the only remaining decision is to choose the optimal path of investment. Here no distinction is made between gross and net investment. Fourth, in addition to investment cost (i.e. the price paid for the capital item), firms incur adjustment cost that is convex in investment. The combination of these cost give the total investment cost. Fifth, total investment cost is financed either internally or externally and the accumulation of total investment cost over time defines the capital structure of the firm.

In this model, a firm chooses investment to minimize total cost. This is in contrast to the conventional profit or firm value maximization approach. As will be shown, the results derived under this approach is substantively the same as those of conventional approach, however, inclusion of the wedge between the cost of internal and external capital in the cost of maintaining capital is straight forward.

Let the level of investment in period t for firm i be I_{it} and its tax-adjusted price at period t be p_t and the associated adjustment cost be $C(I_{it}, K_{it})$ such that the total cost of investment sums to $p_t I_{it} + C(I_{it}, K_{it})$. Also define K_{it} as the capital stock for firm i in period t, κ_{jit} as the cost of j finances in period t for firm i, where j stands for internal (R), debt (D) and equity (E) sources of fund. From the second assumption $\kappa_{Rit} < \kappa_{Dit} < \kappa_{Eit}$. The weighted average cost of capital in period t for firm i, κ_{it} is:

$$\kappa_{it} = \kappa_{Rit}\frac{R_{it}}{K_{it}} + \kappa_{Dit}\frac{D_{it}}{K_{it}} + \kappa_{Eit}\frac{E_{it}}{K_{it}} \quad for t = 0, 1, 2, ..., \infty \tag{4.8}$$

That is, the weighted average cost of capital for firm i in period t, κ_{it}, is given as the value weighted average cost of the individual sources of funds. If a firm can rent or buy capital, then κ_{it} is equal to the rental or user cost of capital for firm i in period t. Defining $\eta = \frac{R_{it}}{K_{it}}$ then from the fifth assumption, firm i at any time t will face total cost of acquiring, maintaining and adjusting capital at time t given by:

$$\sum_{t=0}^{\infty} \left[\left(\kappa_{it} - \eta\, \kappa_{Rit} \right) K_{it} + p_t I_{it} + C(I_{it}, K_{it}) \right] \tag{4.9}$$

and capital stock evolution is given as:

$$K_{it+1} = K_{it} + I_{it} - \delta_{it} K_{it} \tag{4.10}$$

Each firm also has a profit function given as $\Pi(K_{it})$ and a profit target after interest and taxes, $\bar{\Pi}$, each period. The firm problem is to minimize the cost

of servicing the funds (for instance interest and dividends) employed to finance capital in order to attain the profit target:

$$\begin{array}{cc} \underset{\{I_{it}\}_{t=0}^{\infty}}{Min} & \sum_{t=0}^{t} \frac{1}{(1+r)^t} \left[(\kappa_{it} - \eta\, \kappa_{Rit})\, K_{it} + p_t I_{it} + p_t^y C\,(I_{it}, K_{it}) + wL_{it} \right] \\ & K_{it+1} = (1-\delta_{it})\, K_{it} + I_{it} \\ subject\ to & p_t^y \Pi\,(K_{it}) \geq p_t^y \bar{\Pi}_{it} \\ & I_{it} \geq 0 \end{array} \tag{4.11}$$

Where p_t^y is the price of output and, in the presence of imperfect competition, p_t^y depends on output with a constant elasticity of demand, $\varsigma > 1$. This condition is necessary only for the derivation of Euler equation and if it is assumed in deriving Tobin q, then average q and marginal q will not converge. For now, p_t^y is normalised to one. Using period and firm specific multiplier, λ_{it} and γ_{it}, the Lagrangian form for this problem is expressed as follows:

$$\begin{aligned} \mathscr{L} = \sum_{t=0}^{t} \frac{1}{(1+r)^t} \{ & (\kappa_{it} - \eta\, \kappa_{Rit})\, K_{it} + p_t I_{it} + C\,(I_{it}, K_{it}) + wL_{it} - \\ & c_5 \sum_{t=0}^{t} \gamma_{it} \left[\bar{\Pi} - \Pi\,(K_{it}) \right] - \sum_{t=0}^{t} \lambda_{it} \left[(1-\delta_{it})\, K_{it} + I_{it} - K_{it+1} \right] \} \end{aligned} \tag{4.12}$$

Define $q_{it} = \lambda_{it} \frac{1}{(1+r)^t}$ and $m_{it} = \gamma_{it} \frac{1}{(1+r)^t}$, then the Lagrangian can be rewritten as:

$$\begin{aligned} \mathscr{L} = \sum_{t=0}^{t} \frac{1}{(1+r)^t} \{ & \left[(\kappa_{it} - \eta\, \kappa_{Rit})\, K_{it} + p_t I_{it} + C\,(I_{it}, K_{it}) + wL_{it} \right] - \\ & c_5 m_{it} \left[\bar{\Pi} - \Pi\,(K_{it}) \right] - q_{it} \left[(1-\delta_{it})\, K_{it} + I_{it} - K_{it+1} \right] \} \end{aligned} \tag{4.13}$$

The first order conditions are

$$[p_t + C_I(I_{it}, K_{it})] = q_{it} \tag{4.14}$$

$$[p_{t+1} + C_I(I_{it+1}, K_{it+1})] = q_{it+1} \tag{4.15}$$

$$q_{it} = \frac{1}{(1+r)}\{q_{it+1}(1-\delta_{it+1}) - (\kappa_{it+1} - \eta\,\kappa_{Rit+1}) - C_K(I_{it+1}, K_{it+1}) + c_5 m_{it+1}\Pi_K(K_{it+1})\} \tag{4.16}$$

Equation (4.16) states that the shadow price of a unit of capital stock must equal the discounted value of four terms: the depreciated shadow value of capital in the next period, the wedge between the cost of external and internal finance, the contribution of the new unit of capital to the marginal reduction of future adjustment cost and the contribution of the new unit of capital to real revenue. Letting $\kappa_{Rit} = 0$ and assuming a perfect capital market where internal and external capital are perfect substitutes such that $\kappa_{Rit} = \kappa_{Dit} = \kappa_{Eit}$. Thus, equation (4.16) reduces to:

$$q_{it} = \frac{1}{(1+r)}\{q_{it+1}(1-\delta_{it+1}) - C_K(I_{it+1}, K_{it+1}) + m_{it+1}\Pi_K(K_{it+1})\} \tag{4.17}$$

Rearranging equation (4.14) yields:

$$p_t + C_I(I_{it}, K_{it}) = q_{it}^p \tag{4.18}$$

where q_{it}^p is obtained by reiterating equation (4.17) such that:

$$q_{it}^{p} = \frac{1}{(1+r)} \sum_{j=0}^{\infty} \left(\frac{1-\delta}{1+r} \right)^{j} \left\{ m_{it+j} \Pi_{K} \left(K_{it+j} \right) - C_{K} \left(I_{it+j}, K_{it+j} \right) \right\} \quad (4.19)$$

Recall $\kappa_{Rit} = 0$ and this implies that κ_{it} gives the wedge between the cost of internal and the cost of external capital. Thus, the imperfect capital market equivalent of equation (4.19), which is obtained by imposing $\kappa_{Rit} = 0$ and reiterating equation (4.16) and using equation (4.19) gives:

$$q_{it}^{p} = q_{it}^{ip} - \frac{1}{(1+r)} \sum_{j=0}^{\infty} \left(\frac{1-\delta}{1+r} \right)^{j} \kappa_{it+j} \quad (4.20)$$

Equation (4.20) implies that imperfections in capital markets reduce q_{it} by an amount proportional to the wedge between the cost of external and internal finance. The right hand side is the marginal q_{it}^{ip} under imperfect capital market, which is lower than the marginal q_{it}^{p} under perfect capital market. Marginal q_{it}^{p} is defined in equation (4.19) as the present discounted value of expected stream of benefits in the form of increase in profits and reductions in the installation cost (Erickson & Whited, 2000) of new fixed capital investment. The marginal q_{it}^{p} is given by equation (4.19) with the exclusion of the term κ_{it+j}. However, under imperfect capital markets, the left hand side of equation (4.20) has an additional term; additional cost of capital arising from the wedge, κ_{it+j}, between the cost of internal and the cost of external finance.

Presence of κ_{it+j} under imperfect capital markets impose stricter conditions than those required under the Tobin Q investment model (such as the one defined by equation (4.18) and (4.19)) by reducing the expected returns from a unit of capital. An increase in the cost of capital, as captured by the wedge, κ_{it+j}, raises the discount rate of the firm and some of the investment opportunities that were

viable in Tobin's Q model is rendered infeasible in the presence of imperfections in the capital markets.

Invoking assumption four and following the q literature (see for instance: Hubbard, 1998) so that average and marginal Q are equal, the adjustment cost can be stated as:

$$C\left(I_{it}, K_t\right) = \frac{a}{2}\left(\frac{I_{it}}{K_{it}} - b_i\right)^2 K_{it} \tag{4.21}$$

where a is a scale parameter and b is costless level of adjustment. Taking the derivative of equation (4.21) with respect to I_{it} and substituting the derivative into equation (4.18) and making I_{it}/K_{it} the subject yields:

$$\frac{I_{it}}{K_{it}} = b_i + \frac{1}{a}\left(q_{it}^p - p_t\right) + \xi_t \tag{4.22}$$

where ξ_{it} is the optimization error (Hubbard, 1998). If capital, factor and product markets are perfectly competitive and the fixed capital and the technologies for production and adjustment cost is homogeneous of degree one, then marginal Tobin Q can be approximated by average Tobin Q constructed from financial market data. Defining $Q_{it}^p = \left(q_{it}^p - p_t\right)$ and $\alpha = 1/a$, then the empirical Tobin Q equation can be written as:

$$\frac{I_{it}}{K_{it}} = b_i + \alpha Q_{it}^p + \xi_t \tag{4.23}$$

Note that Q_{it}^p is equivalent to $Tobin\,Q_{it}$ as defined in the q literature. $Q_{it} = \left(q_{it}^{ip} - p_t\right)$ is lower than $Tobin\,Q_{it}$, since $Tobin\,Q_{it}$ does not capture the effects

of $\left(\kappa_{it+j}\right)$ on investment. The measurement of *Tobin* Q_{it} is controversial and this study does not attempt to measure the extent of measurement error (see for instance: Erickson & Whited, 2000). The purpose of this analysis is to determine how informational cost are linked to q. With additional assumptions, specifically taking into consideration that p_t^y is not normalized and $\varsigma > 1$, Bond and Meghir (1994) solved the investment Euler equation (4.22) to obtain equation (4.31).

To see the implication of this model, recall the cost of internal funds, κ_{Rit}, was set to 0 so that the weighted average cost of capital will be 0 if internal and external capital are perfect substitutes. Substituting equation (4.20) into equation (4.18) and setting $C_I\left(I_{it}, K_{it}\right)$ as the subject of the equation yields:

$$C_I\left(I_{it}, K_{it}\right) = q_{it}^{ip} - p_t - \frac{1}{(1+r)} \sum_{j=0}^{\infty} \left(\frac{1-\delta}{1+r}\right)^j \kappa_{it+j} \tag{4.24}$$

Substituting the derivative of equation (4.21) (with respect to I_{it}) into equation (4.24) and making I_{it}/K_{it} the subject yields:

$$\frac{I_{it}}{K_{it}} = b_i + \frac{1}{a}\left(q_{it}^{ip} - p_t\right) - \frac{1}{a}\left\{\frac{1}{(1+r)} \sum_{j=0}^{\infty} \left(\frac{1-\delta}{1+r}\right)^j \kappa_{it+j}\right\} + \xi_t \tag{4.25}$$

Using the definition of Q_{it} and

$$\gamma(r, \delta, \kappa_{it}, \kappa_{Rit}, \eta) = \frac{1}{(1+r)} \sum_{j=0}^{\infty} \left(\frac{1-\delta}{1+r}\right)^j \kappa_{it+j} \tag{4.26}$$

gives:

$$\frac{I_{it}}{K_{it}} = b_i + \alpha Q_{it} + \frac{1}{a}\gamma(r, \delta, \kappa_{it}, \kappa_{Rit}, \eta) + \xi_t \tag{4.27}$$

If investment equation (4.23) is estimated instead of (4.27) then $\frac{1}{a}\gamma(r,\delta,\kappa_{it},\kappa_{Rit},\eta)$ will be captured by the error term. This adds to the measurement problem of Tobin Q_{it}. Note that if $\kappa_{it+j} = \kappa_{Rit+j}$ then

$$\gamma(r,\delta,\kappa_{it},\kappa_{Rit},\eta) = 0 \tag{4.28}$$

In this case, the first best level of investment is attained. Second, if internal and external capital are not perfect substitutes, then $\gamma(r,\delta,\kappa_{it},\kappa_{Rit},\eta) \neq 0$ and $\gamma(r,\delta,\kappa_{it},\kappa_{Rit},\eta)$ which rises with the increase in the wedge between the cost of internal and external capital, depreciation rate and the discount rate will reduce profitable investment opportunities. The wider the wedge the higher the value a firm that borrows will transfer to debt-holders hence leading to a decline in firm value. Thus, a wider wedge will increase the discount rate resulting in a lower firm value, and vice versa.

Recall $1-\eta$ is the proportion of external capital used in investment. In addition, if external capital is costly and the wedge between the cost of internal and cost of external capital increases in the use of external capital, then the following hypothesis can be derived from the model. First, an increase in cash flow, by reducing the use of external capital $1-\eta$, reduces the wedge, bringing $\gamma(r,\delta,\kappa_{it},\kappa_{Rit},\eta)$ closer to zero and hence increases investment and the value of the firm. Even if the cost of external capital remains the same, the cash flow can reduce κ_{it} by reducing reliance on external capital, $1-\eta$. Second, an increase in expectations of future profits as captured by Q_{it} will ease access to external capital, by reducing the need to reserve external financing capacity for future financing. From equation (4.27) and using the negative relationship between external capital and cash flow (López-Gracia & Sogorb-Mira, 2014), the following testable hypothesis can be derived.

