

https://dspace.org/

The impact of shorter settlement period on risk and liquidity: the case of Johannesburg Stock Exchange

Marumo, Nkhahle

2017

https://hdl.handle.net/10539/26885

Marumo, Nkhahle Sylvar, (2017) The impact of shorter settlement period on risk and liquidity: the case of Johannesburg Stock Exchange, University of the Witwatersrand, Johannesburg, https://hdl.handle.net/10539/26885

Downloaded from a DSpace repository. https://dspace.org/

MMFI RESEARCH PROJECT

The impact of shorter settlement period on risk and liquidity: The case of Johannesburg Stock Exchange.

WITS BUSINESS SCHOOL
STUDENT: NKHAHLE MARUMO
STUDENT NUMBER: 1509833
RESERCH SUPERVISOR: T. MOKOTELI

10/2/2017

DECLARATION OF INDEPENDENT WORK

I HEREBY DECLARE THAT THIS REPORT CONTAINS MY OWN INDEPENDENT WORK AND THAT IS SUBMITTED FOR THE RESEARCH PROJECT FOR MASTER IN MANAGEMENT OF FINANCE AND INVESTMENTS |AT WITS BUSINESS SCHOOL.

*I CONFIRM THAT I HAVE NOT COMMITTED PLAGIARISM IN THE ACCOMPLISHMENT OF THIS WORK AND I HAVE NOT INVENTED EXPERIMENTAL DATA.

Name: NKHAHLE MARUMO Signature: 

Date: 10 NOVEMBER 2017

ACKNOWLEDGEMENTS

This research project has been quite a challenge for me and would have not been a success without the assistance and support of various people that I would like to acknowledge. First and foremost, I would like to thank my research supervisor, Professor Thabang Mokoaleli-Mokoteli for all her guidance to shape this research project. Secondly, I would like to acknowledge my supervisor at work, Mrs. 'Mamotlohi Mochebelele who served as a coach and an anonymous supervisor to ensure that this project remains on course and saw it through to completion. Last but not least, I would like to acknowledge my mother who contributed to this work in her own unique but affirmative way. Finally, I am short of words to address my son who had to sacrifice all our quality time together to ensure that this project is complete. To my family and friends and colleagues at work, your meaningful support has also been observed. I send my heartfelt appreciation to all these people; for, without them, this project would have not been what it is.

ABSTRACT

Capital markets reforms in emerging, and particularly African markets are of a growing concern. Despite various institutional reforms that began in the early 1980s, the capital markets in emerging countries still exhibit signs of illiquidity, high volatility of returns, high concentration levels and inefficiency. Ambiguous results for such reforms have brought into question the affectivity of major capital markets reforms such as change of settlement cycles, particularly in countries where stock markets are sponsored with public funds. This thesis, therefore, intends to assess the effectiveness of capital markets reforms on development of stock markets by looking at the impact of changing settlement cycle on risk and liquidity at JSE. The objective is met through an assessment of a link between institutional structures and stock micro-structural variables, especially liquidity and risk in the literature review and an assessment of past studies on effects of stock market reforms and changes of settlement cycle on liquidity, risk and efficiency of stock markets. The study then tests the effects of settlement cycle on risk by assessing changes in abnormal returns and changes of variance of returns as a result of settlement cycle change at JSE. It also looks at the impact on liquidity by assessing the effects on the illiquidity measure first proposed by Amihund and Mendelson (2002). The study finds that change of settlement cycle at JSE had positive effects of reducing risk and increasing liquidity. The study also finds that there are no effects on trading activity and concludes that changing settlement cycle impacts largely on risk and to a smaller extend liquidity.

Table of Contents

CHAPTER 1: INTRODUCTION 6
1.1 BACKGROUND 6
1.2 RESEARCH PROBLEM 8
1.3 GAP IN THE LITERATURE 9
1.4 RESEARCH OBJECTIVES 10
1.5 STRUCTURE OF THE THESIS 10
CHAPTER 2: LITERATURE REVIEW 11
2.1 Introduction 11
2.2.2 Capital markets microstructure theories 11
2.2.1 Institutional Factors 11
2.2.2 Risk as a microstructural factor 13
2.2.3 Stock market microstructure and Liquidity 15
2.3 Stock Market Reforms 24
2.4 Impact of changes in settlement cycles 27
2.5 CHAPTER SUMMARY 28
CHAPTER 3: METHODOLOGY 30
3.1 Introduction 30
3.2 Data and Data Sources 30
3.3 Research Design 31
3.3.1 Assessing impact on risk 31
3.3.1.2 Calculating JSE index returns 31
3.3.1.3 Calculating expected returns 31
3.3.1.4 Determining abnormal returns 32
3.3.1.5 Assessing changes in variance of returns of JSE 33
3.3.2 Assessing changes in liquidity of JSE 33
3.3.2.1 Measure of illiquidity 34
3.3.2.2 Trading Activity 34
CHAPTER 4: EMPIRICAL RESULTS 35
4.1 Introduction 35
4.2.1 Results for expected normal return model 35
4.2.2 Results for Cumulative Abnormal Returns and Variance Measures 37

4.3.1 Results for illiquidity measure 39
4.3.2 Results for trading activity 40
4.4 Final Assessment 42
CHAPTER 5: CONCLUSIONS 43
APPENDIX 1 50
APPENDIX 2 52
APPENDIX 3 54
APPENDIX 4 61

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

The Johannesburg Stock Exchange (JSE) changed its equity settlement cycle from trading day plus five working days (T+5) to trading day plus three working days (T+3) on July 11, 2016. The move to a shorter settlement cycle involves a complete process of receipt of payment against full delivery of the traded instrument. The settlement cycle, according to JSE, refers to the period from which the trade is booked into the broker dealer accounting (BDA) system from the broker to JSE whereby all transactions are confirmed, cleared and settled through central securities depository (Strate). The settled securities are also accounted for and maintained in the electronic register of all the approved securities within Strate.

The new settlement cycle was implemented from 2013 in three phases as discussed in the JSE training modules that were meant to sensitize all stakeholders participating in the equity markets before the effective change. Phase one began with changes of settlement regulations and automation processes of the broker dealer accounting systems. Phase two involved a process whereby JSE implemented an integrated and automated IT platform from its BDA system to the new equities clearing system. The last phase was when the change finally came into effect on July 11, 2016 as scheduled.

The shorter settlement cycle was motivated by the need to align with current global equity settlement standards, and to mitigate the risks embedded in equity trading which are all expected to improve operational efficiency and performance of JSE. In November 2012, Financial Standards Board mandated JSE to reduce its settlement time in the license renewal letter that read, "...concerns were raised by the Licensing Committee regarding the continued delay in the implementation of the T+3 settlement cycle for equities as well as the perceived lack of prioritizing the shortening of the settlement cycle. We request that the JSE do whatever is necessary to ensure the successful

completion of this project" Johannesburg Stock Exchange (2016). Besides the regulatory authorities' call for the shortening of settlement cycle, JSE is ranked amongst the top twenty global stock exchanges by market capitalization and thus needed to move towards the settlement cycles closer to that of other global stock exchanges.

In the United States of America, the Securities Exchange Commission mandated migration from T+5 to T+3 in 1995 for transferable asset classes. The Deposit Trust and Clearing Corporation of the United States has further taken an initiative to migrate to an even shorter settlement cycle of T+2 that is expected to take effect in the second quarter of 2017. Many other global stock exchanges migrated to T+2 settlement cycles in October 2014. Stock exchanges that are already on T+2 settlement cycles include London Stock Exchange, exchanges in the European Union countries, Hong Kong, Bulgaria, Japan and Canadian. Other stock exchanges that are considering a move to T+2 cited in the settlement cycle studies are Australian, Brazilian, and Mexican Stock exchanges. The change towards shorter settlement cycle in developed markets as well as other emerging markets made it imperative for JSE to move from a longer T+5 settlement cycle.

There are a number of benefits to the exchanges for shortening settlement cycles. The Deposit Trust and Clearing Corporation in the US issued a preliminary statement indicating that shorter settlement cycles reduce systematic risks such as counterparty risks and settlement risks in stock markets. Jamcharudsri and Jia (2012) also posit that shorter settlement cycles reduces margin and liquidity needs resulting in reduced counterparty and credit risks due to trades that settle quickly and enable capital to be freed up for other reinvestment purposes. The shorter settlement cycle is expected to improve liquidity and therefore return in exchanges as a result of declining risk premiums and raising trading volumes in the exchanges. In a note to its stakeholders, JSE cites the following, "A shorter settlement cycle will bring about a reduction in the

value of unsettled trades (thereby contributing to the management of systematic risk), as well as improving liquidity in the market. Increased market liquidity will assist in making South Africa more attractive to foreign investors," Johannesburg Stock Exchange (2016). The excerpt above along with other findings allure to increased performance as a result of migration to a shorter settlement cycle. There are, however, costs involved with automation of processes for all stakeholders in the equities market and the likelihood of increased failed trades as a result of shorter settlement cycles that deprive participants enough time to confirm trades and amend trades if need arises. The aim of this paper is to assess the impact of a change in settlement cycle by JSE on liquidity, risk and overall efficiency of the market.

1.2 RESEARCH PROBLEM

Emerging capital markets, particularly those in African have undergone a series of capital markets reforms. Ngugi (2001) discusses various reforms from as early as 1980s in African markets, all institutional reforms such as enactment of stock markets regulations, regulations that enhance integration of African stock markets allowing participation of foreign investors into local markets or opening local markets to permit local firms to register in global markets and improvements of electronic trading systems. Despite reforms made in emerging markets, Kumar and Tsetsekos (1999) posit that there is weak evidence of convergence of emerging stock markets to that of developed markets. Emerging stock markets continue to remain illiquid, exhibit segmented trading, and capitalization remains concentrated on few stocks.

Therefore, the results for various forms of capital markets reforms are ambiguous. Bekaert and Harvey (2002) indicate that reasons for inconclusive results from reforms are attributable to abundant different forms of barriers to investment climate in emerging markets. The barriers to investment climate vary from direct legal barriers to

indirect barriers such as investor protection rights, information asymmetry, and issues relating to good corporate governance and accounting standards. The various barriers to investment climate show that some reforms yield insignificant results because they require changes in other barriers or a series of more reforms. Therefore, there is a need to continually interrogate the affectivity of such reforms on stock micro-structural factors or assess results of the reforms on capital markets development.

1.3 GAP IN THE LITERATURE

The studies on stock market reforms in African markets largely cover effects of integration of capital markets and other regulatory reforms. There is less focus on the effects of changing electronic trading systems or settlement cycles of stock exchanges. There are two studies attempted in China and Europe that have evaluated impact of changing settlement cycle. Li et al (1997) study the impact of settlement time change on the stock exchanges in China, both Shanghai Stock exchange and Shenzhen Stock Exchange. The two exchanges changed settlement time from same day settlement to following day settlement.

In a similar study, Jamcharudsri et al (2012) study the impact of shorter settlement cycle on return and liquidity using London Stock Exchange as a case study. Although the study finds positive effects of changing settlement cycle on liquidity and risk at the LSE, it notes that shorter settlement cycles can drive up required rates of return, especially in in areas where there is limited capital. Shorter settlement cycle results in shorter time for investors to get financed, which results in higher financing costs that could drive up required rates of returns. This finding defies the stipulated purpose of shortening settlement cycles, that of lower risk premiums in trading markets. However, this factor can become can become more prevalent in African markets where there is limited capital.

The current research project, therefore, intends to fill the literature gap by studying the impact of settlement cycle reform on liquidity and risk in an African Market. Particularly, the study intends to evaluate whether settlement cycles have a positive or negative impact on African Stock Markets like the JSE.

1.4 RESEARCH OBJECTIVES

- To understand the relationship between intuitional factors such as regulatory frameworks and electronic trading systems on stock microstructural factors.
- To assess the extend at which institutional reforms have impacted on stock market micro-structural factors such as liquidity, risk and efficiency of stock markets
- To also evaluate the impact of settlement cycle reform on liquidity and risk in an African Market.

1.5 STRUCTURE OF THE THESIS

This thesis is divided into five chapters. Chapter 2 presents the literature review and assesses the literature on stock market micro-structure including the impact of capital market reforms in including settlement cycle reforms in different jurisdictions. Chapter 3 discusses the methodologies adopted to test the impact of changing settlement cycle on liquidity and risk at JSE. Chapter 4 presents the results together with analysis while the last chapter discusses the results in line with the extant literature and concludes the report.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter reviews capital market microstructure theories and effects of institutional factors on stock market microstructures in particular, the effect on liquidity, risk and market efficiency. The chapter os organized as follows: Section 2.2 discusses capital market micro-structure theories. Section 2.3 presents empirical studies and findings of capital markets reforms while the last section covers settlement cycle reforms on their effects on liquidity and risk.

2.2.2 Capital markets microstructure theories

This subsection discusses capital markets micro-structure theory. It will show the link between institutional structures and microstructure variables, particularly the variables of liquidity and risk. The two variables will also be thoroughly assessed to understand factors that drive the stock micro-structural variables and how they have been modeled over time.

2.2.1 Institutional Factors

Literature on capital markets micro-structure theories discusses the effects of exogenous institutional factors that are intended to enhance the efficiency of stock markets to enable efficient price discovery process. An efficient price discovery is one that minimizes information asymmetry and trading costs in determining market clearing prices for securities or one that security prices reflect all information available. Madhavan (1992) and Roell and Pagano (1996) advocate for more transparent trading platforms that minimize price distortion resulting from informed traders making abnormal profits at the expense of uninformed traders in the price formation process. Therefore, efficiency is the main goal for reform process or any other institutional structural changes.

In addressing efficiency or development of stock markets, Kumar and Tsetsekos (1999) establish that information related attributes and institutional infrastructure are the main qualitative factors that differentiate emerging capital markets from developed capital markets. Emerging markets do not only exhibit lower levels of economic growth, but have inadequate institutional infrastructures and information dissemination platforms conducive for efficient price discovery process; hence emerging markets exhibit some inefficiency and higher trading costs. Trading costs and inefficiency in emerging stock markets results in low activity and size of the markets compared to developed markets.

Dermiguc-Kunt and Levine (1996) shows that most institutionally developed markets (Japan, United States and United Kingdom) are liquid, less volatile and less concentrated. The study further notes that the most integrated and open markets tend to be less volatile showing that volatility might not only be driven by institutional development alone, but integration and openness of the market.

The studies cited above clearly identify liquidity and risk as microstructural factors that drive efficiency of capital markets. There is a need to enhance efficiency of African Markets, enhance their liquidity and reduce their risks which are main characteristics that segregate them from developed stock markets. The importance of liquidity in financial instruments is emphasized by Amihund and Mendelson (1991), who notes that there is a need to enhance liquidity of instruments because it lowers costs of trading and reduces the cost of capital for issuing companies.