Testable hypotheses were derived under the assumption of two period investment horizons. In particular, this study follows the theoretical model of Froot et al. (1993) and Kaplan and Zingales (1997). Define R as internally generated cash flow, I as investment and therefore external capital, then E equals $I-R$. As defined in Kaplan and Zingales (1997), let the return on investment be given by the production function $F(I)$ and the total opportunity cost of internal funds be given by a convex function $C(E)$. The firm's maximization problem is:

$$p(R) = \underset{I}{Max} F(I) - I - C(E) \; such\, that \; E = I - R \tag{4.29}$$

The first order condition is $F_I - C_E = 1$, however, when internal and external capital are perfect substitutes, then $C(E) = 0$ and therefore first order condition becomes $F_I = 1$. The latter gives the first best level of investment. As shown by equation (4.30), internal finance will only have positive effects on investment if $C(E) \neq 0$ and $C(E)$ is convex:

$$\frac{dI}{dR} = \frac{C_{EE}}{C_{EE} - F_{11}} \tag{4.30}$$

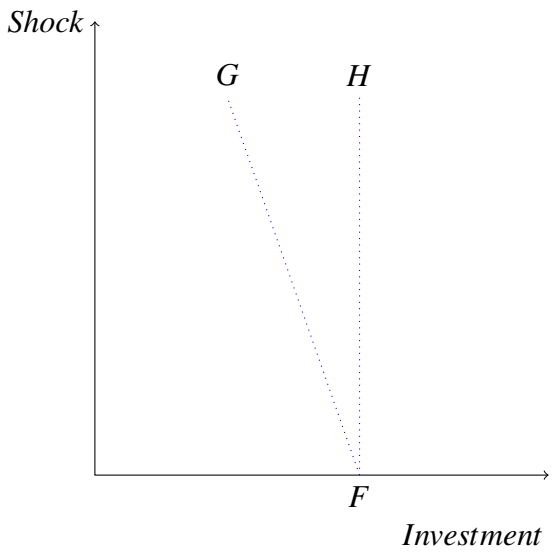
$C(E) \neq 0$ in the presence of financial constraints and therefore the effects of internal finance on investment is positive since $C(E)$ is convex. When external capital is not costly, firms can use cash flow to smoothen investment (Fazzari et al., 1988) and hedging can be used to smoothen cash flow fluctuations (Froot et al., 1993).

The implication of these results are as follows: first, if external capital is costly, then it should have a negative effect on investment and therefore an increase in cash flow provides an opportunity for firms to reduce the use of external

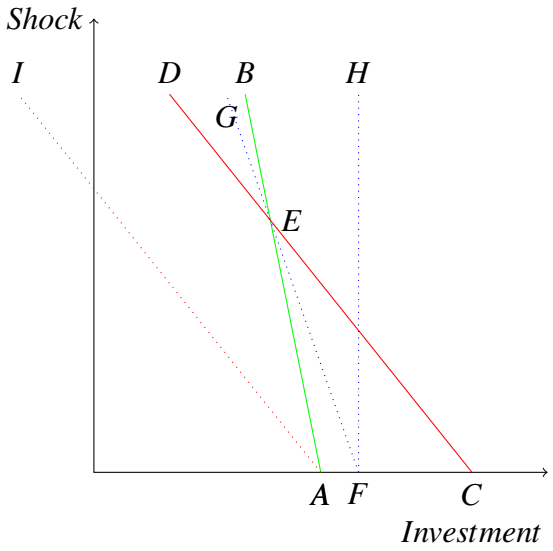
capital. Reduction in the level of external capital results in a fall in the cost of financing and hence a rise in investment. This is likely to be the case for firms that are already using high risk costly debt. Similarly, constrained firms hoard cash if they have less debt stock and less investment opportunities. In this case, an increase in cash flow should increase investment but the increase should be higher for financially constrained firms conditional on investment opportunities. The second objective on estimating the effects of dependence on external capital on investment examined these hypotheses.

One of the strategies of estimating the effects of financial constraints on firm's investment is by exploiting exogenous shocks that affect firm's cash flow and has no effect on investment opportunities and hence firm's investment behaviour. However, a bias arises if the responses of firm's investment to shocks differ with the degree of financial constraints. This is illustrated in the following section. Consider an economy with two types of firms: financially constrained and financially unconstrained, with constrained firms initially having a high level of investment than their unconstrained counterparts. In addition, assume as documented by Campello et al. (2010) that constrained firms respond more to shocks such that the differences in response to shocks cause the differences in after-the-shock investment rate to shrink.

A negative shock will result in investment contracting more for constrained than for unconstrained firms hence the narrowing of the gap in investment rate between the two groups. Thus, if financial constraint is ignored, the changes in firm investment behaviour due to shocks is understated or, in the extreme, reversed. Figure 4.2 graphically demonstrate how ignoring financial constraint status introduces a bias.



(a)



(b)

Figure 4.2: Effects of Shock under Different Assumptions of Financial Constraints
Source: Author's derivation.

Panel (a) and (b) of Figure 4.2 are derived under the following assumptions: the effects of financial constraints and shocks are assumed to be linear, constrained firms form a small proportion of firms and they are uniformly distributed within the economy. In addition, shocks have no effects on financial constraint status of the firm and on the determinants of investment. With a different set of

assumptions, the substantive conclusion of this analysis (that is ignoring financial constraint status introduces bias) will still hold. Panel (a) shows a case where firms are distinguished based only on shocks so that the investment path of those firms affected by shocks is given by line $\overline{FG}$ and the investment path of those not affected by shocks is given by $\overline{FH}$. The effects of the shock equal G less H (G-H).

Introducing financial constraints dimension in Panel (b) so that firms are split into two: constrained and unconstrained firms, with one group responding more to the shocks that the other. This gives the before-the-shock difference in investment behaviour and the after-the-shock difference in investment behaviour for constrained and unconstrained firms. The difference in before-the-shock difference and after-the-shock difference gives the effects of the shock. Before-the-shock difference in investment path equals C less A (C-A) and after-the-shock difference in investment path is D less B (D-B). The true effects of the shock equals (D-B)-(C-A). In a nutshell, the true effect of the shock is I-B which is larger than the effects of the shock, G-H (in panel (a)), when the effects of financial constraints and its interaction with the shock is ignored. The effects of the shock, I-B, is obtained by shifting the line CD to the left until point C converges to point A. The size of the bias is {(D-B)-(C-A)}-(G-H)[7].

4.3.3 Model Specification

Neoclassical intertemporal optimization model of investment is used in this study. There are two avenues for implementing this model: regression of investment on marginal q and the Euler equation. Marginal q which represents the shadow value of capital is difficult to estimate and therefore average q is

[7]This bias can also arise due to errors in classification of firms. If constrained firms are misclassified as unconstrained it will bias the coefficient of cash flow towards that of constrained sub-sample, taking it closer to it, and in the extreme, to the population average.

commonly used instead. As shown by Hayashi (1982) average q is a good approximator of marginal q under constant returns to scale technology and perfect markets; conditions which are stringent and unrealistic. In addition, regressions of investment on q yields low R^2 and serially correlated residuals (Chirinko, 1993).

Alternatively, neoclassical intertemporal optimization model of investment can be implemented empirically by direct estimation of Euler equation. This approach as pointed out by Whited (1998) is likely to be misspecified due to its simplifying assumptions. However, it is not affected by the measurement errors in q. Furthermore, introducing additional variables to account for financial constraints improves the fit of the Euler equation (Bond & Meghir, 1994; Hubbard & Kashyap, 1992; Whited, 1992). Following Bond and Meghir (1994) the empirical Euler equation to be used is given as:

$$\left(\frac{I}{K}\right)_{i,t} = \alpha_1 \left(\frac{I}{K}\right)_{i,t-1} + \alpha_2 \left(\frac{I}{K}\right)^2_{i,t-1} + \beta \left(\frac{C}{K}\right)_{it-1} + \tau r_{t-1} + c_5\gamma \left(\frac{Y}{K}\right)_{it-1} + \varphi \left(\frac{B}{K}\right)^2_{it-1} + \alpha_t + \alpha_i + \xi_{i,t} \tag{4.31}$$

where the subscript i and t, respectively, refers to the firm and the time period, I/K is the investment rate, C/K is the ratio of real cash flow to the capital stock, r is the user cost of capital, Y/K is the ratio of real sales to the capital stock, B/K is the ratio of borrowing to the capital stock and controls for non-separability between investment and borrowing decision and disappears under Modigliani and Miller debt irrelevance (Bond & Meghir, 1994), ε is the forecast errors and $\alpha's$, β, γ and φ are parameters to be estimated. The coefficient for lagged investment rate, α_1 is positive and greater than one, α_2 is negative and its absolute value is greater than one, β and τ are negative and depend on the magnitude

of the adjustment cost, γ is positive under imperfect competition and is zero under perfect competition, φ is zero if financing and investment decisions are independent, otherwise it is positive, α_t is a time-specific effects and α_i is the firm-specific effects.

As suggested by Hoshi et al. (1991) to remove firm-specific effects and eliminate macro shocks, a firm dummy and a year dummy were included. Thus the effects of the user cost of capital is eliminated since it is firm specific. Apart from controlling for the effects of the user cost of capital, including fixed effects under certain conditions helps in controlling for non-random sampling. Firms meeting certain (listing) criteria self-selects into a sample of listed firms. The dynamic investment equation (4.31) implies that $E\left(\left(\frac{I}{K}\right)_{i,t-1}, \xi_{i,t}\right) \neq 0$, if $\xi_{i,t}$ and $\xi_{i,t-1}$ are correlated. Therefore, ordinary least squares (OLS) estimates will be biased. This is further complicated if cash flow variable is endogenous.

To address the endogeneity problem in equation (4.31), general method of moments (GMM) due to Arellano and Bond (1991) was used. GMM finds a variable Z, which is correlated with the lagged investment and cash flow variables and satisfies the condition that $E\left(Z_{i,t}, \xi_{i,t}\right) = 0$. This method is most suitable for panels with small T and large N. Although the data used in this study might not strictly fit into this description, this method is appropriate due to lagged dependent variable on the right hand side of equation (4.31) and possible endogeneity in cash flow. In addition, general method of moments produces heteroscedastic consistent asymptotic standard errors. Sargan test and Hansen J statistic was used to determine the validity of the instruments.

In the absence of financial constraints, the coefficient of cash flow (β) was hypothesized to be negative. This hypothesized relationship, however, fails due to liquidity constraints and marginal profitability (Bond & Meghir, 1994). This study begins by testing the hypothesis of no financial constraints. This

hypothesis was rejected and the study proceeded to examine differences across the sub-samples using two approaches. First, firm characteristics, that is size and age, that are associated with different financial constraint regimes were included in the investment equation. Size as measured by total fixed assets is a proxy for liquidity; firms with high value assets can pledge them to obtain debt or loans. Similarly, firms that have been followed by analysts for a long period of time are likely to face less informational problems and hence experience only a few problems obtaining external capital.

In the second approach, size and age were then used to generate a binary variable, which took a value of one in financially constrained firm-years and zero otherwise. This dummy variable was interacted with all the right-hand side variables in equation (4.31). Unlike Bond and Meghir (1994) who used share issues and dividend payments, this study used firm characteristics associated with financial constraints, particularly, age and size (see for instance: Hadlock & Pierce, 2010) to construct the dummy variable. This approach allows for a direct test for the presence of financial constraints.

In the final step, interactions of the financial constraints dummy variable and the right hand side variables were used to examine whether the relationship between the right hand side variables and investment rate depended on financial constraint status. In this case, when the dummy for financial constraints take a value of one, then the coefficients of the right hand side variables j is given by the derivative of the investment rate with respect to the variable j, which equals the coefficient of variable j plus the coefficient of the interaction of variable j with the dummy variable, otherwise the coefficient of variable j equals the coefficient of variable j without interaction. In the absence of financial constraints, the coefficients should not differ with financial constraint status. That is, incremental $F\,or\,Chi2$ should be insignificant.

The hypotheses developed in section 1.7 are examined using equation (4.27) which is restated as:

$$\frac{I_{it}}{K_{it}} = b_i + \alpha Q_{it} + \frac{1}{a}\gamma(\kappa_{it}, \kappa_{Rit}, \eta) + \alpha_t + \alpha_i + \xi_t \tag{4.32}$$

where α_t is a time-specific effects and α_i are the firm-specific effects. Other variables are as earlier defined. Note that $\gamma(\kappa, \kappa_{Rit}, \eta)$ differ from $\gamma(r, \delta, \kappa_{it}, \kappa_{Rit}, \eta)$ derived in section 4.3.2 since they are firm specific and is controlled by the inclusion of the firm dummy.

Following Kaplan and Zingales (1997), this study assumes that total cost of raising external funds increases in the amount of funds raised and in the extent of the agency or information problems. The first part is captured by the variable $\gamma(\kappa, \kappa_{Rit}, \eta)$ and is proxied by the proportion of external capital used while the second part is captured by dividing firms into different degrees of financial constraints.

The third objective was implemented using quasi-experimental design methods, that is, regression discontinuity and difference in differences approach. These methods are suitable for controlling endogeneity (Cameron & Trivedi, 2005). The average treatment effects on investment due to real exchange rate shocks under regression discontinuity model is:

$$\tau = E\{Y_1 - Y_0 \mid X = \bar{x}\} \tag{4.33}$$

where Y_1 and Y_0 are the outcomes with and without treatment, respectively and $\bar{x}$ is the threshold. The rule of assignment into treatment or control group is known to follow the rule where an individual is put into control group if $X < \bar{x}$,

otherwise it is placed under treatment group. That is, $Y = \begin{cases} Y_0 & if\, X < \bar{x} \\ Y_1 & if\, X \geq \bar{x} \end{cases}$.
This model is implemented using the code developed by Calonico, Cattaneo and Titiunik (2014). Under mild continuity conditions, Hahn, Todd and Van der Klaauw (2001) proposed the following:

$$\tau = \underset{lim X \downarrow \bar{x}}{E\{Y_1 \mid X = \bar{x}\}} \quad \underset{lim X \uparrow \bar{x}}{-E\{Y_0 \mid X = \bar{x}\}} \tag{4.34}$$

Under regression discontinuity design, the idea is to use values close to the threshold, on either side of the threshold, as shown by Equation (4.34). In addressing the third objective, this study tested a null hypothesis of a large increase in investment for unconstrained firms relative to their constrained counterparts following a relative improvement in real exchange rate. The most common tool in this approach is the regression discontinuity plot. This study followed the robust regression discontinuity design plot developed by Calonico et al. (2014).