2.2.2 Risk as a microstructural factor

In financial markets, the amount of risk of an instrument is equated to its total return. Due to uncertainty of future returns, the amount of risk of a security can be explained as variation of the expected returns derived as variance or standard deviation of historic returns of a security. Computation of the variance of historic returns for one security or a portfolio of two or three securities is more conceptual and easier to compute. However, determining the risk for a portfolio of four or more securities through a variance measure, which involves the weights of the securities in the portfolio, standard deviations of the assets and correlations of each pair of securities, becomes computationally hard and virtually impossible for a portfolio with many securities. Resultantly, risk has been observed at an aggregated level whereby total risk is equated to total return which is equal to the sum of expected return and unexpected return, Jordan, Miller and Dolvin (2012).

On the other hand, risk can be decomposed into two forms, systematic and unsystematic risk. According to Jordan, Miller and Dolvin (2012), the systematic risk principle states that the expected return of an asset depends only on systematic risk. Unsystematic risk is not rewarded because it can be eliminated through diversification at no cost. The systematic, sometimes referred to as a market risk is the average risk of the assets in the market given various conditions that affect the returns of all assets. Beta coefficient is used to measure the systematic risk of the assets, and it mainly shows the sensitivity of each security to the relative market or average security in the market. Given the beta coefficient, various scholars from Sharpe (1964), Lintner (1965) and French and Fama (1992), have developed different models to measure the total risk of securities.

Sharpe (1964) and Lintner (1965) worked on development of a classical asset pricing model (CAPM) indicating that expected returns of capital assets are linearly related to

Beta risk and returns of a risk free rate. Bhandari (1988) and later Fama and French (1992) find that risks in the stocks are multi-dimensional if priced rationally. Their studies show that the cross sections of expected returns cannot only be captured by Beta, but other accounting variables that explain firm characteristics such as size as measured by market equity, leverage as well as beta that capture the cross section of average returns of securities, or fully explain the risk of securities.

The Fama-French model, has been critiqued in that it is more data dependent because it has been derived from empirical observations without any underlying theory. Resultantly, the factors can change at different times. The example of the phenomena is seen through a plethora of variants of CAPM that have been proposed with different variables added to better explain the variation of returns. Fama and French (2015) later updated the three factor model to a five factor model whereby profitability and investment are extra variables that are observed to affect the variations of returns.

Besides the CAPM asset pricing models, there have been other models and concepts used to measure risk in the market. For instance, Rose (1976) pioneered the arbitrage pricing model while Black and Scholes (1973) developed the option pricing model. The option pricing model, just as the name suggests, is used to price the risk of options and derivative instruments which are out of the scope of the current paper. Brealey, Myers and Allen (2011) indicate that the arbitrage pricing theory assumes that each stock depends on macroeconomic factors and partly on events that are unique and particular to the company. The model also states that the expected return of a security is a function of all the factors that affect its price together with the sensitivity of security to those factors.

The theoretical models studied above indicate the measurement of risk in light with various factors that affect the returns. However, in order to evaluate the effect of changes in settlement cycle on risk, there is a need to study the variation of returns before the change and after the change. The evaluation can be met by comparing changes in unexpected or abnormal returns before the change and after the change.

Ngugi, Murinde and Green (2003) and Li, Lin and Li (1997) use different econometric models to study the changes in volatility structures of returns. The applied econometric models assist them to evaluate the changes in risk as depicted by the changes in volatility structures of returns. This models can be more applicable in assessing impact of settlement cycle change on risk as a result of its effects on volatility structure of returns.

2.2.3 Stock market microstructure and Liquidity

The relationship between liquidity and asset price returns has, for the longest time, been a subject of research in finance since Amihund and Mendelson (1986) began to question the lack of consideration of liquidity on expected returns in classical capital asset pricing models.

Amihund and Mendelson (1986) scrutinized the impact of liquidity on pricing of capital assets by examining the relationship between stock returns and bid-ask spreads. Bid-ask spreads represent the price that market makers or dealers require for providing liquidity services and immediacy of execution. Not only does the study succeed in defining liquidity as price concession for willingness to either buy or sell securities but also shows that bid-ask spreads, as a percentage of stock prices, are appropriate measures of liquidity. The study establishes that there is a positive correlation between

bid-ask spread and stock returns because they represent stock characteristics that reflect trading volumes, number of dealers making market, degree of price continuity and number of shareholders. Premiums in the bid-ask spreads are natural measures of the cost of illiquidity of stocks.

Amihund and Mendelson (1991) studied the relationship between liquidity effect and asset prices and implications for portfolio management and for policy making. The study established that liquidity effect can be related to the effect of risk on capital assets. Thus, in equilibrium, the expected returns on capital assets are increasing functions of both risk and illiquidity. The study highlights the importance of liquidity as a determinant of returns on capital assets in that, the higher the illiquidity of an asset, the higher is its trading costs and therefore the higher the return on its expected yield as compensation to investors for illiquidity costs. However, the study states that the effects of liquidity costs are more pronounced on more liquid assets because they tend to trade more frequently and transaction costs are incurred more regularly. As a result, the study finds that the expected return of stock are an increasing and concave function of the bid-ask spread. The concavity of the curve as the study discusses is brought by illiquid assets that trade less frequently and of which their transaction costs are spread over longer periods.

Subrahmanyam and Brennan (1995) investigate liquidity and asset returns using different measures of illiquidity. They classify the illiquidity cost measures in two different forms, fixed and variable costs of transacting. Their study indicates that illiquidity costs can either be brought about by adverse selection model whereby the presence of privately informed investors create illiquidity costs for uninformed investors as discussed in Glosten and Milgrom (1985). The adverse selection costs are classified as fixed costs of transaction while other illiquidity measures such as French and Fama (1992) factor costs and bid-ask-spread by Amihund and Mendelson (1991) are classified

as fixed transacting costs. Subrahmanyam and Brennan (1995) finds that there is a relation between average required rates of returns and liquidity as shown by the significance of both fixed and variable transacting cost measures. The relation between illiquidity measures brought by information asymmetry and adverse selection with asset returns is concave. However, they find that there is a convex relation between fixed costs measures and asset returns which is inconsistent with the relation proposed by Amihund and Mendelson (1991).

Further research on liquidity and cross variation of asset returns supports theory that shows the limitation of the classical asset pricing model in explaining cross sectional variation of returns and proposes revisions to the capital asset pricing model. Gottesman, Fowler and Jacoby (2000) developed a CAPM based model that takes into consideration the liquidity costs. They argue that beta and liquidity risks are inseparable, hence they derive a liquidity-adjusted CAPM based on the returns calculated after accounting for the effects of bid-ask spread. The research develops the after spread beta that is found to be non-linear in nature with the consideration of liquidity costs. Gottesman, Fowler and Jacoby (2000) further explore the relationship between the expected returns and newly derived spread adjusted beta and find that the relationship is convex in nature. Once again, the relationship is different from Amihund and Mendelson's (1991) concave relationship and agrees with the relationship found by Subrahmanyam and Brennan (1995). Gottesman, Fowler and Jacoby (2000) support their convex relationship by showing that for securities with high spreads that approach one, on a scale of zero to one, investors demand an infinite compensation in terms of expected gross returns before entering a long position in such an asset.