The estimate of firm's investment response to shocks in the presence of financial constraints is likely to be biased if the assignment of firms into different degrees of financial constraints is non-random. As a result, the before-the-shock average investment rate might vary with financial constraint status. Failure to take into consideration the differences in before-the-shock means might introduce bias in the estimates. To avoid this bias, the before-the-shock differences in investment rate and after-the-shock differences for the different degrees of financial constraints were determined and the difference in the differences gives the effects. The difference in differences is implemented using equation

(4.35). Letting FC and S be the dummies for financial constraints and shock, respectively, yields the difference in differences equation given by:

$$\left(\frac{I}{K}\right)_{ifs} = \beta + \pi FC_f + \gamma S_s + \tau\left(FC_f \times S_s\right) + \xi_i \tag{4.35}$$

Other variables are as defined earlier. The equation was augmented with the right hand side variables of equation (4.32), to further control for other factors that drive investment. The interpretation of the additional coefficients is summarized in Table 4.1. The coefficient of interest, τ is hypothesized to be negative and captures the change in investment for the financially constrained firms relative to the base (financially unconstrained firms) as result of shocks.

Table 4.1: Coefficients of Difference in Differences Approach

	Financial constraint status		
	Unconstrained	Constrained	Difference
Investment before the shock	β	$\beta+\pi$	π
Investment after the shock	$\beta+\gamma$	$\beta+\pi+\gamma+\tau$	$\pi+\tau$
Change in mean Investment	γ	$\gamma+\tau$	τ

4.3.4 Definition and Measurement of Variables

The variables defined hereunder were used in this study.

Variables	Measurement	Expected sign	Literature source
Investment Rate	Is the dependent variable in the investment equation. It is the ratio of the purchase of property, plant and equipment to the capital stock, measured by the book value of property, plant and equipment in year *t*		Fazzari et al. (2000, 1988); Kaplan and Zingales (1997, 2000)
Financial constraints	Is a dummy variable for identifying financially constrained firms which takes one if a firm is financially constrained and zero, otherwise. For details on this variable see section 2.3.2 on page 51.		Hadlock and Pierce (2010)
Size	Log of the book value of assets	Size is negative related to financial constraints	Hadlock and Pierce (2010); Hubbard (1998)
Age	Number of years a company has been listed in NSE	Age is negative related to financial constraints	Hadlock and Pierce (2010)
Sales to Capital Stock	Is the ratio of total sales of a company to the book value of property, plant and equipment	Sales to Capital Stock is positive under imperfect competition and zero under perfect competition	Bond and Meghir (1994)
Cash flow to Capital Stock	Ratio of cash flow book value of property, plant and equipment	Negative in the absence of financial constraints and positive, otherwise.	Bond and Meghir (1994)
Debt to Capital Ratio	Is the ratio of debt and long term borrowings to the book value of property, plant and equipment	Zero if financing and investment decisions are independent and positive otherwise.	Bond and Meghir (1994)
Tobin Q (measured at the beginning of the year)	Market value of assets divided by the book value of assets. Market value of assets equals book value of assets plus the market value of common equity less the sum of the book value of common equity and balance sheet deferred taxes	Positive effect on investment	Kaplan and Zingales (1997)

Dependence on external capital	Is the ratio of external capital used in investment and working capital to the total finance used in investment and working capital	Negative effect on investment	López-Gracia and Sogorb-Mira (2014)
RER Shock	The relative improvement in real exchange rate in 2008 is taken as the shock.	Positive effect for financially unconstrained firms and no effects for financially constrained firms	
Foreign ownership	Percentage of shares in firms held by foreigners.	Higher percentage is associated with lower financial constraints	To capture the important of internal capital markets (Lamont, 1997).
Bilateral Real Exchange Rate	Is expressed as the price of domestic currency in terms of foreign currency converted into real values using domestic price level and the foreign price level.	A depreciation has positive effect on investment and an appreciation has a negative effect.	Ellis (2001)
Real exchange rate shock	The discontinuity in real exchange rate in 2008 is taken as a shock. It is a dummy taking the value of 1 after 2008 and zero, otherwise.	A relative improvement in competitiveness of domestic products should promote investment	Lamont (1997)
Capital stock	Is the book value of property, plant and equipment in Kenya Shillings.		Hadlock and Pierce (2010)

4.3.5 Diagnostic Tests

The test for endogeneity in the right hand variables was performed before using GMM. This was important because OLS is more efficient relative to GMM when all the right hand variables are exogenous. There was need to check for correlation of selected instruments with the variables they instrument and also over-identification; having more instruments than regressors that requires to be instrumented.

In addition, a test was done to confirm that the condition $E(Z_{i,t}, \xi_{i,t}) = 0$ is satisfied. That is, the set of instruments are uncorrelated with the error terms. Hausman test was used to determine whether to use fixed effects or random effects model. Random effects model yields efficient and consistent estimates and therefore should be preferred over fixed effects models. However, when individual characteristics is related with the error term the results of the random effects model are inconsistent, in which case fixed effects to prevail.

4.3.6 Data Sources and Description

This study used a sample of firms listed in Kenya covering the period 1999 to 2016. The data was collected from published financial statements that companies file at Capital Markets Authority. Published financial statements consist of balance sheet, income statement and cash flow statements, which are the principal sources of the data used in this study. The sample consists of all (13) companies in the manufacturing sector listed Nairobi Securities Exchange (NSE). Supplementary data on variables not reported in financial statements were obtained from NSE. These include market prices of stocks and the year the company was listed in NSE. Data on exchange rate and consumer price index for Kenya and its major trading partners were sourced from World Bank.

To avoid introducing sector related bias in investment behaviour this study focused on studying firms in the manufacturing sector. Manufacturing firms have specialized assets which have high sunk cost and are therefore difficult to collateralize, hence can be considered as relatively illiquid. Consequently, firms in the manufacturing sector are likely to suffer from financial constraints. The effects of liquidity for the manufacturing vis-à-vis non-manufacturing firms were confirmed by Chirinko and Schaller (1995) who found the coefficient for the former to be twice as large. Combining manufacturing firms with non-manufacturing firms may introduce complexities in modelling. Furthermore, to avoid survival bias, data for listed manufacturing companies that entered or exited the NSE between 1999 and 2016, were all included. In addition, observations without data on the variables of interest were dropped. All figures were expressed in 2010 constant prices. All variables were winsorized to remove outliers at the 1st and 99th percentiles.

4.4 Empirical Results

This section presents the empirical results of the third essay. Annual panel dataset of all NSE-listed manufacturing firms in Table A1 spanning the period 1999 to 2016 was used in the analysis. First, summary statistics of the variables used is presented, followed by the regression analysis and discussion of the empirical results.

4.4.1 Descriptive Statistics

Summary statistics are presented for the entire sample and for the various dimensions of financial constraints and real exchange rate shock. First, summary statistics across shock and financial constraints sub-samples are presented. Because of the interest on before-the-shock and after-the-shock under different financial constraints statuses in this study, summary statistics were presented in

Table 4.4 along this dimension as well as for the entire sample. Table 4.3 presents the summary statistics across shock and financial constraint regimes:

Table 4.3: Summary Statistics

	Shock		**Constrained Status**	
Variables	**Pre-shock**	**Post-shock**	**NFC**	**FC**
Investment Rate	0.1231	0.1539	0.1054	0.1550
	0.1094	0.1005	0.0700	0.1192
	106	78	73	148
Financial Constraints Status	0.6491	0.6795	0.0000	1.0000
	0.4794	0.4697	0.0000	0.0000
	114	78	76	155
Age	2.9472	3.1854	3.6011	2.8555
	0.8335	0.7296	0.1411	0.8376
	103	78	76	144
Size	11.0953	11.0307	12.1865	10.4839
	1.1484	1.1804	0.6082	0.9673
	105	78	73	147
Sales	2.8397	3.4193	2.1987	4.0030
	3.0343	2.8103	1.1185	5.0695
	106	78	73	148
Cash flow	0.5398	0.5336	0.5401	0.3968
	0.4647	0.3670	0.3912	0.7551
	106	77	73	146
Debt Squared	0.0539	0.0603	0.0905	0.0367
	0.1488	0.1242	0.1754	0.1006
	98	72	73	131
Tobin Q	2.2821	3.4400	4.0470	2.7074
	2.3478	2.4788	2.8441	3.0910
	95	78	69	142
External Financial	1.9833	1.2848	1.0658	2.1465
Dependence	4.1902	2.1881	2.7507	4.5155
	103	77	71	145
Real Exchange Rate Shocks	0.0000	1.0000	291.9868	364.3355
	0.0000	0.0000	713.5550	777.5569
	114	78	76	155
Log of Assets	10.2861	10.0576	11.5697	9.4431
	1.4216	1.5263	0.6148	1.4433
	106	78	73	148

Sources: Author's Computation

For each variable, the first row presents the mean, the second row the standard deviation and the last row presents the number of observations used.

Clearly, there are differences in summary statistics for the before-the-shock and after-the-shock as well as for not financially constrained and financially constrained firms' sub-samples. Investment rate is higher after the relative improvement in terms of trade than before the improvement. Investment rate is also high for financially constrained firms relative to unconstrained firms. Severity of financial constraints increased after the shock. This suggests that investment rate after the shock could have been even higher if the severity of financial constraints had remained at before-the-shock level or even reduced. That is, the adjustment in investment rate due to a positive shock is incomplete. Investment rate rose by 16.5 percent while investment opportunities rose by 50.7 percent. Thus, the incomplete adjustment in investment rate is due to supply side constraints, in particular, quantity constraints.

After-the-shock age and size remained closer to before-the-shock level. This implies that distribution of firms remained the same in the period before-the-shock and after-the-shock. They, however, significantly vary with financial constraint status. Financially constrained firms tend to be young and small. Interestingly, sales increased after the shock. This reflects increase in exports due to improvement in terms of trade. Depreciation in real exchange rate enhanced the competitiveness of domestic exports as well as domestically produced import substitutes leading to increase in sales to foreign and domestic market, respectively. In addition, constrained firms have higher levels of sales than their unconstrained counterparts.

Liquidity declined following the shock and it varies with financial constraint status. In terms of use of debt, there was a slight increase after the shock and a

wide variation with financial constraints. Unconstrained firms' stock of debt is about 2.5 times that of constrained firms. Use of external capital is lower in after-the-shock period and for financially unconstrained firms. The low level of use of external capital in after-the-shock period can be linked to increased severity of financial constraints after-the-shock caused by quantity rationing. Investment opportunities are higher in after-the-shock period and for unconstrained firms. A combination of after-the-shock increase in severity of financial constraints and investment opportunities, suggests an increase in investment forgone by firms.

A detailed treatment of how the characteristics of financially constrained and unconstrained firms vary with shock is presented in table 4.4:

Table 4.4: Detailed Summary Statistics

	Entire	**Unconstrained**		**Constrained**	
Variables	**All Obs**	**Pre-shock**	**Post-shock**	**Pre-shock**	**Post-shock**
Investment	0.1386	0.0867	0.1400	0.1442	0.1604
Rate	0.1079	0.0618	0.0727	0.1249	0.1112
	221	39	25	67	53
FC Status	0.6710	0.0000	0.0000	1.0000	1.0000
	0.4709	0.0000	0.0000	0.0000	0.0000
	231	40	25	74	53
Age	3.1131	3.4874	3.6956	2.6042	2.9447
	0.7689	0.0790	0.0513	0.9118	0.7764
	220	40	25	63	53
Size	11.0488	12.1543	12.1986	10.4695	10.4798
	1.1794	0.6096	0.6302	0.9068	0.9564
	220	39	25	66	53
Sales	3.4070	2.2134	2.2964	3.2043	3.9490
	4.2785	1.1183	1.2944	3.6825	3.1669
	221	39	25	67	53
Cash flow	0.4445	0.4755	0.6042	0.5772	0.4997
	0.6591	0.4088	0.3829	0.4935	0.3580
	219	39	25	67	52
Debt Sq	0.0559	0.0991	0.0567	0.0240	0.0622
	0.1344	0.2083	0.0931	0.0793	0.1389
	204	39	25	59	47

Continued on next page

Table 4.4 – *Continued from previous page*

	Entire	Unconstrained		Constrained	
Variables	**All Obs**	**Pre-shock**	**Post-shock**	**Pre-shock**	**Post-shock**
Q	3.1455	2.9617	4.8374	1.9033	2.7808
	3.0710	2.4828	2.7592	2.1994	2.0502
	211	34	25	61	53
Ext Fin Dep	1.7913	1.1161	1.0070	2.4695	1.4183
	4.0471	3.0175	2.7265	4.6735	1.8922
	216	37	25	66	52
RER Shocks	340.5325	0.0000	1.0000	0.0000	1.0000
	756.3113	0.0000	0.0000	0.0000	0.0000
	231	40	25	74	53
Log of Assets	10.1455	11.5921	11.5038	9.5259	9.3755
	1.5876	0.5947	0.6487	1.1903	1.3325
	221	39	25	67	53

Sources: Author's Computation

For each variable, the first row presents the mean, the second row the standard deviation and the last row presents the number of observations used.

Compared to constrained firms, unconstrained firms' investment increased significantly after the shock. Unconstrained firms recorded about 61.5 percent increase in investment after-the-shock while the constrained counterparts registered an increase of about 11.2 percent. If constrained firms were to respond like the unconstrained firms to the shock, then constrained firms' corporate investment would have been Kshs 246.8 billion instead of Kshs 45 billion that was realised. There were 117 firm-years in post shock period, 69.23 percent of which were constrained. Thus, the lost investment of Kshs 201.8 billion (Kshs 246.8 billion less Kshs 45 billion) translates to Kshs 2.49 billion per firm-year. Age and size remain almost at the same level after-the-shock for both constrained and unconstrained firms. This implies that factors that identify financially constrained firms are independent from the factors that cause the shock or the shock itself.

After-the-shock cash flow rose for unconstrained firms while it declined for constrained firms. It was higher by about 27 percent for unconstrained firms and lower by about 13 percent for constrained firms in the post-shock period. Dependence on external capital for unconstrained firms registered a slight decline of 9.8 percent while it decreased by about 42.6 percent for constrained firms. Investment opportunities increased by 63 percent for unconstrained firms and by 46 percent for constrained firms in the post-shock period.

Sales for unconstrained firms increased by about 3.8 percent and by about 23.2 percent for constrained firms. However, the dispersion of sales for constrained firms is high and is even higher than the dispersion of the entire sample in the after-the-shock period. This applies also to other firms' characteristics such as investment rate, age, size, external capital dependence and foreign ownership. The implication is a higher variability of these characteristics among constrained firms than unconstrained firms.