Acharya and Pederson (2003) also derive the liquidity adjusted CAPM model from the research that evaluates the determination of asset prices in equilibrium with liquidity risk as a one of the factors that affects asset returns. The research shows that

unexpected changes in liquidity over time also serve as additional factors that affect liquidity risk and returns. This model shows that expected returns on assets are dependent on the assets' illiquidity as well as the covariance of the assets' return and illiquidity with market return and market illiquidity. Therefore the research proposes a three liquidity factor model that shows that the returns on securities are driven by three covariance factors. The first effect is that the return increases with the covariance between the asset's illiquidity and the market illiquidity. This is because investors want to be compensated for holding a security that becomes illiquid when the market in general becomes illiquid. The second effect on expected returns is due to covariation between a security's return and the market liquidity. Investors pay a premium for an asset with a high return in times of market illiquidity. The third effect on required returns is due to covariation between a security's illiquidity and the market return. This effect stems from investors' willingness to accept a lower expected return on a security that is liquid in a down market. The model indicates the present relationship between liquidity and asset price returns. It shows the limitation on the classical capital asset pricing model and further attempts to modify the CAMP model to capture the liquidity risk that is not fully captured in beta risk.

Factors that affect liquidity have mostly been studied from the perspective of market microstructure. This section of the paper discusses both microstructure and macrostructure variables that affect liquidity of stocks as discussed in the literature. Lynch and Tan (2003) and Constantinides (1983) found that the costs on per annum liquidity premia is found to be less than the determined six to seven percent expected per annum spread on per annum liquidity spread. They investigate different liquidity drivers that are expected to bridge the gap between Constantinides (1983) theoretical findings and the empirical magnitude of the liquidity premium. They evaluate the changes in liquidity of assets given changes in labor income (wealth shocks), different settings of dividend yields and in volatile transaction costs rates when prices are predictable. The research finds that empirical liquidity premium increases under

different settings. Liquidity premium can be altered under different stochastic correlations of wealth shocks and transactions costs, showing that such factors affect the liquidity premium.

Some research has shown that in addition to other factors or under different circumstances, illiquidity itself has a large effect on liquidity premium. For instance, Huang (2002), shows that the illiquidity has a large effect when agents face liquidity shocks and borrowing constraints. The study is motivated by the discrepancy between theoretical and empirical liquidity premium that is also determined by Lynch and Tan (2003). Huang (2002), thus develops a model of an economic changes in liquidity premium when investors face surprise liquidity shocks and in either liquid or illiquid riskless assets. Huang (2002) finds that the impact of transaction costs on asset returns is fairly big when investors have constraints on borrowing against future income. According to the study, the liquidity premium of investors who face liquidity shocks depends not only on the expected holding horizon, which determines investors' average frequency of trading, but also on the surprise (and random) nature of such holding horizon. The study also establishes that randomness of holding horizons has a small effect on liquidity premium in an economy where there are no borrowing constraints, but the effects are significantly large when there are borrowing constraints.

Jones (2001) shows how liquidity can affect future liquidity by showing that bid-ask spreads and turnover can both predict future excess returns up to three years. Jones (2001) explores the changes in the US equity market trading frictions and liquidity using Dow Jones Stocks from 1900 to 2000. The study makes a number of critical findings that also show factors that drive liquidity of stocks. Jones finds evidence that measures of liquidity, either turnover or bid-ask spreads are able to predict future stock returns as he shows that high spreads predict larger returns while higher turnover is a sign of lower stock return in the future.

Jones (2001) posits that two factors affect liquidity are policy measures and cyclical changes in the economy, particularly during crisis periods. This finding is reinforced by Amihund and Mendelson (1991) who emphasize the effects of crisis on liquidity of stocks. Amihund and Mendelson (1991) study a sample of 451 stocks that are included in Standard and Poors' 500 and traded on NYSE and find that the bid-ask spreads of such stocks averaged 27.1 cents or 0.788% before the crash during the great depression on October 05 – 09, 1987. The bid-ask spreads of the stocks studied widened to 44.2 cents or 1.715% on the day of the crash. Stocks traded on London stock exchange also experienced a same phenomenon. The crisis period variable highlighted from both studies by Jones (2001) and Amihund and Mendelson (1991) addresses some macrostructure effects that drive liquidity. Chordia, Sarkar and Subrahmanyam (2005) also study the effect of monetary policy and fund flows, particularly during crisis periods to determine their effects on liquidity. The study by Chordia, Sakar and Subrahmanyam (2005) find that monetary easing during crisis periods or unanticipated changes on federal funds rate are associated with liquidity changes. The discussed studies identify two key variables that affect liquidity, policy measures and crisis events.

Microstructure studies in finance also attribute trader behavior and relative information in the markets as some of the determinants of liquidity of stocks. A study by He and Wang (1995) shows how information flow and differential information affect trading volume. He and Wang (1995) find that investors trade on information, both private and public and that nature and flow of such information affects trading volume over time. The study differentiates information in two forms, exogenous information that includes private and public announcements and endogenous information that is security clearing price information. Exogenous information is always accompanied by large price changes while endogenous or existing information does not affect price significantly (He

and Wang, 1995). He and Wang (1995) also determine that private information generates trading in the current period and also affects trading in the future period because informational trading investors expect gains from speculative risks.

Public information on the other hand affects current period trading as indicated by He and Wang (1995). Although the study shows that the nature and flow of information can affect liquidity through affecting trading, the study does not clearly evaluate the effects of information on volume of trading. However, it can be derived that the relative high frequency of private and exogenous information over public and endogenous information results in higher liquidity in the market. Glosten and Milgrom (1985) also show that the presence of information asymmetry in the markets directly affects bid-ask spreads. The study finds that the magnitudes of the spreads are determined by the patterns of liquidity traders and insiders. That is, if the market entails more informed traders, market-makers extract rents on traders through wider spreads especially in the presence of material information.

Academic literature in finance also addresses the existence of anomalies and analyst recommendation as macrostructure factors that do not directly affect liquidity but asset returns. A wide scope of literature has studied and determined the existence of anomalies which are defined as unexpected deviations from the norm exhibited by returns on specific dates. Some of the anomalies covered in literature are the weekend effect, January and December effect that are described by Schwert (2003), who also finds that the anomalies only exist for a certain period of time and fade away mostly after they have been publicized through research. Although the effects of anomalies have been observed on returns, Brusa, Liu and Schulman (2000) identify the correlation between the weekend effect anomaly and firm size. In the evaluation of existence of weekend effects as shown by abnormal returns on Monday, Brusa et al (2000) identify that mean returns turn to be negative for smaller firms and positive for larger firms

from the stocks of Down Jones Industrial Aggregate, S&P 500 and NYSE indices on Mondays. Overall, the study finds weekend effects for smaller size firms and reverse weekend effects for large firms on Mondays.

Besides the evaluated microstructure variables that drive liquidity, literature also covers a number of macrostructure variables that affect liquidity. . Wang (2003) discusses the role of institutional investor funds towards equity markets on liquidity. Wang (2003) finds that institutional investor acquisition of equity markets affects liquidity of stocks. However, institutional investors' appetite for stock markets can also be driven by increased liquidity of stock markets which suggests a bi-directional effect. The appetite for institutional investors is also driven by various institutional factors such as trading platforms and settlement cycles (see Ladekarl and Zervos (2004)).

Having moved from establishing the relationship between liquidity and asset returns, factors that affect liquidity, research in asset pricing models have moved towards developing appropriate measures of liquidity. Amihund and Mendelson (1986) proposed bid-ask spread as an appropriate measure of liquidity of stock returns in the past. In the later years, Amihund and Mendelson (2002) proposed new measure of illiquidity from daily stock data. The daily ratio of absolute stock returns to the stock dollar volume is proposed as the new measure of illiquidity. The new measure of liquidity simply shows the stock price reaction to a dollar of trading volume.

Radcliffe, Naik and Datar (1998) developed an alternative liquidity model. The researchers use turnover rate (number of shares traded as a fraction of number of shares outstanding) as a proxy for liquidity. Their study intended to check the significance of liquidity that was initiated by Amihund and Mendelson (2002) using turnover rates as a proxy for liquidity. Radcliffe, Naik and Datar (1998) argue that if

liquidity cannot be observed directly, it can be observed from the turnover rates as the proxy for liquidity. Turnover rates appear to be strongly significant under different tests such as when they control for size, book to market ratio, beta and under different conditions.

Baekaert, Harvey and Lundblad (2007) use a different liquidity measure to assess the impact of liquidity on expected returns in emerging markets. Baekaert, Harvey and Lundblad (2007) use the incidence of zero daily returns as a proxy for liquidity factor in emerging markets. Similarly, the research shows that the derived proxy is easier to compute using only time series daily equity returns data that is readily available The research shows that most academic and empirical research on liquidity and asset prices have been performed in the US market that has a wide number of traded assets, diversified ownership and multitude of investors both on the long and short term horizons. Baekaert, Harvey and Lundblad (2007) argues that the incidence of zero daily returns is more of an appropriate measure in emerging markets because of the information scarcity whereby market participants choose not to trade when the information is insufficient and outweighs the costs of transacting.

Evidence of prevalent zero returns is particularly observed in emerging equity markets, whereby all emerging markets experience an incidence of zero daily returns. The study found that Columbia experienced the highest level of zero daily returns by showing 52% incidence of zero returns on stocks of firms listed domestically while Taiwan showed the smallest incidence of zero daily returns of 6.6%. The proxy is found to be positively correlated with the bid-ask spreads in the US and also negatively correlated with turnover effects that have both been used as liquidity proxies in developed financial markets. The study also find that the zero daily returns significantly predicts the returns in emerging markets and also shows that liquidity shocks are positively correlated with returns in emerging markets.

2.3 Stock Market Reforms

In the recent past, stock markets have experienced major reforms including changes in settlement cycles, integration or openness of capital markets and changes in regulatory frameworks (Ngugi, Murinde and Green (2003), Henry (2000), Jain-Chandra (2002), De la Torre, Gozzi and Schmukler (2006) and Bekaert and Harvey (2002)). The purpose of the reforms is to improve institutional structures in emerging markets to enhance liquidity and risk of stock markets in an effort to improve their efficiency.

Ladekarl and Zervos (2004) cite financial structures referred to as "housekeeping, plumbing and size issues" as factors that appeal to global portfolio managers to send funds to emerging markets. House-keeping issues are identified as solid macroeconomic policies, economic growth of a country, legal and regulatory framework while plumbing issues are cited as custody, clearing and settlement issues and size are availability of large issues. Various regulatory and financial reforms have been enacted by emerging and African markets in an attempt to develop the state of capital markets.

Ngugi (2001) discusses the evolution of stock exchanges in Africa; showing various regulations, capital control acts, and enhancements of trading platforms. The JSE, in particular, enhanced its trading platform in 1995 moving to a fully automated trading system. Despite reforms made in emerging markets, Kumar and Tsetsekos (1999) posit that there is weak evidence of convergence of emerging market stock characteristics to that of developed markets. Therefore, the main question particular for emerging and African Markets is whether the reforms have or will in-deed heed improvements in liquidity, risk and eventually result in efficient financial markets.

Ngugi, Murinde and Green (2003) test the response of Emerging Stock Exchanges in Africa to established reforms. The study evaluates the response of African markets to three main types of reforms: revitalization of capital markets regulations, modernization of trading platforms and relaxation of foreign investor restrictions. The study uses econometric methods to compare changes in volatility and market efficiency as a result of reforms by assessing microstructural effects before and after the reforms for ten different countries. The study finds evidence of no weak form of efficiency for all African stock markets except South Africa. On the actual tests, the study finds that in the presence of high volatility, reforms in trading systems do not show significant gains while a comparative study across countries show that modernized trading systems are less inefficient. The study concludes that trading systems reforms result in efficiency gains only when the reform is paired with tight investor protection rights as in JSE. Therefore, although there are apparent effects of market reforms on liquidity and risks, the results remain unique in different countries, rendering such effects ambiguous.

Just as in Ngugi, Murinde and Green (2003), De la Torre, Gozzi and Schmukler (2006) evaluate the impact of various capital markets reforms on domestic stock market development and internationalization of domestic firms. The study posit that despite various reforms, emerging stock markets continue to remain illiquid, exhibit segmented trading, and capitalization remains concentrated on few stocks. The study, therefore, attempts to assess whether reforms result in more internationalization of domestic firms that contribute to growth of developed markets contrary to the expectation of developing domestic markets. The study uses regression analysis to assess the effect of the reforms on market capitalization over GDP and value traded during a given time period to assess effects of reforms on domestic market development. To test for internationalization, the study employs the same mechanism but testing effects of reforms on market capitalization of international firms over GDP and value traded abroad over GDP. The study finds significant evidence that the reforms result in increases in domestic stock market activity as well as evidence of increased

internationalization of domestic firms. The study, however, does not conclude on any effects of internationalization on domestic market development, rendering results inconclusive.

Other notable studies of capital markets reforms have been conducted by Henry (2000), Jain-Chandra (2002) and Kim and Singhal (2000), using various methods to study the effect of liberalization of stock market. The research by Henry (2002) evaluates changes in cumulative returns as a result of stock market liberalization reforms controlling for other reforms such as privatization and macro-economic developments. The study finds that the assessed index experiences abnormal returns indicating the positive effect of the reform on aggregate cost of capital. Still evaluating the similar reform, Jain-Chandra (2002) uses variance test ratios to measure effects on efficiency and evaluates effects on liquidity measured as turnover, volume and number of days traded. The study finds that trading volumes and turnover increases as a result of the reform just as efficiency increases. Kim and Singhal (2000) also evaluate the impact of stock market openings on volatility and efficiency of stock markets using ARCH and GARCH models to assess changes in volatility structures of returns. Unlike all the other studies discussed, Kim and Singhal (2000) finds that liberalization of stock market affects stock market returns without necessarily changing volatility of the returns. However the study, also finds that the returns become less auto-correlated which suggests gains in efficiency.

Bekaert and Harvey (2002) re-emphasize the findings that a large portion of finance related research in emerging markets has been on studies that evaluate the impact of integration of emerging markets on asset prices instead of microstructure variables. Integration in emerging market finance is attributed to structural reforms that enable free accessibility of local capital markets and the ease at which local investors can access the foreign markets. Research in emerging markets finance shows that although

integration affects market microstructure variables, the impact is ambiguous. Bekaert and Harvey (2002) indicate that reasons for inconclusive results from reforms are attributable to abundant different forms of barriers to investment climate in emerging markets. The barriers to investment climate vary from direct legal barriers to indirect barriers such as investor protection rights, information asymmetry, and issues relating to good corporate governance and accounting standards. The various barriers to investment climate show that some reforms yield insignificant results because they require changes in other barriers or a series of more reforms. Therefore, there is a need to continually interrogate the affectivity of such reforms on stock micro-stuctural factors or assess results of the reforms on capital markets development.

2.4 Impact of changes in settlement cycles

The discussion on effects of stock market reforms show that a large scope of research has focused on effects of liberalization of stock markets. Studies that have attempted to evaluate effects of trading platform reforms assessed mainly assess effects of automation of trading platforms. There have been other studies conducted in emerging market that attempt to evaluate the effects of settlement cycle changes (Li, Lin and Li (1997) and Jamcharudsri and Jia (2012)).