4.4.2 Financial Constraints and Firm Investment

The first specific objective of this study was to examine how financial constraints affect investment. The idea was to identify the existence of financial constraint regimes in investment behaviour, and this was implemented in three steps using investment Euler equation. In the first step, equation (4.31) under the assumption of no-financial constraints was fitted. Under this assumption, the coefficient of cash flow was hypothesized to be negative. When the hypothesized relationship in step one was violated, firm characteristics associated with different financial constraint regimes were introduced as additional regressors in step two. In the final step, a proxy of financial constraint regimes was interacted with the right hand side variables of equation (4.31).

Table 4.5 presents the results for equation (4.31) under the null hypothesis of no financial constraints and the alternative hypothesis of financial constraint regimes.

Table 4.5: Investment Euler Estimation: Firm Characteristics and Investment

	(1)	(2)	(3)	(4)
Variables	No FC Regime		FC Regime Included	
Inv. Rate(-1)	0.8773***	0.8955***	0.8894***	0.8968***
	(0.000)	(0.000)	(0.000)	(0.000)
Inv. Rate(-1) Sq	-0.8599***	-0.8880***	-0.9747***	-1.0077***
	(0.000)	(0.000)	(0.000)	(0.000)
Cash flow	0.0264*	0.0188	0.0212	0.0171
	(0.075)	(0.199)	(0.137)	(0.239)
Sales	0.0057***	0.0049***	0.0035*	0.0030*
	(0.000)	(0.001)	(0.054)	(0.082)
Debt Sq	0.1320	0.1168	0.1431	0.1305
	(0.228)	(0.267)	(0.204)	(0.218)
Age			-0.0191*	-0.0214**
			(0.056)	(0.034)
Size			-0.0047	-0.0033
			(0.275)	(0.480)
Constant	0.0068	-0.0211	0.1288**	0.0000
	(0.593)	(0.235)	(0.048)	(.)
Observations	189	189	184	184
Number of Firms	12	12	12	12
Year FE	NO	YES	NO	YES
All	528.76	286.26	621.04	253.39

The levels of significance are: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.
P-values are in parenthesis below the coefficients.
Source: Author's calculation based on published company financial statements.

Column labelled (1) and (2) presents the results under the null hypothesis of no financial constraints while column labelled (3) and (4) present the results of the model under the alternative hypothesis of financial constraint regimes. The first column and the second column (no financial constraints and financial constraint regime) present the results of dynamic panel without and with year fixed effects, respectively. The second last row labelled $'$All$'$ presents the results of a joint test

of significance of all the coefficients for each of the four specifications estimated. Sargan test statistic and Hansen J statistic of over-identifying restrictions are statistically insignificant and thus the instruments are valid. The test for AR(1) process in first differences rejected the null hypothesis as expected. The test for AR(2) in first differences were, however, not rejected implying that there is no autocorrelation in levels. This also applies to the results in Table A4 in the appendix.

The results in Table 4.5 are consistent and substantively similar across estimation approaches considered. Lagged investment rate and its squared value has the expected signs. However, they are less than one in absolute values. The coefficient of sales is significantly different from zero suggesting imperfect competition in the product market. The coefficient for debt for the GMM specification suggests that financing and investment decisions are independent. Generally, the results of the dynamic panel, to a large extent, are similar to those of random and fixed effect specification in Table A4 in the appendix and thus are valid. The results show that the coefficient of cash flow is positive and significant at 10 percent. This is hypothetically incorrect under the null hypothesis of no-financial constraints, and it suggests the presence of financial constraints.

To further examine the presences of financial constraints suggested by the positive coefficient of cash flow, firm characteristics associated with financial constraints which include age and size were included in the investment equation. Significant coefficient of age and size indicate presence of financial constraints. Column labelled (3) and (4) of Table 4.5 presents the results for the model with both age and size as proxies of financial constraints. Age is significant in the investment equation suggesting financial constraints are important. Firms investment depends on age. Old firms tend to have lower investment rate than young firms. The effect of size is negative but insignificant. The significant

effect of age on investment suggests that financial constraints affect investment, however, if older firms tend to be more profitable than younger firms, then the relationship between age and investment is spurious. To avoid this possibility, financial constraint regimes are allowed in the investment equation.

Table 4.6 presents the results of the model with interacted right hand variables, a significance test for marginal effect alongside the results under no-financial constraints assumption.

Table 4.6: Financial Constraints and Investment

Variables	(1)	(2)	(3)	(4)
	FC Regime Included		No FC Regime	
Inv. Rate(-1)	0.8900***	0.8842***	0.8773***	0.8955***
	(0.000)	(0.000)	(0.000)	(0.000)
Inv. Rate(-1) Sq	-1.2967***	-1.3184***	-0.8599***	-0.8880***
	(0.000)	(0.000)	(0.000)	(0.000)
Cash flow	0.0242	0.0185	0.0264*	0.0188
	(0.177)	(0.283)	(0.075)	(0.199)
Sales	0.0064***	0.0060***	0.0057***	0.0049***
	(0.001)	(0.000)	(0.000)	(0.001)
Debt Sq	0.4907***	0.5005***	0.1320	0.1168
	(0.000)	(0.000)	(0.228)	(0.267)
Z*Inv. Rate(-1)	-0.1882	0.0917		
	(0.622)	(0.831)		
Z*Inv. Rate(-1) Sq	0.3881	-0.3360		
	(0.777)	(0.823)		
Z*Cash-flow	0.0391*	0.0290		
	(0.067)	(0.270)		
Z*Sales	-0.0076	-0.0128*		
	(0.270)	(0.083)		
Z*Debt Sq	-0.5083***	-0.5443***		
	(0.000)	(0.000)		
Constant	0.0163	-0.0122	0.0068	-0.0211
	(0.236)	(0.412)	(0.593)	(0.235)
Observations	189	189	189	189
Number of Firms	12	12	12	12
Year FE	NO	YES	NO	YES
Cashflows	19.57	6.50		
Interacted	317.92	277.41		
All			528.76	286.26

The levels of significance are: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.
P-values are in parenthesis below the coefficients.
Source: Author's calculation based on published company financial statements.

To test the hypothesis of no financial constraints, the measure of financial constraint status was interacted with the right hand variables in equation (4.31). Financial constraint status was measured using a dummy, Z, which took the

value of 1 if a firm is financially constrained and, 0 otherwise[8]. Insignificant coefficients of the interacted terms imply there is no differences in investment behaviour across the financial constraint sub-samples. This is, however, inconclusive and therefore a significance test for marginal effect is necessary. Table 4.6 on page 191 presents the results.

The results for the interacted dynamic panel model without and with fixed effects are presented in column labelled (1) and (2), respectively. The first five coefficients are coefficients of the sub-sample of firms facing no financial constraints, while the next five coefficients (starting with the letter Z) present the differences in coefficients on each variable arising from financial constraints. The row named cash flow presents Chi square statistics for the test that the coefficients of cash flow under financial constraints is zero. Similarly, the row labelled interacted and all presents similar results for the test that the coefficient of cash flow under interaction terms and all variables are jointly zero.

Sargan test statistic and Hansen J statistic of over-identifying restrictions are statistically insignificant and thus the instruments are valid. The test for AR(1) process in first differences rejected the null hypothesis as expected. The test for AR(2) in first differences were, however, not rejected implying that there is no autocorrelation in levels. Allowing the coefficients to vary across the sub-samples bring the coefficients of financially unconstrained firms closer to the hypothesized values. That is, it improved the fit of the investment Euler equation.

The coefficient of lagged investment gets closer to one while the absolute value of lagged investment squared is greater than one, as hypothesized. The coefficient of debt differs across the sub-samples. It is positive and significant

[8]In the absence of financial constraints the coefficients should not differ with financial constraint status. To implement this test, incremental F is computed (using testparm) on the interacted right-hand variables, or ftest of baseline (original model that did not allow for any difference across groups) and interacted model (that allowed for differences across groups).

for unconstrained firms, which shows that Modigliani and Miller independence of financing and investment decisions does not hold. When financial constraint is taken into consideration, the coefficient of debt is negative and significant. The coefficient of sales suggests imperfect competition in the product market.

The coefficient of cash flow for financial unconstrained sub-sample is positive and insignificant while it is positive and significant at 10 percent for the model without fixed effects. Including fixed effects, the coefficient of cash flow for financial constrained sub-sample become insignificant. The marginal effects[9] of cash flow is 0.0633 and 0.0475 with Chi square statistics of 19.57 and 6.50, respectively, for the model without and with fixed effects. These are significant at 1 and 5 percent level of significant, respectively. Thus, financial constraints affect investment rate.

Furthermore, the joint significance test of the interacted right hand side variables provide evidence of existence of financial constraint regimes. Although the results show that imperfections in capital markets are important and affect investment, whether the wedge between the cost of external capital and internal finance increases with financial constraints is not clear. In addition, understanding how cash flow interact with the external financing levels helps in determining how the effects of cash flows on investment differ with financially constraints. The next section addresses these concerns.

4.4.3 Dependence on External Capital and Investment

The effect of cash flow and expectation of future profits on the firm's dependence on external capital, DEP, were considered. Hypothetically, cash flow should increase investment in the presence of financial constraints and its effect should

[9]The marginal effect of cash flow is $\frac{\partial I}{\partial cfs} = \beta_{cfs} + \beta_{zcfs}$ where β_{cfs} and β_{zcfs} are, respectively, the coefficient of cash flow and the interacted cash flow.

be higher for severely financially constrained firms. Unlike in the case of financially constrained firms, cash flow reduces reliance on external capital for firms close to financial distress hence the investment-cash flow sensitivity for these firms are low. Financially distressed firms unlike financially constrained firms prioritize reduction of costly high risk debt over investments (Kim & Park, 2015).

The effect of expectations of future profits as captured by Q on the dependence on external capital on investment is ambiguous. Expectations of future profits may ease access to external capital hence increasing current investment. The increased dependence on external capital as borrowing increases due to high levels of current investment will in turn increase the wedge between internal and external capital. This increases wealth transferred by firms to debt-holders; which impact negatively on decision to borrow and hence investment. Table 4.7 presents the results for cash flow and expectation of future profits for the entire sample.

Table 4.7: External Finance Dependence and Investment

Variables	(1) Inv. Rate	(2) Inv. Rate	(3) Inv. Rate	(4) Inv. Rate	(5) Inv. Rate
Q	0.0083***	0.0080***	0.0068**	0.0078***	0.0052*
	(0.002)	(0.003)	(0.022)	(0.004)	(0.087)
Cash flow	0.0188*	0.0082	0.0159	0.0057	0.0126
	(0.082)	(0.473)	(0.162)	(0.621)	(0.269)
DEPxCash flow		0.0113***		0.0128***	
		(0.001)		(0.001)	
DEPxQ			0.0010*		0.0016**
			(0.073)		(0.013)
Dep				-0.0024	-0.0036*
				(0.165)	(0.082)
Constant	0.1056***	0.1074***	0.1109***	0.1124***	0.1210***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	207	202	202	202	202
Number of Firms	13	13	13	13	13
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Overall R-sq	0.42	0.47	0.43	0.47	0.43
Test of dfx	3.02	12.16	7.70	13.85	5.90

The levels of significance are: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.
P-values are in parenthesis below the coefficients. Hausman test indicated that random effect model adequately accounts for the individual-level effects in the models reported in this table.
Source: Author's calculation based on published company financial statements.

The dependent variable is investment rate. Least squares dummy variables estimation technique was used. Column labelled (1) presents the results for the standard investment-cash flow sensitivity approach. Column labelled (2) and (3) extends the standard approach by including an interaction of the external capital dependence and cash flow on one hand, and the interaction of the external capital dependence and Q on the other. Column labelled (4) and (5) augments the models in column labelled (2) and (3) with external capital dependence.

In a perfect capital market, Tobin Q carries all the information required for investment decisions and therefore any other variable, other than Tobin Q should

not influence investment. However, the standard investment-cash flow sensitivity approach, in Table 4.7, shows that cash flow have positive effects on investment rate, which are significant at 10 percent level of significance. Literature on capital market imperfection takes the positive coefficient of cash flow to be indicative of the presence of financial constraints in capital market.

The effects of cash flow on investment vanish when an interaction of cash flow and dependence on external capital is added into the equation. This suggests that the effect of cash flow on investment is indirect. Indirect effect implies that the effects of cash flow on investment is higher the higher the level of dependence of external capital. That is, firms which depends more on external capital rely heavily on cash flow to financed their investment. This might arise if it is more difficult for firms with higher dependence of external capital to secure new debt contracts. One immediate implication of indirect effect is that the standard investment-cash flow sensitivity equation is misspecified.

The indirect effects of cash flow hold even when both the dependence on external capital, and an interaction of cash flow and dependence on external capital are included. The results for this extended model are shown in column labelled (4). The interaction of cash flow and the dependence on external capital have positive effect on investment which is significant at 1 percent. Dependence on external capital, on the other hand, has no effect on investment. These results arise if subsequent lenders face a higher risk of loss in case of bankruptcy and hence require higher compensation, which increases the cost of funds. This in turn increases the wedge between the cost of internal and external capital and hence increases the amount of wealth transferred to debt-holders. Under this condition, any additional issue of debt is not firm value maximizing move and this causes firms to rely heavily on cash flow to financed their investment.

In a similar way, expectations of future profits, Tobin Q, have positive and significant effects on investment rate. Expectations of future profits are all the information that a firm need to make investment decisions. Moreover, when financial constraints are binding and if lending is based on future profitability, then expectations of future profits may play a second role of easing difficulties in access to capital[10]. Thus, the former is the direct effect and the latter is the indirect effect of expectations of future profits on investment. Existence of indirect effect on expectations of future profitability is confirmed by a positive coefficient of the interaction term (of dependence on external capital and Tobin Q) in column labelled (3) and (5) of Table 4.7.

Furthermore, the effect of expectations of future profits was weakened by the inclusion of both the dependence on external capital and an interaction of Tobin Q and dependence on external capital. Thus, the influence of Tobin Q on investment is mainly indirect, probably, by signalling future profitability and hence easing financial constraints. This suggests that the effects of Tobin Q on investment rate largely depend on the current leverage. The higher the dependence on external capital the higher the effects of future cash flow on investment. The effect of dependence on external capital on investment is negative and significant at 10 percent. This implies that lower investment rate is associated with higher dependence on external capital. This is the case if the supply curve of external capital for firms with higher dependence on external capital is inelastic.