Li, Lin and Li (1997) study the impact of changing settlement cycles on stock exchanges in China (Shanghai Stock Exchange and Shenzhen Stock Exchange). The study adopts the econometric methods, using GARCH time series models to assess the effect of settlement cycle on volatility and volatility structure of returns for stock markets in China. The study finds that changing settlement cycle from same day settlement to T+1 decreases stock market volatility and efficiency of stock markets in China. Jamcharudsri and Jia (2012) also studies the impact of settlement cycle change on liquidity and risk of London Stock Exchange. The study evaluates the impact on risk

by adopting an event study approach that evaluates changes in variation of abnormal returns. It uses Amihund and Mendelson (2002) illiquidity measure to assess changes in liquidity before and after implementation of settlement cycle change, and assesses changes in logarithms of volume and turnover. The study finds that settlement cycle change has a positive effect on cumulative asset returns with the smallest 30% of the firms experience the highest positive effect of cumulative asset returns. However, the cumulative returns began to rise a number of days before the actual date of the settlement cycle because investors can begin to anticipate the change some time after the announcement and prior to the time the change comes into effect. Liquidity also increases after the settlement cycle change.

2.5 CHAPTER SUMMARY

The literature review above discusses the capital markets theories that draw a link between institutional factors, effects of the state of institutional factors on information asymmetry and trading costs which affect the price discovery process. The undeveloped institutions in emerging markets are characterized as main distinguishing factors from their peer stock markets in developed countries as they exhibit higher risks, illiquidity, inefficiency and underdeveloped capital markets. The research discusses both concepts of liquidity and risk, their role in capital markets discuss ways at which both stock micro-structural factors have been modeled. The discussed models will then be used in the developing the methodology for testing effect of settlement cycle change on liquidity and risk at JSE. Past studies covering the effects of reforms such as the one intended to be studied are addressed. The review establishes that most studies on the affectivity of capital markets reforms intended to improve institutional factors in emerging markets are conducted on liberalization of stock markets and little has been studied on settlement cycle, particularly in African Markets. Again, the results of such reforms are determined to be ambiguous as they are found to be different in different markets or requiring a series of reforms. This assessment renders the current study on

the impact of settlement cycle at JSE more necessary as it attempts to evaluate whether the settlement cycle change at JSE achieved the intended results of lowering risks and improving liquidity of the market.

CHAPTER 3: METHODOLOGY

3.1 Introduction

The purpose of this chapter is to present the data and models to be used to evaluate the impact of changing settlement cycle by JSE on market efficiency, liquidity and risk of the market. The chapter is organized as follows. Section 2.1 discusses data and data sources. Section 2.3 presents the research design and concludes the chapter.

3.2 Data and Data Sources

The study uses JSE all share index returns, market capitalization and volume data. The index returns are used to assess impact on risk as measured through changes in cumulative abnormal returns. Market capitalization volume data is used to evaluate the impact on liquidity as assessed by log trading volume and Amihund and Mendelsons's illiquidity measure. All the data are obtained from Bloomberg. The research period will be between July 1 2016 and 31 July 2017. The change in settlement cycle happened on the 13 July but the analysis will start a month before the change was made. Kim and Singhal (2000) and Henry (2000) allude to the challenges in recognizing the actual dates at which the market begins to integrate effects of the reforms between the announcement date and the actual effective date. Some reforms are a gradual process while others can be priced into the security sometime after announcement but before the effective date of the reform, indicating that certain changes in risk and liquidity can at times be recognized before the actual effective date. Therefore, study uses weekly data from January 1 2016 to capture the effects for a longer period before the settlement cycle change.

3.3 Research Design

The study employs event study methodology to test market reaction to change in settlement cycle on market efficiency, liquidity and risk.

3.3.1 Assessing impact on risk

The event study methodology has been used in finance studies to evaluate changes in security prices around or as a result of certain events. This study intends to find the impact of an event, in this case, settlement cycle change that came into effect on July 11, 2016 which will be taken as day 0 or the day of an event while the time before that will be taken as pre-event date and the time after is post-event date. One of the main assumptions of event studies is that the market is efficient enough to integrate all information in the prices and JSE was found by Ngugi, Murinde and Green (2003) to display evidence of weak form efficiency. Evidence of weak form of efficiency at JSE shows that prices do reflect some information; hence the event study can be conducted to evaluate the impact of risk by assessing the changes in cumulative abnormal returns following or leading up to the effective date of a change in settlement cycle.

3.3.1.2 Calculating JSE index returns

The index data from JSE come in forms of price data; hence, there is a need to convert the price to returns with the following computation.

JSE normal return = Ln $(\frac{P1}{Po})$ or $\frac{P1-P0}{Po}$

3.3.1.3 Calculating expected returns

In order to compute cumulative abnormal returns, the study develop the expected normal return model using French and Fama (1992) expected return model which requires market returns, returns of risk free rate, the difference of returns between

large and small companies by market capitalization and the difference of returns between companies with high and low price/earnings ratios. MSCI emerging markets index returns will be used as market returns while S&P 500 returns will be used as risk free rate which was also used as risk free rate in the analysis by Henry (2000) on a study on emerging markets. Weekly data from January 2014 to December 2015 will be used to estimate the normal return model, which is outside the sampling period of the study. Normal returns will be computed using the French and Fama (1992) model for expected returns as shown below.

$E(R_t) = B_o + B_1(R_{m,t} - R_{f,t}) + B_2(SML) + B_3(HML)$

$E(R_t)$ = Weekly returns of JSE index at time t

R_{ft} - Weekly returns of S&P 500 at time t.

R_{mt} - Weekly MSCI emerging market returns at time t

SML – Returns of small companies – returns of large companies by market capitalization. This variable will be obtained by weekly returns for JSE small 40 index – weekly returns of JSE top 40 index.

HML - Difference of returns between high book to market and low book to market will be computed by creating an index of all JSE companies ranked by their respective average book to market ratios and splitting them into top 40 and lowest 40 companies indices as attached in appendix 1.

3.3.1.4 Determining abnormal returns

Therefore, abnormal returns will be determined by subtracting the expected returns during the sample period from the actual index returns obtained in the sample period January 2016 to December 2016.

Abnormal returns = JSE index returns – normal returns

Weekly cumulative abnormal returns will be plotted throughout the sample period to observe how they change. Cumulative abnormal returns have to increase for the period, particularly after the settlement cycle change which will reflect declining risk and risk premiums as a result of the evaluated reform.

3.3.1.5 Assessing changes in variance of returns of JSE

To further interrogate the effects on risk, simple variance measures for returns prior and following settlement cycle are assessed. Variance is computed as simple standard deviation of returns as follows:

$$O^2 = \frac{\sum(Xt-U)}{N}$$

The expectation is for variance measures to decline following settlement cycle change which indicates declining volatility of returns

3.3.2 Assessing changes in liquidity of JSE

To assess the effects of settlement cycle change on liquidity, measures of liquidity that are used are of the levels of trading activity measured as log of trading volume adopted from the study by Jamcharudsri and Jia (2012) and illiquidity measure from Amihund and Mendelson (2002). The study compares changes in average log trading volumes and illiquidity measures before and after the settlement cycle change. The natural methods of measuring liquidity and changes in liquidity as discussed in literature are bid-ask spreads or turnover. However, due to the difficulty in obtaining firm and trading data in emerging markets, the two measures of liquidity are used. These measures utilize index returns and trading volumes that are readily available from the data sources used in the study.

3.3.2.1 Measure of illiquidity

The illiquidity measure is defined by Amihund and Mendelson (2002) as the ratio of absolute price change to trading volume on that day and signals the response of the price to the order flow. The measure is computed below.

Illiquidity Measure = $|R_t| / vold_t$

$|R_t|$ is the absolute index return at time t and $vold_t$ is the daily volume of returns at time t as well. The higher the ratio, the more illiquid the market is and lower the ratio the more less liquid the market is. Descriptive statistics of means, medians, and variance of the measures before and after the settlement cycle change will be compared to evaluate whether illiquidity increased or decreased as a result of the settlement cycle change.

3.3.2.2 Trading Activity

The measure simply describes changes in trading activity with the log function meant to smooth out large values to smaller numbers.

Trading volume = Log (trading volume for JSE index)

Similarly, the descriptive statistics of averages, means, medians and variance measures before and after the settlement cycle change will be compared to evaluate effect of settlement cycle change on trading activity.

CHAPTER 4: EMPIRICAL RESULTS

4.1 Introduction

This chapter presents results obtained from the test assessing impact of settlement cycle on risk and liquidity. The chapter presents results obtained from the measures used to assess risk, results obtained from assessment of liquidity effects and concludes with final observations of the results.

4.2.1 Results for expected normal return model

The test began with estimating the French and Fama (1992) three factor model model for expected normal returns using ordinary least square regression model. The results of the model obtained are shown in the table below.

Table 1

Dependent Variable: JSE_ALL_SHARE_INDEX
Method: Least Squares
Date: 10/01/17 Time: 21:05
Sample (adjusted): 1/10/2014 12/25/2015
Included observations: 103 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001377	0.001496	0.920612	0.3595
MRKT_EXCESS_RETURNS	0.536454	0.099910	5.369393	0.0000
SML	0.334978	0.085556	3.915324	0.0002
HML	0.860114	0.416550	2.064853	0.0416

R-Square – 0.455432

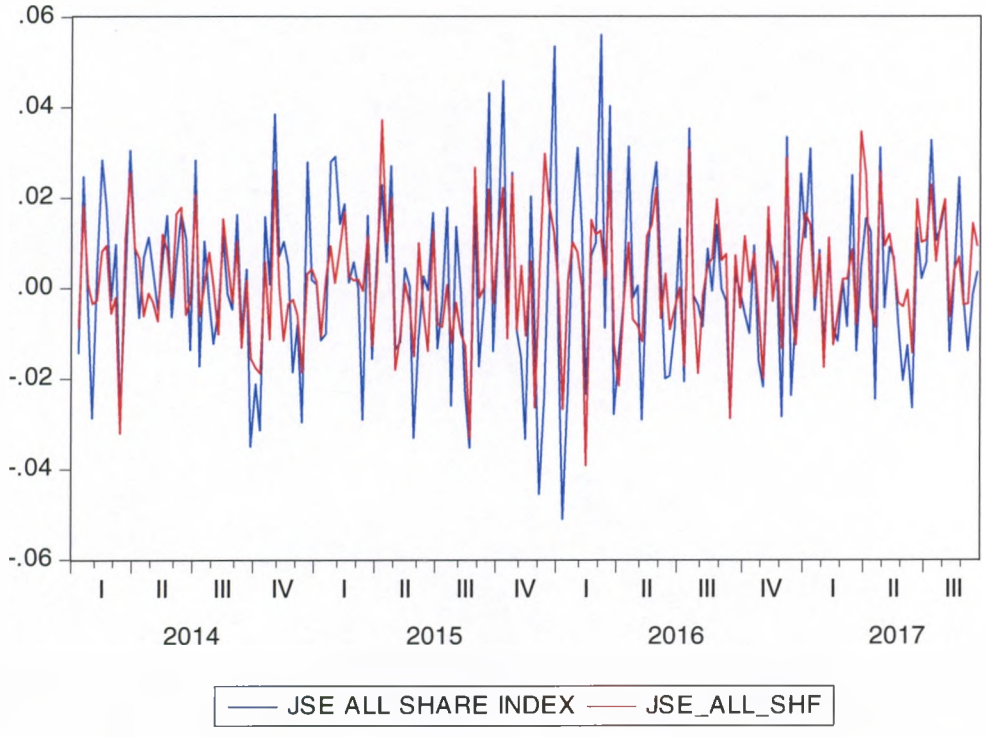
Table one above presents the results of the estimated beta coefficients of the model, the t-statistics for the beta coefficients indicating the significance of the coefficients and the R-square results showing the rigor at which the estimated model can explain the returns for the JSE all share index. The estimated model is therefore as follows:

$$E(R_t) = 0.001377 + 0.536454(R_{m,t} - R_{f,t}) + 0.334978\,(SML) + 0.860114(HML)$$

As expected from the theoretical predictions, all the coefficients are positive. The coefficients are all highly significant at 5% confidence level except for the constant that

is insignificant and close to zero. The R-square obtained for the model is 0.455432 showing that the model can explain a substantial amount of the variation of the returns of all share index. Although the model was estimated using classical linear regression model, the tests for violations of the classical linear regression model assumptions were not performed because the purpose of this study is to estimate a given theoretical model. However, figure 1 below show the goodness of fit of the estimated model compared with the actual returns of JSE for the entire period from 2014 – 2015 (model estimation period) and 2015 – 2017.

FIGURE 1

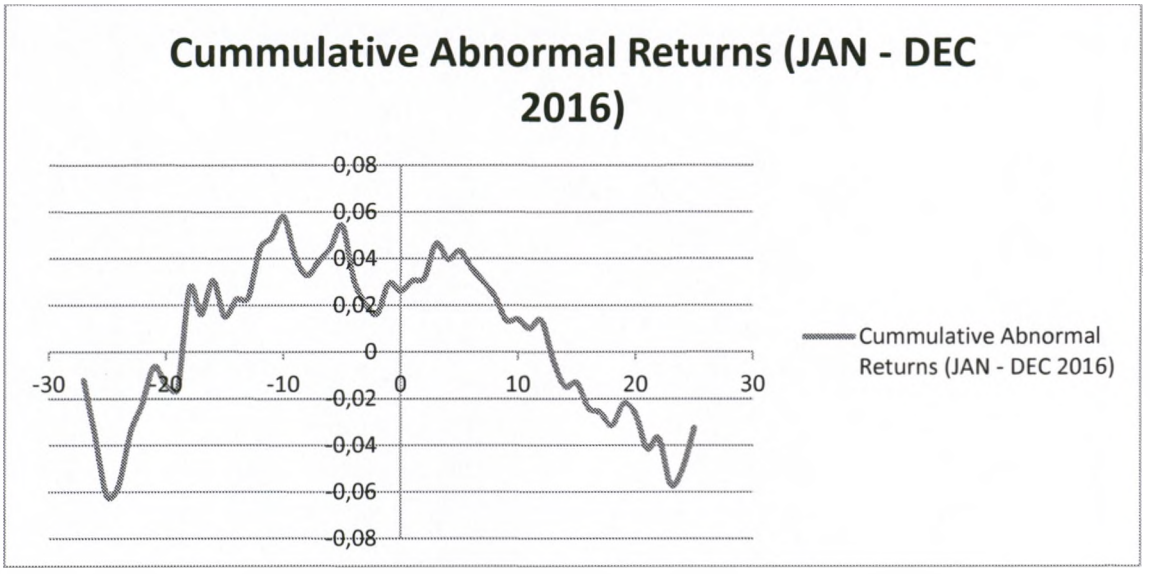


The red line indicates the forecasted values using the estimated model while the blue line shows the actual values. The estimated line moves together with the fitted line for actual values showing that the estimated model can predict the returns with high degree of precision, and therefore, is a fairly reliable model. Therefore, having computed the model for expected return, the abnormal returns were computed.