In summary, the results in this section shows that the higher the dependence on external capital the higher the effects of both the current and the future cash flow on investment. The effects on current cash flow arises due to wedge between the

[10]Lenders lend into the future by basing their lending decisions on the future prospects of the company, in terms of, ability to repay loans or redeem issued debt.

cost of external capital and the opportunity cost of internal capital. Therefore, firms prefer not to issue debt to finance investment since if they do so they will transfer substantial value to debt-holders. This is price constraints on access to capital. The effects of future cash flow is associated with inelastic supply curve of external capital and hence arise due to quantity constraints on access to external capital. In the next section, the analysis above for current cash flow is replicated for firms facing different degrees of financial constraints.

Table 4.8 present the results for the analysis of how cash flow affect investment controlling for the dependence on external capital for each constraint status.

Table 4.8: External Finance Dependence, Cash flow and Investment

	(1)	(2)	(3)	(4)
	Standard Invest-CFS		Interacted	
Variables	NFC	FC	NFC	FC
Cash flow	0.0871**	0.0095	0.0801**	-0.0091
	(0.016)	(0.474)	(0.033)	(0.516)
DEP			-0.0014	-0.0067
			(0.455)	(0.121)
DEPxCash flow			0.0051	0.0218***
			(0.356)	(0.001)
Constant	0.0688**	0.1359***	0.0752**	0.1458***
	(0.017)	(0.000)	(0.014)	(0.000)
Observations	99	108	97	105
Number of Firms	8	9	8	9
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Overall R-sq	0.49	0.40	0.49	0.49
Test of dfx			5.63	10.73

The levels of significance are: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.
P-values are in parenthesis below the coefficients. Hausman test indicated that random effect model adequately accounts for the individual-level effects in the models reported in this table.

All the four specifications include *Tobin Q* as a control variable.

Source: Author's calculation based on published company financial statements.

Column labelled (1) and (2) presents the results for the standard investment-cash flow sensitivity for financially unconstrained and constrained sub-samples, respectively. In a similar way, column labelled (3) and (4) presents the results for the model with interaction terms. Cash flow has no effect on financially constrained firms' investment under the standard investment-cash flow sensitivity approach. Cash flow, however, is the main driver of investment for financially unconstrained firms under the standard investment-cash flow sensitivity approach. Extending the model by including dependency on external capital and its interaction terms with cash flow, shows that cash flow have a direct effect on investment for financially unconstrained firms and an indirect effect for financially constrained ones.

For financially constrained firms, a positive coefficient of the interaction term implies that the effects of cash flow on investment is higher the higher the dependence on external capital. The interaction of cash flow and dependence on external capital has a positive effect and unlike in López-Gracia and Sogorb-Mira (2014), these effects are significant at 1 percent for only financially constrained firms. This indirect effects arises if subsequent debt ranks lower than earlier debt and therefore debt-holders might demand higher returns to accept any additional debt issues leading to transfer of a higher value of firm's wealth to debt-holders and thus limiting value growth of the firm. The positive effect of the interaction term does not exist for financially unconstrained firms, which implies that constrained firms face a steep internal-external capital wedge cost curve compared to their unconstrained counterparts.

The indirect effects implies that the effects of cash flow on investment is higher the higher the level of dependence of external capital for financially constrained firms while the direct effects implies that investment is higher the higher the cash flow. This points to the possibility that firm investment is limited by the

amount of cash flows. Thus, firms forego profitable investments as they rely on cash flow to undertake investment. These results show that the effect of financial constraints on investment depends on severity of financial constraints: for constrained firms the effects of cash flow are indirect while for unconstrained firms the effects is direct.

The findings of indirect effects of cash flow for constrained firms and the direct effects of cash flow for unconstrained firms provide evidence that the relationship between cash flow and investment is not linear on the degrees of financial constraints. This evidence contradicts the monotonicity of investment-cash flow sensitivity on the degree of financial constraints documented by Fazzari et al. (1988). These findings also offer insights into reconciling the findings of Kaplan and Zingales (1997) and Kaplan and Zingales (2000) that the investment can be sensitive to cash flow for financially unconstrained firms to those of Fazzari et al. (1988) and Fazzari et al. (2000) who found that investment is sensitive to cash flow for financially constrained firms.

Kaplan and Zingales (1997) and Kaplan and Zingales (2000) considered 49 low dividend payout firms studied by Fazzari et al. (1988), and therefore the firm-years they considered as financially constrained might be severely constrained firms whose effect of cash flow on investment is indirect, hence investment for such firms are not directly sensitive to cash flow. Kaplan and Zingales (1997) and Kaplan and Zingales (2000) considered only the direct effect of cash flow, this study documented evidence of the existence of indirect effect of cash flow, especially for severe constrained firms.

The indirect effects reconcile the differences between the work of Fazzari et al. (1988) and Fazzari et al. (2000) on one hand and Kaplan and Zingales (1997) and Kaplan and Zingales (2000), on the other. The approach used in this study do not rely on monotonicity in the coefficient of cash flow to determine the effect

of financial constraints, instead it relies on the interaction terms. This way, the study addresses the criticism such those by Kaplan and Zingales (1997) and the controversy in the interpretation of the results (Romer, 2012).

4.4.4 Analysis of Firm Response to Shocks under Financial Constraints

Simple Hypothesis Test of the Effect of Discontinuity in Real Exchange Rate

The discontinuity in real exchange rate if arbitrary causes unanticipated changes in resources required for exports and investment. Favourable real exchange rate shock like in 2008 offer immediate and future profitable opportunities. Immediate profitable opportunities will manifest themselves as expansion of exports as firms use existing idle capacity to increase production in the short run. Due to increase in resources required to support an expanded export level, investment might contract if firms are unable to borrow.

Future profitable opportunities, on the other hand, show up as an increase in investment rate, once firms exhaust idle capacity and also as firms invest in the long-run to meet the increased demand. Investment rate was used to examine the hypothesis of no change or a decline in investment for constrained firms and a positive change in investment for unconstrained firms. If a firm is financially constrained increase in exports might crowd out investment in the short run. Table 4.9 present a detailed analysis of investment rate, net investment, cash flow[11] and profitability across the shocks regime within financial constraint status[12].

[11]Cash flow is defined as profit after tax plus depreciation.

[12]Investment rate, net investment, cash flow and profit after tax have be scaled down using property, plant and equipment.

Table 4.9: Real Exchange Rate, Investment and Profitability

	Unconstrained		Constrained	
	Pre-shock	Post-shock	Pre-shock	Post-shock
Investment Rate	0.0867	0.1269	0.1442	0.1639
Net investment rate	0.0059	0.0525	0.0436	0.0259
Cash flow	0.4755	0.6142	0.5772	0.2437
Profit after tax	0.3946	0.5398	0.5075	-0.0966
Observations	39	34	67	81

Source: Author's calculation based on published company financial statements.

Table 4.9 reveals that investment rate for financially unconstrained firms increased significantly following the shock while it remained fairly the same for their constrained counterparts. Simple test of difference in before-the-shock and after-the-shock mean investment rate show that the increase for unconstrained firms is significantly different from zero while there are no significant differences in before-the-shock and after-the-shock mean investment rate for constrained firms. This is consistent for both measures of investment rate: gross and net investment rates. Similarly, after-the-shock cash flow and profit after tax increased for the financially unconstrained firms and declined for the financially constrained firms.

A favourable real exchange rate shock improves competitiveness of domestic firms leading to increased demand for their products. However, with these opportunities firms have to deploy additional capacity, implying more resources mainly to support higher export levels and higher levels of production. Compared to unconstrained firms, financially constrained firms are unlikely to invest in extra capacity and inventories hence they operate near or at full capacity, making it difficult to adjust, in the short-run, to favourable shocks. Capital and inventories holdings support this view. Average capital and inventories held by unconstrained firms is about four times that of constrained firms.

Under these conditions, an attempt to increase exports and/or production might lead to a fall in exports and/or production. For example, an attempt to accommodate a higher level of exports by financially constrained firms might crowd out production activities hence resulting in a fall in export in the next period. Diversion of resources from production activities to support increased export levels might cause financial difficulties especially with payment of suppliers of factors of production, which in turn affect the credit standing or rating and further constrain production. A fall in production in one export cycle can lead to a decline in exports in the next export cycle which in turn leads to a decline in production in the following export cycle.

Another possible explanation for the decline in profitability and investment for financially constrained firms are associated with the J – curve phenomena. J – curve phenomena posit that devaluation will first lead to deteriorations in trade balance followed by an improvement. If firms respond differently to real exchange rate shocks, then the mechanism behind J – curve phenomenon also applies to the behaviour of financially constrained firms. Alternatively, investment and export behaviour of financially constrained firms might explain J – curve phenomena. When capital markets are perfect, all firms will borrow to adjust to these changes. But do adjustments to these changes occur uniformly across firms? If imperfections in capital markets exist and have disproportionate effects on firms, then firms will adjust differently to shocks. Thus, the results in Table 4.9 show evidence of imperfections in the capital market.

Quasi-experiment Analysis

A relative improvement in real exchange rate, which generates export opportunities, is considered here. Kernel density and Regression discontinuity design (RDD) was used to examine firm's investment response to shocks in the

presence of financial constraints. Kernel density plots for the period before the shock is presented in Figure 4.3

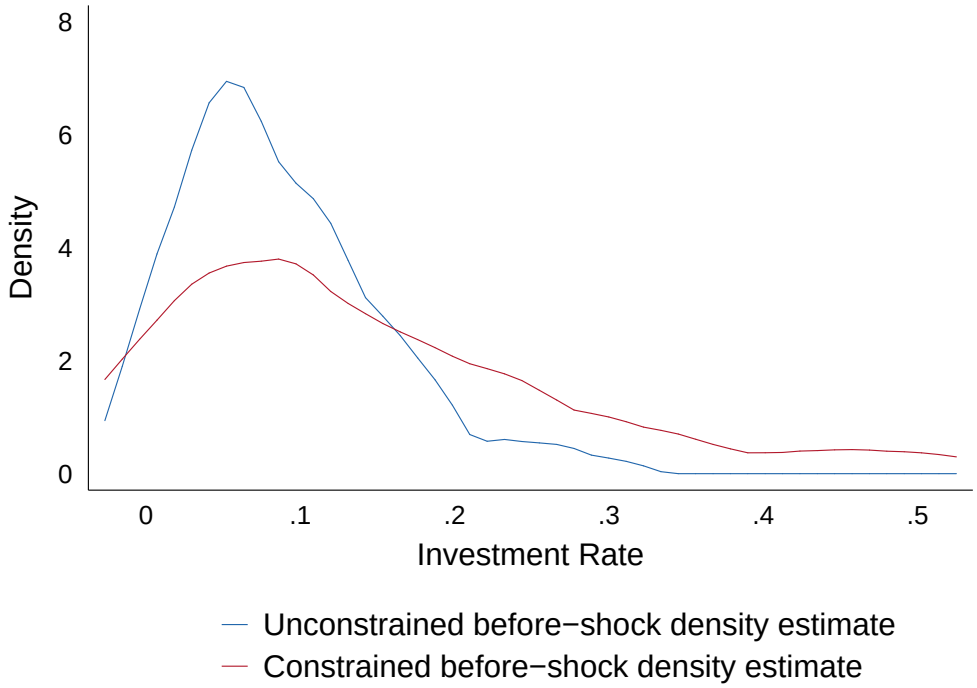


Figure 4.3: Before-the-shock Kernel Density Plot
Source: Author's calculation based on published company financial statements.

Before the shock mode investment rate for constrained and unconstrained firms was about 0.05 as shown in Figure 4.3. Kernel density plots for the period after the shock is presented in Figure 4.4

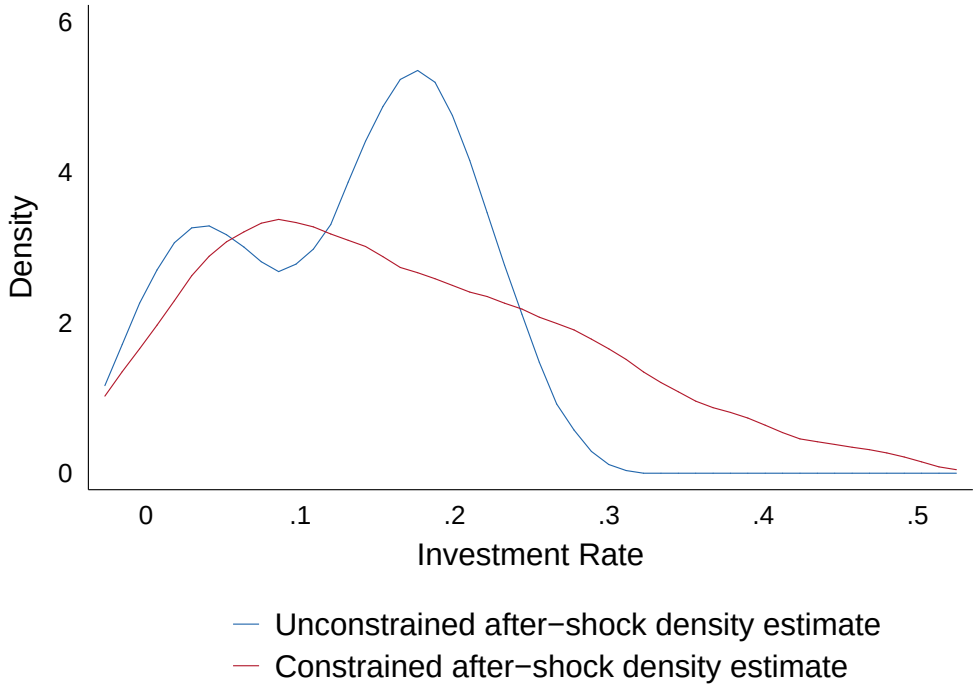


Figure 4.4: After-the-shock Kernel Density Plot
Source: Author's calculation based on published company financial statements.

The mode investment rate increased by 100 percent to 0.1 for constrained firms and 300 percent to 0.2 for unconstrained firms following the shock as shown in Figure 4.4. This implies that the effect of the shock was not uniform across financial constraints states and constrained firms might have foregone some of the profitable investment opportunities due to difficulties in access for capital. Thus, the reason for a low response of investment rate to shock. Using dummies from other years, other than 2008, did not generate changes in investment rate similar to those in Figure 4.3 and 4.4.

The RDD plot for financially unconstrained firms is presented in Figure 4.5. The time variable is centred at 2008.

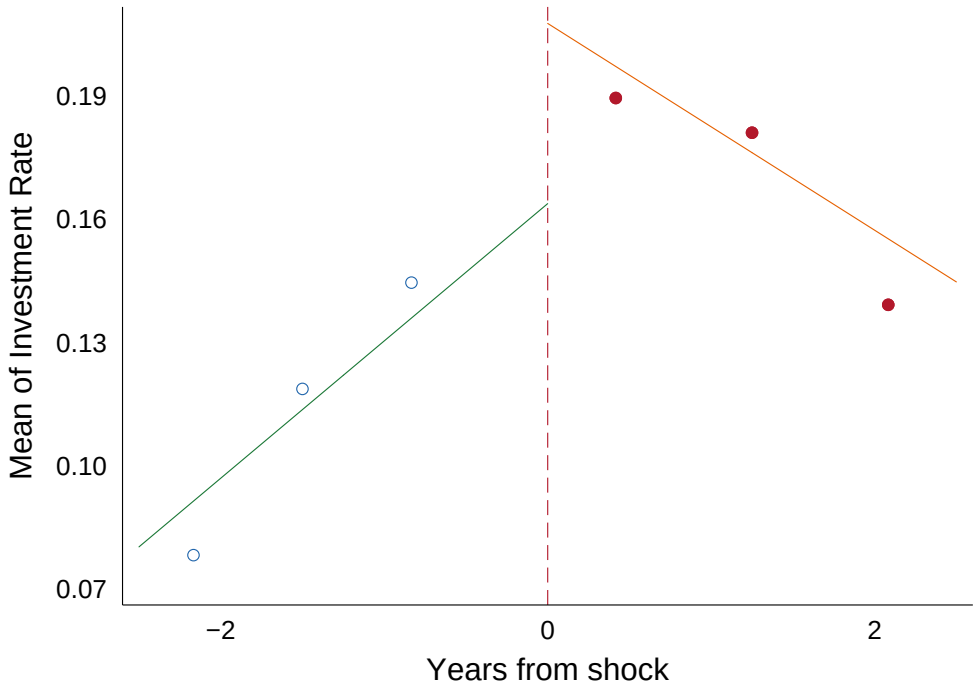


Figure 4.5: Regression Discontinuity Design for Unconstrained Firms
Source: Author's calculation based on published company financial statements.

The RDD plot for financially constrained firms is presented in Figure 4.6.

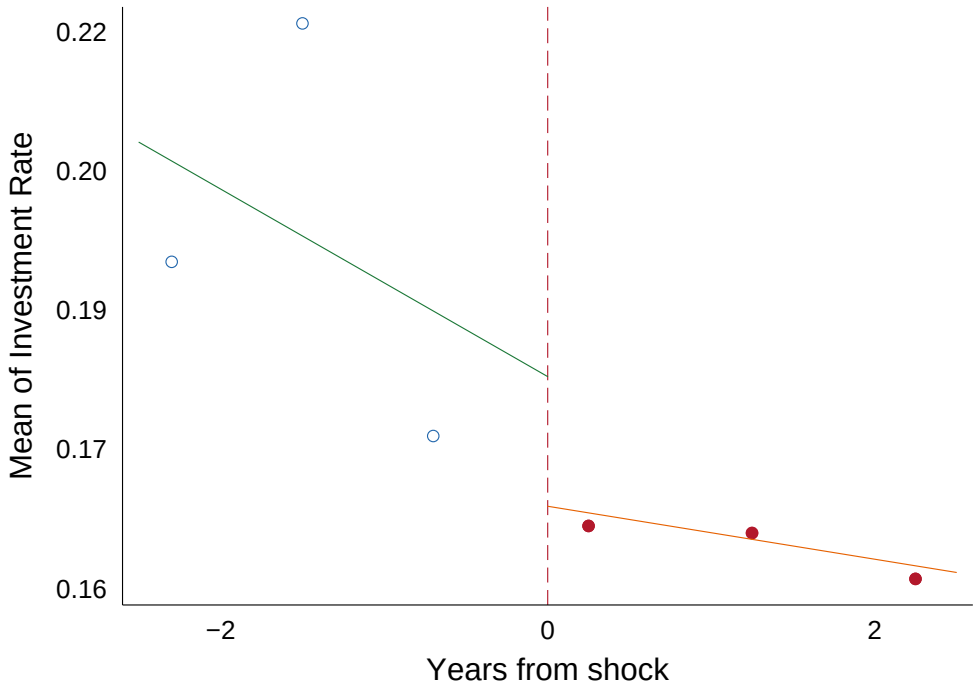


Figure 4.6: Regression Discontinuity Design for Constrained Firms
Source: Author's calculation based on published company financial statements.

Figure 4.5 shows an increase in investment rate for financially unconstrained firms. The increase in investment for the unconstrained firms is significant. On the other hand, Figure 4.6 shows a drop in investment rate for financially constrained firm's following a relative improvement on competitiveness of domestically produced products. Sharp regression discontinuity estimates put the decline in investment rate at an average of about 0.02 and the decline is not significant. The increase in investment rate prior to 2007 coincides with the economic recovery and expansion brought about by the implementation of Economic Recovery Strategy for Wealth and Employment Creation development program.

The speed of adjustment suggests that the changes in investment for financially unconstrained firms were driven by expectations while the adjustments for financially constrained firms were driven by resource constraints. In addition, the

rate of decline in investment rate differs; it is slower for financially constrained firms than for financially unconstrained firms suggesting that, in the absence of shocks, financially constrained firms build their production capacities to catch up with the financially unconstrained firms. This is likely to apply if financial constraints lead to production capacity constraints.

There are three possible explanations for the interpretation of the results. First, a relative improvement in competitiveness leads to increased demand for the firm's product by foreigners, and since exporting entails more resources, firms face a trade-off between immediate gains and long term gains. Immediate gains include utilising existing excess capacity to increase exports while long-term gains include expanding capacity through increased capital expenditures. Differences in discount rates that vary with financial constraints may cause differences in preferences. A high discount rate makes short-term or immediate gains more attractive than long-term gains.

Financially constrained firms face a higher wedge between the cost of external funds and the opportunity cost of internal funds and hence have higher marginal cost of capital which is positively related to discount rate and consequently they might prefer exporting over investment activities and vice versa for firms with lower discount rates. The focus of financially constrained firms might be in activities that are likely to alleviate financial constraints, hence short term gains are attractive to these firms. If financial constraints are binding, the trade-off between short-term and long-term gains is unavoidable and it implies exports increase at the expense of investment and vice versa.

A second explanation borrows from $J-$curve phenomena. If the sum of the absolute value of domestic and foreign price elasticities of demand is greater than one, then depreciation in exchange rate, initially causes deterioration in trade balance then followed by an improvement (Baek, Mulik & Koo, 2006; Ziramba

& Chifamba, 2014). Hence causing a J-shaped path of trade balance. In the short run the value effect (the increase in import unit price) dominates the volume effects (increase in the quantity of exports and decline in the quantity of imports) and the reverse applies in the long run. For instance, exchange rate depreciation might lead to an immediate fall in the terms of trade while the quantity demanded of imports and exports might adjust sluggishly leading to scenario where almost the same flow of trade takes place at lower terms of trade.

Financially unconstrained firms' capitals and inventories is about four times those of financially constrained firms. This point to the possibility that it might take longer for financially constrained firms to adjust their supply to take advantage of the increased demand following a real exchange rate depreciation. Thus, these firms might continue to trade the same quantity (as before the shock) at a lower terms of trade leading to a decline in export earnings and hence profitability and cash flow. Recall from the summary statistics that after-the-shock cash flow was higher by about 27 percent for unconstrained firms while it was lower by about 13 percent for constrained firms.

A decline in cash flow led to a decline in investment rate for financially constrained firms since cash flow is one of the determinants of investment for these firms. Moreover, the increase in the import unit value can have implications if a firm imports inputs or capital equipment and this is likely to be severe for financially constrained firms. Under these conditions, the path of response to an improvement in competitiveness is a drop followed by period of recovery; exhibiting a locus similar to J – curve phenomena in trade balance.

Lastly, the findings of Gertler and Gilchrist (1991) that bank lending to small firms contracts while it rises for large firms following a contractionary monetary policy might offer an explanation to the observed differences in investment behaviour. The definition of constrained firms in this study almost coincide with

small firms in Gertler and Gilchrist (1991) sample[13]. Thus, their findings might apply to this study without modification or loss of information. The focus of the banks might shift from that of lending to that of keeping their balance sheets liquid and lending to financially constrained firms might be restricted if they are perceived to be illiquid than financially unconstrained firms. Therefore, in the context of this study, the shock caused lending to unconstrained firms to be more attractive than lending to constrained firms, hence causing a shift in access to capital or finance in favour of unconstrained firms.

On the other hand, a relative improvement in real exchange rate causes financially unconstrained firms to increase investment rate. However, the jump in investment rate is likely to be followed in the subsequent period by an adjustment towards the before-the-shock investment rate. The shock was unexpected and therefore firms expected the real exchange rate to depreciate further. However, as more information is realised firms revised their investments to incorporate new information. The real exchange rate depreciation in subsequent period fell short of firms' expectations, hence investment rate was revised downwards. Thus, the fall in investment rate in subsequent years following the shock. Clearly, firm's response to a shock varies with the degree of financial constraints. The next subsection quantifies the firm's response to a shock in the presence of financial constraints.

Table 4.10 presents the results for the effects of a relative improvement in real exchange rate in the presence of financial constraints. To retain the null hypothesis of no financial constraints, $FC\,status$ takes the value of 1 for firms that are financially constrained and 0, otherwise. The value of the shock equals 1 after the shock and 0 before the shock.

[13]By definition unconstrained firms are large and old, and old firms are likely to be large, thus there is a close similarity between large and old firms considered in this study and large firms in Gertler and Gilchrist (1991) sample. This also applies for small firms.

Table 4.10: Financial Constraints, Positive Shock and Investment

Variables	(1) No Controls	(2) Controlled for Tobin Q
FC Status	0.0446*	0.0444*
	(0.057)	(0.072)
RER Shock	0.0510***	0.0419**
	(0.006)	(0.029)
FC StatusxRER Shock	-0.0488*	-0.0442*
	(0.063)	(0.096)
Constant	0.1032***	0.0868***
	(0.000)	(0.000)
Observations	221	209
Number of Firms	13	13
df/dx of FC Status	0.0191	0.0201
	(0.335)	(0.339)
df/dx of RER Shock	0.0253**	0.0183
	(0.046)	(0.170)

The levels of significance are: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.
P-values are in parenthesis below the coefficients. Hausman test indicated that random effect model adequately accounts for the individual-level effects in the models reported in this table.
Source: Author's calculation based on published company financial statements.

The coefficient of the financial constraints dummy is 0.044, implying a higher investment rate for financially constrained firms compared to unconstrained firms by about 0.044. That is, financially constrained firms investment rate was higher than that of unconstrained firms by about 0.044. The coefficient of the real exchange rate shock, RER Shock, is positive implying that the positive real exchange rate shock increased investment rate by between 4.2 percent and 5.1 percent. This effect, as shown by a negative coefficient of the interaction of financial constraints dummy and the real exchange rate shock, FC StatusxRER Shock, is less strong for financially constrained firms. That is, the increase in investment rate for financially constrained firms following the shock was lower than the increase in investment rate of financially unconstrained firms by between 0.044 and 0.049. This shows that the response of firms to

shocks depend on financial constraint status. These effects remain the same even after controlling for Tobin Q.

The marginal effects of RER Shock is 0.0253 and is significant at 5 percent level of significance. The marginal effects of RER Shock, however, fall to 0.0183 and become insignificant when Tobin Q is included. On the other hand, the marginal effects of FC Status is 0.0191 and 0.0201 for equation without and with Tobin Q, respectively, but insignificant. FC StatusxRER Shock is negative and lies between 0.044 and 0.049 and the marginal effects conditional on financial constraints status for financially constrained firms is 0.002 and is insignificant while it is 0.051 for financially unconstrained firms and is significant at 1 percent level of significant[14]. Therefore, this study conclude that investment rate for financially unconstrained firms significantly increased following the shock while it did not change for financially constrained firms.

The results of this section can be reconciled to those of Lamont (1997) who found that an adverse shock to a parent company leads to a decline in investment of the company's segment(s) not directly affected by the shock, Rauh (2006) who documented that an increase in mandatory contribution due to change in asset values of a pension fund leads to a decline in investment, and Campello et al. (2010) who showed that an adverse shock to financial system causes a decline in investment. Rauh (2006) and Campello et al. (2010) showed that financially constrained firms respond more to these shocks. However, this study documented evidence that financially unconstrained firms respond more to positive shocks.

Moreover, the findings that a relative improvement in real exchange rate has more effect on investment rate for a subset of firms than for other subset of

[14]Controlling for Tobin Q, the marginal effects become -0.002 and 0.042 for financially constrained and unconstrained firms, respectively. The former is insignificant while the latter is significant at 5 percent.

firms is similar to the work on the effect of credit conditions on firms' demand for inventories and other firm's real decisions. The results of Gertler and Gilchrist (1991) that output for small manufacturing firms decline at a faster pace than those of large firms for a period of more than two years following a contractionary monetary policy augur well for the finding of this study. Both results together with those of B. S. Bernanke, Gertler and Gilchrist (1999) show how changes in macroeconomic conditions amplify and propagate shocks in the economy through firm's real decisions and these effects vary with the difficulty in access to capital. These results can also be reconciled with those of Zulkhibri (2013) who documented evidence that the investment of bank-dependent firms and high leverage firms respond more to tightening of monetary policy.

Unique to this study is the finding that financial constraints hinder firm response to a positive shock. In this regard, the effect of policies targeted at promoting investment or production such as real exchange rate depreciation, tax incentives and improvement in business climate may fall short of desired effects if imperfection in capital market and hence financial constraints is widespread in the economy. And in the case of severe imperfections may achieve opposite effects. This finding is in sharp contrast to those documented by studies that considered negative shocks such as Rauh (2006) and Campello et al. (2010), who found that financially constrained firms respond more to a negative shock than the unconstrained ones. This study documented evidence that financially unconstrained firms respond more to a positive shock than financially constrained firms.

4.5 Conclusion and Policy Implications

This essay examined the effect of financial constraints on firm investment. This objective was implemented in three ways. First, the right-hand side variables

of investment Euler equation were interacted with proxies of financial constraint regimes. In the second approach, the variation in investment behaviour across financial constraint status were analysed using standard investment-cash flow sensitivity model augmented with full interaction of the dependence on external capital and the right hand side variables. Lastly, simple hypothesis test and quasi experiment methods (regression discontinuity design and difference in differences approach) were applied to study how firm investment response to shock is affected by financial constraint status.

Overall, the results provide evidence of imperfection in capital markets. The imperfections in capital markets documented by this study are robust in different approaches and specifications of the models. Proxies of financial constraints was found to have significant effect on investment. In addition, financial constraints affect investment. Cash flow which is thought to reduce the effects of financial constraints have positive effects on firm investment. The effects of cash flow on investment is wiped out by the effects of the interaction of cash flow and dependence on external capital, suggesting cash flow have indirect effects on investment, which implies that the effects is higher the higher the level of dependence of external capital.

This study also documented evidence that indirect effects of cash flow exists for constrained firms while only direct effects of cash flow exist for unconstrained firms. This provide evidence that the relationship between cash flow and investment is not linear on the degrees of financial constraints. Furthermore, the indirect effects implies that the effects of cash flow on investment is higher the higher the level of dependence of external capital for financially constrained firms while the direct effects implies that investment is higher the higher the cash flow. These findings imply that constrained firms face a steep internal-external capital wedge cost curve compared to their unconstrained counterparts.

Moreover, the high sensitivity of investment to cash flow show that any shocks that cash flow will affect investment. In addition, any movement in the economy that affect ability to access external capital, such as contractionary monetary policy, affects firm's real decisions in general and, in particular, investment. Since financially unconstrained firms respond more to positive shocks than an average firm in the economy, then the latter is indicative of an additional channel of monetary policy transmission; the excess response due to financial constraint status over and above the response of an average firm.

This study also documented evidence that firm's response to shock depends on financial constraint status. Investment rate for financially unconstrained firms significantly increased following the shock while it did not change for financially constrained firms. This indicates that improving the environment such as operating environment or the ease of doing business might not work if financial constraints are important. Thus, it might be necessary to address financial constraints before improving the business operating environment or ease of doing business. A conducive business environment with difficulty in access to capital might attract very little investment. Programmes aimed at improving ease of doing business and investment incentives might achieve little if the access to capital component is not incorporated in such programmes or appropriately prioritized.

This study brings to light new findings. The findings of how a firm respond to a positive shock and indirect effect of cash flow have not been documented before at least for the case of Kenya. Only negative shocks have been considered in the literature. Hitherto, cash flow is thought to only affect investment directly in the presence of financial constraints. This study, however, found that investments increased for unconstrained firms while it did not change for constrained firms following a relative improvement in real exchange rate. Thus,

to minimize the undesired effects of a policy change, policy makers should take into consideration financial constraints in designing the level of interventions.

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CHAPTER FIVE

SUMMARY, CONCLUSION AND POLICY IMPLICATIONS

5.1 Summary of the Study

This thesis examined firm capital structure and investment, and analysed the role of financial constraints in this context in Kenya. All manufacturing firms that were listed in Nairobi Securities Exchange between 1999 and 2016 were studied. The thesis is organized into essays. The first essay evaluated how well measures of financial constraints capture experienced financial constraints. Specifically, this study identified financially constrained firm-years in Kenya, evaluated how sensitive the classification generated by endogenous switching regressions is to the choice of the starting values and the specification of the outcome and selection equation, and estimated severity of financial constraints in Kenya. Endogenous switching regressions eliminates the need for ex ante sample separation.

Two measures of financial constraints – size-age combination and dividend payout – were used to sort firms into different degrees of financial constraints. The dividend payout measure was constructed from dividend payout ratio using distance from the frontier approach while under size-age starting values a firm is classified as financially unconstrained if it is old and large, otherwise it is financially constrained. The two measures were used as starting values in the endogenous switching regression. Endogenous switching regression requires specification of a selection equation and outcome equation in addition to starting values.

It was hypothesis that the endogenous switching regression model will improve on the starting values to yield efficient measure of financial constraint status. However, the final classification generated by endogenous switching regression model using the right-hand size variables of Hadlock and Pierce (2010) index, Kaplan and Zingales (1997) index and Whited and Wu (2006) index as selection equation, and investment Euler and pecking order equation[1] as outcome equations did not outperform starting values. That is, size-age and dividend payout starting values outperformed final classification values generated by endogenous switching regression in identifying financially constrained firms. This implies that there was no efficiency gain in using endogenous switching regression indices. Furthermore, this study documented evidence that the final indices generated by endogenous switching regression were sensitive to the choice of the starting values and the specification of the selection equation and outcome equation.

With a correlation coefficient between size-age measure and the measure of experienced financial constraints of 0.78, size-age is the only measure that is a good proxy of experienced financial constraints and that produce consistent sub-samples. Therefore, size and age of the firms are the main determinants of financial constraints in Kenya. The measure of experienced financial constraints puts severity of financial constraints in Kenya at 50 percent while size-age puts it at 67 percent implying that up to about two in every three firm-years listed in Nairobi Securities Exchange between 1999 and 2016 suffer some level of financial constraint.

These findings are important for three reasons. First, understanding that the final classification of items into regimes by endogenous switching regression

[1]Outcome equations have investment rate and changes in debt, respectively, as the dependent variable.

is sensitive to the choice of the starting values and the specification of the selection equation and outcome equation is important in checking the robustness of endogenous switching regression results in financial constraints literature and other areas applying endogenous switching regressions. Second, proxies that approximate the experienced financial constraints well captures the reality of firm's financial constraint status and is key in generating reliable estimates of the effects of financial constraints on firm's real decision. Third, reliable estimates mitigate against the controversy in the interpretation of the results caused by classification errors.

This study is similar in spirit to the work of Farre-Mensa and Ljungqvist (2015), however, it departs from this study by considering performance of classification of firms in an endogenous switching regression context; where the structural (for instance, investment) equations and sample separation equation is simultaneously estimated. In addition, this study may be considered as one of the first attempts to develop a criteria for identifying financially constrained firms in Kenya. Few studies, if any, have attempted to construct a criteria for identifying financially constrained firms in Kenya.

The second essay studied the effects of financial constraints on firm capital structure. This was implemented by interacting a financial constraints dummy with the right-hand side variables of pecking order test equation. This approach allows for financial constraint regimes and investigation of the effects of financial constraints on capital structure. Internal finance was found to be a major source of finance for capital expenditure for both unconstrained and constrained firms. However, the propensity to use internal funds is lower for constrained firms than for unconstrained firms. This could arise if internal funds are lower relative to capital expenditure in the case of constrained firms. Furthermore, unconstrained firms account for about 30 percent of debt issued despite holding more than half

of the tangible assets and this suggests that the decision to issue debt is driven by the value the firm will transfer to debt-holders if it decides to use debt.

Pecking order theory was rejected for all specifications considered and for both constrained and unconstrained firms. The effects of financial constraint regimes could not be rejected, even after controlling for debt capacity constraints in PoH test equation. Thus, the effects of financial constraints on capital structure decisions cannot be ruled out. The more severe financial constraints are the wider the wedge between the cost of debt and the opportunity cost of internal funds. Firms facing a wider wedge do not issue debt whenever needs for external capital arise since if they do so then they will be transferring substantial value of the firm to debt-holders. This is the main cause of the results that contradict pecking order theory. When debt capacity constraints are included, pecking order hypothesis returns hypothetically correct results. Thus, the explanation for reversal of prediction of pecking order theory lies in controlling for debt capacity constraints and allowing for financial constraint regimes.

The findings of this essay are important for two reasons. First, understanding how financial constraints affect firm's capital structure and the cost of external funds is important in shaping the interpretation of the observed investment-cash flow sensitivities. Second, the form which financial constraints takes is important in developing policies to alleviate constraints on access to external capital. This study made two key contributions. Methodologically, this study contributed in testing of pecking order theory in the presence of financial constraint regimes. An approach which interact the regime variable with the right-hand side variables of a pecking order equation was employed to test pecking order theory; a departure from earlier work such as Lemmon and Zender (2010).

Second, this study is related to emerging literature on explaining why the data contradicts pecking order theory such as Lemmon and Zender (2010) and Yang

(2014). The closest paper to this study is Lemmon and Zender (2010), however, instead of augmenting the pecking order equation with debt capacity constraints as they did, this study allowed for financial constraint regimes and relied on the marginal effects to test for the existence and the effects of financial constraints on financing behaviour.

The third essay investigated the effects of financial constraints on firm investment using three approaches. A standard Euler investment equation, Tobin Q and quasi-experiment methods were used. Investment Euler equation estimates provided evidence of existence of financial constraints in investment behaviour of listed firms in Kenya. Financially constrained firms were found to have lower than optimal investment rates. Quasi-experiment approach corroborates these findings. Furthermore, there is evidence that, depending on financial constraint status, firms respond differently to shocks. Specifically, regression discontinuity design (RDD) results show that the response of firms to shocks depend on financial constraint status.

Financially constrained firms responded to a relative improvement in competitiveness by not changing investment rate while unconstrained firms responded by significantly increasing investment rate. Unlike the response to a negative shock, the response to a positive shock for financially constrained firms is lower than that of unconstrained ones. The explanation for this behaviour lies in differences in financial constraint status. These results suggest that failure to take into consideration differences in firm's response to shocks might lead to biased results. To address this concern difference in differences approach was used.

Difference in differences approach concurs with the results of the other approaches, confirming that the results reported here were not sensitive to the approach used. Thus, this study concluded that financial constraints are

important in Kenya, they affect mostly young and small listed firms and have negative effects on corporate investment. It leads to suboptimal level of investment for financially constrained firms. Sub-optimal investment implies the sector and hence the economy does not realize its full potential, and this explains the dismal performance registered in the manufacturing sector. Between 1999 and 2016, manufacturing sector's contribution to GDP oscillated between 9.1 percent and 14 percent.

Moreover, the high sensitivity of investment to cash flow show that any shock to cash flows such as contractionary monetary policy will affect investment. This study also documented evidence of a high response by financially unconstrained firms to shocks over and above that of an average firm. This suggests that the effectiveness of policy shocks such as monetary policy shocks depends on financial constraint status. In the presence of financial constraints, the response to a positive shock was found to be zero. For instance, evidence from this study suggests that a positive shock such as real exchange rate depreciation which leads to improved competitiveness has little impact on financially constrained firms' investment.

The findings of the third essay are important for three reasons. First, widespread underinvestment in the economy leads to a lower investment at macroeconomic level, which if it persists for a longer period results in low productive capacity and hence reduces the future rate of economic growth. Second, shocks to cash flows affect investment when it (investment) depends on internally generated funds. Thus, understanding the source of fluctuation in investment is important in modelling of business fluctuations. Lastly, it highlights the importance of supply side constraints, in particular, access-to-finance dimension of business environment on firm investment. This essay contributed methodologically by showing that focusing on exogenous shocks and ignoring financial constraints

results in biased estimates of the effects of financial constraints. Second, it contributed to the literature by empirically analysing firm's investment response to shocks in the presence of financial constraints.

5.2 Conclusion

Overall, the findings of this study provide evidence of imperfection in capital markets. The imperfections in capital markets documented by this study are robust in different approaches and model specifications. There is no efficiency gain in using endogenous switching regression over dividend payout and size-age measure of financial constraints. In addition, endogenous switching regression produced sub-samples that were inconsistent across the starting values. Moreover, the final indices generated by endogenous switching regression were found to be sensitive to the choice of the starting values, and the specification of the outcome equation and the selection equation. The sample separation provided by endogenous switching regression should be starting values invariant. However, varying the starting values and holding the outcome and selection equation constant, the sample separation did not converge.

Financially constrained firms were found to be young and small compared to their unconstrained counterparts and therefore, age and size are the major determinants of financial constraints in Kenya. They are small in terms of size, assets, sales and profitability. Unlike constrained firms, unconstrained firms use less debt capital. All firms rely largely on internal finances but unconstrained firms have a higher marginal propensity to use internal funds. In addition, unconstrained firms relative to constrained firms have more cash. Although, financing behaviour varies with financial constraint status, pecking order theory was not supported even when financial constraint regimes were allowed. Controlling for debt capacity constraints and allowing for financial

constraint regimes in pecking order equation improves the model fit and aligns the findings to the prediction of pecking order theory.

Proxies of financial constraints was found to have significant effect on investment implying that financial constraints affect investment. Cash flow have positive effects on firm investment. The effects of cash flow on investment vanish when an interaction of cash flow and dependence on external capital is added into the equation but the coefficient of the interaction terms is positive and significant. This suggests cash flow has indirect effects on investment, which implies that the effects is higher the higher the level of dependence of external capital. This indirect effects of cash flow exists for constrained firms while only direct effects of cash flow exist for unconstrained firms.

This provide evidence that sensitivity of investment to cash flow is not monotonic on the degrees of financial constraints. Furthermore, the indirect effects implies that the effects of cash flow on investment is higher the higher the level of dependence of external capital for financially constrained firms while the direct effects implies that investment is higher the higher the cash flow. Thus, constrained firms relative to unconstrained firms face a steep internal-external capital wedge cost curve. Financially unconstrained firms significantly increased following the shock while it did not change for financially constrained firms. Thus, financial constraints alter firm's response to a favourable shock. Overall, financial constraints affect young and small firms causing them firms to forego external capital, underinvest, and alter their response to a positive shock.

5.3 Policy Implications

Industrialization plays an important role in economic development. Kenya has identified investment climate and the manufacturing sector as key in transforming Kenya into an industrialized country by 2030. However, when the

investment rate and the growth in the manufacturing sector are constrained by limited access to capital as documented by this study, the potential contribution of the manufacturing sector to the country's output and exports will not be realized. Financial constraints as shown in this study causes firms to forego external capital and this results in suboptimal investment at corporate level. Easing access to capital is therefore important in promoting investment and hence the growth of the manufacturing sector.

Policies geared towards reducing the financial constraints by addressing its causes such as information asymmetry will improve access to capital. Size and age determines financial constraints and thus firm's ability to raise capital from external sources. Thus, there is a possibility of sector, size and age specific impediments in access to capital. For instance, the value of tangible assets for sectors such as manufacturing and research and development are likely to be low due to sunk cost and few physical assets, respectively. Manufacturing sector due to specificity in the use of assets have high sunk cost and thus low value of tangible assets.

High value of tangible assets and the longer the analysts have been following the firm lessens the difficulties in raising capital and vice versa. Tangible assets provide collateral which in turn provide a mechanism for reducing informational problems. On the other hand, age (measured as the number of years a firm has been listed) might reduce information asymmetry. Based on the premise that the number of years a firm has been listed corresponds with the number of years a firm has been followed by analysts, then the higher the number of years the lesser the informational opaqueness.

To boost investment at firm level and, in turn, the aggregate level, reforms that reduce impediment in access to capital especially for young and small firms are necessary. These policies can be broadly classified as: policies to improve

liquidity, mechanism to reduce informational problems, policies to reduce the wedge between cost of external funds and the opportunity cost of internal funds and other policy issues.

5.3.1 Measurement of financial constraints

Evidence of sensitivity of endogenous switching regression classification to the choice of the starting values and the specification of the outcome and the regime selection equation points to the need for studies using this approach to conduct statistical tests to check the robustness of their results. This applies to financial constraints literature and other areas applying endogenous switching regressions. In addition, size-age is the only measure that is a good proxy of experienced financial constraints and that produce consistent sub-samples and therefore is recommended for use in measurement of financial constraints in Kenya.

5.3.2 Policies to Improve Liquidity

Evidence from this study shows that financial constraints are important in Kenya and affect mostly young and small listed firms. Thus, to ease financial constraints among young and small listed firms two policy interventions are suggested. First, broadening the scope of assets that can be used as collateral and protecting investors from losses arising from bankruptcy. For companies that offer trade credit to its customers, an introduction of invoice discounting or debt factoring will give access to immediate cash against book debt or accounts payable. In this case, book debt pledged as security provide relief against financial constraints. Second, providing age-based and size-based tax incentives, tax credits and tax holidays to relieve financially constrained firms from financial constraints by reducing the tax burden and hence improving liquidity. With additional cash savings firms will be able to undertake additional investments.

5.3.3 Mechanism to Reduce the Wedge between Cost of External Funds and the Opportunity Cost of Internal Funds

A key cause of financial constraints is information asymmetry, which as shown in this study increases the wedge between the cost of internal and external funds and hence the higher the wedge the more the value-transfer from firms to the providers of external finance. This is costly to the firms, who opt to limit their use of external capital in order to maximize their shareholders' wealth and not to lose it through transfer to the providers of external finance. Policies that help address informational problems include instituting policies to reduce costs associated with verification of the quality of assets, private information, and contract execution and enforcement including legal charge such as by creation of a central depository for collateral.

5.3.4 Other Policy Issues

Evidence from this study shows that a shock that creates opportunities for firms such as improving investment climate and business operating environment when financial constraints are binding is not a welfare-enhancing policy move for financially constrained firms. In the presence of financial constraints, policies intended to improve the economic environment in which firms operate, for instance, by improving demand of a company's product might attract very little investment, if financial constraints are important. Thus, it might be necessary to address financial constraints before instituting policies to boost demand of domestic products. Alternatively, improving access to capital could be incorporated as a component in programmes or policies geared towards improving investment climate and business operating environment.

Incorporating financial frictions in monetary and other macroeconomic policies in order to improve policy effectiveness, minimize policy distortions and

economic fluctuations. In the presence of financial constraints, it was found that financially unconstrained firms response to a shock by increasing investment while financially constrained firms does not respond to the same shock. The shock considered here are similar to policy shocks and therefore, applies to shocks such as monetary policy shocks. To minimize the undesired effects of a policy change, policy makers should take into consideration financial constraints in designing the level of interventions.

5.4 Limitations of the Study and Areas for Further Research

The sample used in this study had relatively small T, thus there is need to replicate the analysis in this study as new data becomes available allowing for a larger T. Larger T will allow for analysis of long run dynamics especially on firm's response to shocks in the presence of financial constraints. The Euler equation derived under conditions of no financial constraints will be violated when liquidity constraints exist (Zeldes, 1989) and thus Euler equation approach may fail to detect financial constraints if liquidity constraints is binding and approximately constant over time (Schiantarelli, 1996). Although, this is likely to be a problem with very short panels, estimates based on longer panels than used in this study might provide more robust results. The longer the time a firm is observed, the higher the probability of capturing changes in individual firms' financial condition and in macroeconomic condition. Therefore, with longer panels, the Euler equation becomes effective in detecting financial constraints, even in the presence of liquidity constraints.

Two important issues, which need further investigation, emerged from this study. First, high sensitivity of investment to cash flow and the differences in response to shocks for financially constrained firms suggest another channel of propagation of business cycles or shocks to the economy. In essence,

financial constraints dwarf or amplify the effects of shocks, especially shocks affecting corporate cash flows, in the economy. Second financial constraints have distributional consequences in the economy. Generally, if unconstrained firms undertake some, or all, investments foregone by constrained firms, then financial constraints generate distributional consequences. There is a possibility of wealth being distributed from domestic owners to foreign owners due to foreign owned companies who are largely unconstrained undertaking investment forgone by constrained firms[2].

[2]About 68 percent of unconstrained firm-years in the sample considered in this study are subsidiaries of foreign companies while about 76 percent of constrained firm-years have local ownership of over 60 percent.

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APPENDIX

A1 Sampling and Sampled firms

A1.1 Sampling

The sample of firms studied consist of all manufacturing firms, listed in Nairobi Securities Exchange between 1999 and 2016. Data for all the 13 firms in manufacturing sector that were listed in Nairobi Securities Exchange and whose published annual financial statements were available at Capital Market Authority Resource Centre were collected. Where financial statements were missing, effort were made to obtain alternate reliable sources. Data were obtained from Balance sheet, Income Statement, Cash Flows Statements and Notes to the financial statements.

A1.2 Sampled firms.

Table A1 on page 259 summarizes sampled firm-years for the 13 firms over the period 1999 to 2016.

Table A1: Sampled Firm-Years

		Before RER Shock								After RER Shock							
Firms	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Athi River Mining	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BOC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bamburi Cement	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BAT	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Carbacid	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Crown Berger	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
EA Cable	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
EA Portland	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	×
EABL	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Eveready	×	×	×	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mumias Sugar	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sameer Africa	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unga	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Sources: Author's Computation.

✓ represents years with complete records while × represents years with missing records

Seven firms had complete records available for the entire sample period with four firms having records missing for only one year. The remaining firms, East African Portland Cement and Eveready, records missing for more than one year. Eveready was listed in 2006. Records for Eveready were missing for the period 1999 to 2004.

A2 Additional results on the effects of financial constraints on firm capital structure

A2.1 Alternative approach for testing pecking order hypothesis

The test results for pecking order hypothesis shows that the prediction power of pecking order hypothesis is sensitive to financial constraints. To verify the robustness of these findings, an alternative approach was used. The results of this approach is presented in Table A2 and A3:

Table A2: Pecking Order Estimation Results - Fama and French (2002) Approach

	(1)	(2)
VARIABLES	No Regime Allowed	FC Regime Allowed
Unconstrained		94.5289
		(0.362)
Zx(Deviation from Target Lev.)		2.0857**
		(0.036)
Investment Rate	177.0575	180.8146
	(0.617)	(0.611)
Inv. Rate(-1)	-361.0696	-304.3456
	(0.305)	(0.388)
Deviation from Target Lev.	0.9823*	
	(0.085)	
Constant	29.0833	18.4699
	(0.660)	(0.793)
Observations	207	207
Number of Firms	13	13
PoH test	2.96	4.41

The level of significance are: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

P-values are in parenthesis below the coefficients. The test for pecking order hypothesis was implemented by $F - test$ and the results for this test are presented in the last row; under POH test.

Source: Author's calculation based on published company financial statements.

Table A3: Target Leverage Estimation Results

VARIABLES	(1) No Regime Allowed	(2) FC Regime Allowed
Unconstrained		16.8997
		(0.888)
Zx(Lag of Market to Book)		1.8852
		(0.626)
Lag of Earning before Interest and Tax	40.3599	16.3641
	(0.289)	(0.501)
Lag of Depreciation	95.4232	86.9111
	(0.622)	(0.641)
Lag of Log of Net Assets	31.9499	37.8703
	(0.338)	(0.354)
Lag of Market to Book	-3.0251	
	(0.490)	
Constant	-485.9501	-582.4824
	(0.305)	(0.344)
Observations	208	208
Number of Firms	13	13
PoH test	0.48	0.24

The level of significance are: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.
P-values are in parenthesis below the coefficients. The test for pecking order hypothesis was implemented by $F-test$ and the results for this test are presented in the last row; under POH test. The complex pecking order holds if the effect on market leverage of market to book value ratio is negative and the simple pecking order theory holds if the coefficient of the deviation from the target leverage is equal to zero.
Source: Author's calculation based on published company financial statements.

The simple pecking order theory was rejected even financial constraint regimes was allowed. The complex version of pecking order theory was also rejected in both cases. This confirms the findings that pecking order prediction does not for the sample of firms considered in this study.

A3 Additional results on the effects of financial constraints on firm investment

A3.1 Financial Constraints and Investment

This section presents investment Euler estimation for the basic model and an extended model consisting of the basic model and firm characteristics. Table A4 presents the results of dynamic panel with and without fixed effects.

Table A4: Investment Euler Estimation: Firm Characteristics and Investment

	(1)	(2)	(3)	(4)
Variables	No FC Regime		FC Regime Included	
Inv. Rate(-1)	0.8773***	0.7118***	0.8894***	0.6232***
	(0.000)	(0.000)	(0.000)	(0.001)
Inv. Rate(-1) Sq	-0.8599**	-0.9025**	-0.9747**	-0.7656*
	(0.030)	(0.032)	(0.015)	(0.071)
Cash flow	0.0264***	0.0322***	0.0212*	0.0230*
	(0.010)	(0.004)	(0.052)	(0.061)
Sales	0.0057***	0.0078***	0.0035*	0.0063**
	(0.001)	(0.003)	(0.079)	(0.024)
Debt Sq	0.1320***	0.1903***	0.1431***	0.1752***
	(0.009)	(0.002)	(0.005)	(0.005)
Age			-0.0191**	0.0130
			(0.029)	(0.542)
Size			-0.0047	-0.0063
			(0.466)	(0.645)
Constant	0.0068	0.0186	0.1288*	0.0662
	(0.682)	(0.352)	(0.093)	(0.685)
Observations	189	189	184	184
R-squared		0.27		0.23
Number of Firms	12	12	12	12
Year FE	NO	YES	NO	YES
Firm FE	NO	YES	NO	YES
Overall R-sq	0.42	0.40	0.41	0.32
All	131.88	12.75	120.78	6.92

The level of significance are: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

P-values are in parenthesis below the coefficients.

Source: Author's calculation based on published company financial statements.

Sargan test statistic and Hansen J statistic of over-identifying restrictions are statistically insignificant and thus the instruments are valid. The test for $AR(1)$ process in first differences rejected the null hypothesis as expected. The test for $AR(2)$ in first differences were, however, not rejected implying that there is no autocorrelation in levels. Column three and four allows for financial constraint regimes by including age and size. The significant effect of age on investment indicate the presence of financial constraint regimes. This effect, however, disappears when year effect is included since age – measured as the number of years from the year of listing to the current year – varies in the same direction with the time series variable – year.

A3.2 Effects on investment rate of $Tobin\,Q$ and dependence on external capital

Table A5 presents the results of the effects of expectations of future profits, $Tobin\,Q$, on investment rate conditional on dependence on external capital for constrained and unconstrained firms.

Table A5: External Finance Dependence, Expectations of Future Profits and Investment

	(1)	(2)	(3)	(4)
	Standard Invest-CFS		Interacted	
Variables	NFC	FC	NFC	FC
Q	0.0102**	0.0069*	0.0083*	0.0016
	(0.013)	(0.069)	(0.053)	(0.713)
DEPxQ			0.0012	0.0022**
			(0.154)	(0.023)
Dep	-0.0028	0.0029	-0.0049**	-0.0011
	(0.134)	(0.363)	(0.038)	(0.766)
Constant	0.1015***	0.1359***	0.1070***	0.1501***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	99	105	99	105
Number of Firms	8	9	8	9
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Overall R-sq	0.46	0.42	0.46	0.46
Test of dfx			5.35	0.93

The level of significance are: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.
P-values are in parenthesis below the coefficients. Hausman test indicated that random effect model adequately accounts for the individual-level effects in the models reported in this table.
Source: Author's calculation based on published company financial statements.

Column one and two presents the results for *Tobin Q*, investment regression augmented with dependence on external capital, respectively for unconstrained and constrained firms. Including the interaction term between dependence on external capital and *Tobin Q* in these two equations give the results presented in the third and the fourth column. Dependence on external capital affects investment only if firms are financially unconstrained. In a model that includes dependence on external capital and its interaction with *Tobin Q*, (column 3 and 4); the interaction term is significant at 5 percent and it eliminates the effect of Q on investment for financially constrained firms. This implies that influence of the expected future profit on investment is indirect and it acts to mitigate the effect of dependence on external capital.

By signalling future profitability, *Tobin Q*, is likely to reduce the wedge between the cost of internal and external capital hence easing access to external capital hence reducing the value firms transfer to debt-holders when they borrow. Firms, which are expected to be above average in profitability, are likely to face a narrower wedge between the cost of internal and external capital than average or below average firms in terms of future profitability. Studies on capital structure have shown that firms issue debt when profitability (and possibly future profitability) rises (see for instance: Frank & Goyal, 2008). Thus, an increase in expected future profit will result in a relative reduction in the wedge between the cost of internal and external capital, which in turn results in increased investment.

In contrast, *Tobin Q*, drive investment decisions for financially unconstrained firms. Dependence on external capital negatively affect investment for financially unconstrained firms. In addition, there is no evidence of indirect effect of expectations of future profitability for the financially unconstrained firms. Therefore, investments for financially unconstrained firms, to a large extent, are guided by the expected profitability of investment. Thus, unconstrained firms invest optimally. In contrast, the results suggest that constrained firms do not invest optimally as *Tobin Q* does not directly drive investment decisions. This relationship suggests that the wedge between the cost of internal and external capital are high for investments on the margin such that an increase in the dependence will render these investments unviable.

In summary, investment decisions for financially constrained firms are driven by how expected profitability affects the dependence on external capital. In contrast, *Tobin Q*, or the expected profitability of investment is the main determinant of investment for financially unconstrained firms. Financially constrained firms face a higher marginal cost of capital due to imperfections in capital markets and this leads to a decline in investment with the use of external capital. An increase

in expected future profitability may act as a relief for financially constrained firms.

For financially unconstrained firms, the wedge might be negligible and therefore the effect of an increase in future profitability is negligible. Thus, the difference in investment behaviour is explained by financial constraint which arises due to imperfections in capital market and whose effects vary disproportionately across firms. The results of standard investment-cash flows sensitivity approach are likely to be biased if cash flows proxies for future investment opportunities. Consequently, quasi-experiment methods which address endogeneity were also used.