4.2.2 Results for Cumulative Abnormal Returns and Variance Measures

The graph below presents a graph of abnormal returns obtained during the sample period while the table shows the obtained variance measure before and after the settlement period. The graph plots the data of cumulative abnormal returns from January 03, 2016 which is 27 weeks before settlement cycle took effect at week 0 and ends at December 30, 2016 which is week 25 post change of settlement cycle.

Figure 2



The graph shows that cumulative abnormal returns were on a decline from December 2015 to the beginning of January 2016. The returns, however, reversed cause and were rising in 2016. South African economy was experiencing very low levels of growth and remained under the raider of credit rating agencies for a possible downgrade to junk throughout the year. Overall, risk premiums were rising which is also reflected by rising cumulative abnormal returns before settlement cycle change. The impact of a settlement cycle can be observed about two weeks before as cumulative abnormal returns ticked downwards and continued to fall after implementation of settlement cycle change to negative levels in towards the end of the year. The first round of the

downgrade were expected in May and June 2016, which South Africa avoided, but the second round of rating opinion were expected in November 2016. Despite heightened expectations of the down-grade in the second half of the year, cumulative abnormal returns continued to decline which is attributable to changing settlement cycle. Declining cumulative abnormal returns around the settlement cycle change indicates that risk premium for returns of JSE all share index were falling. The fall of returns began few weeks before the actual effective data for a change in settlement cycle which is consistent with the reaction of security prices for a market that is weak form efficient as determined by Ngugi, Murinde and Green (2003) and forecasted in the literature review. Henry (2000), as discussed in the literature, also details that the market reaction can occur sometime between the announcement date and the actual effective date or after the effective date depending on the efficiency of the market, and this is also displayed at JSE when the market begins to react 2 weeks before the change in settlement cycle.

Table 2 below shows the results obtained from variance measures of the actual returns before and after settlement cycle change. The results of variance measures also tally with the results above which show declining risks as a result of changing settlement cycle.

Table 2

JSE RETURNS 2016		
STATISTICAL MEASURE	**PRE-SETTLEMENT**	**POST SETTLEMENT**
AVERAGE	0.000245969	0.000354177
STD DEV	0.024103699	0.016766927
VARIANCE	0.000580988	0.00028113

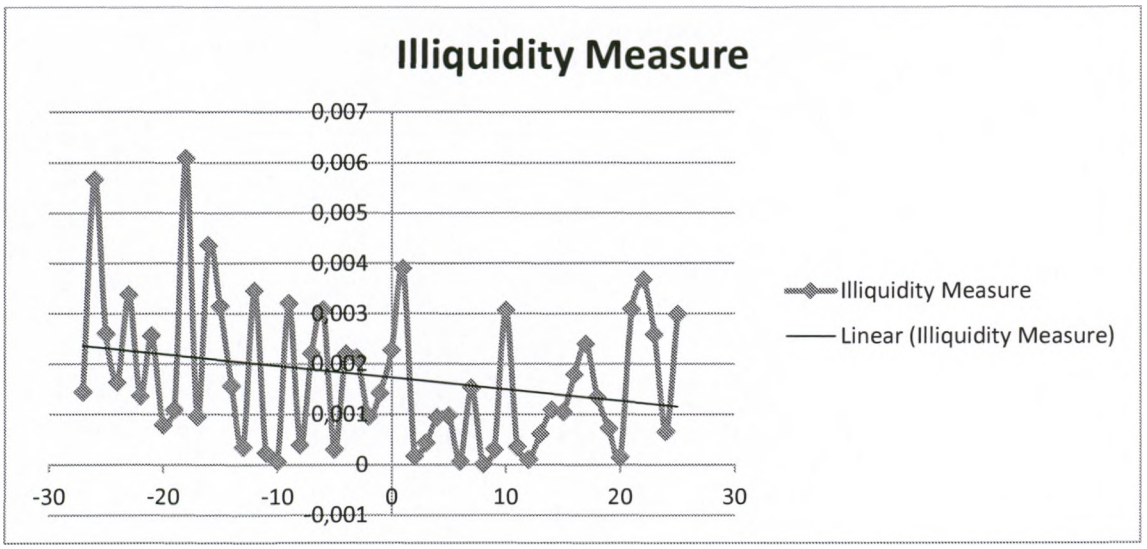
Although average return increased marginally from 0.00025 to 0.00035 the volatility of returns as shown by standard deviation of returns fell from 0.024 to 0.017 just as the

variance also declined. The fall in standard deviation also shows declining volatility which re-emphasize declining risk as a result of changing settlement cycle.

4.3.1 Results for illiquidity measure

The graph below depicts the data points of all illiquidity measures computed from January, 27 weeks before the change in settlement cycle to December which is 25 weeks after the settlement cycle change. The illiquidity measure is the absolute value of price change to trading volume and a decline in this value signals rising liquidity or falling illiquidity in the markets. Below is the graph of computed weekly illiquidity measures for the sample period.

Figure 3



The points for the illiquidity measure are fairly random but trend downwards around the time of the settlement cycle change at time 0 and after. The added trend line with negative slope coefficient shows that illiquidity is declining towards the time for the change of settlement cycle. Overall the data points after the settlement cycle change at 0 are lower than points before the change showing that illiquidity decreases or liquidity increased at JSE as a result of changing settlement cycle. The descriptive statistics of

the illiquidity measure shown in table 3 below also indicate falling illiquidity as a result of settlement cycle change.

Table 3

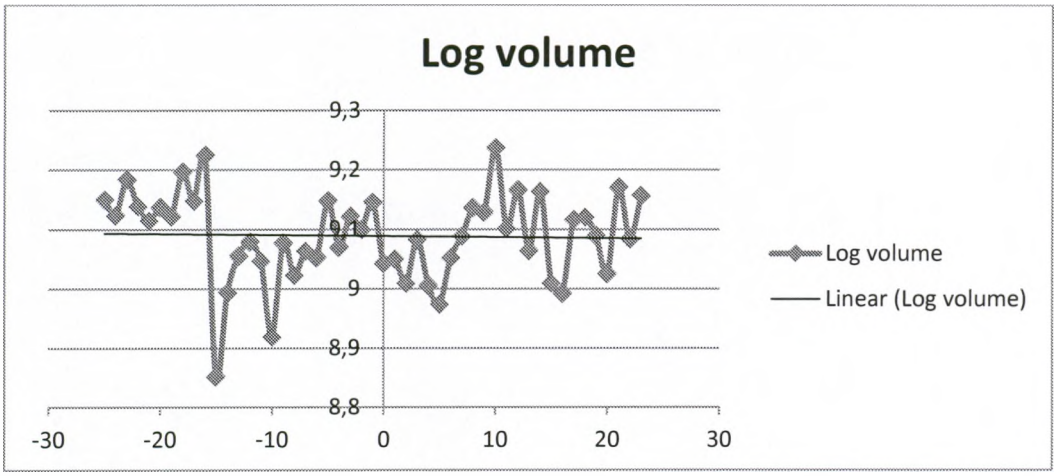
ILLIQUIDITY MEASURE		
STATISTICAL MEASURE	**PRE-SETTLEMENT**	**POST SETTLEMENT**
AVERAGE	0.002108255	0.001362476
STD DEV	0.001553356	0.001226203
VARIANCE	2.41291E-06	1.50357E-06

The table above shows that average illiquidity measure declines from 0.0021 before settlement cycle change to 0.0013 after settlement cycle change. The variation of the illiquidity measure also declines in the data after settlement cycle to 0.0012 from 0.0015 during the pre-settlement cycle period. Overall, the table shows that illiquidity is lower after the change of settlement cycle compared to before the change of settlement cycle.

4.3.2 Results for trading activity

The results for trading activity appear inconclusive. Trading activity remains fairly constant before and after the settlement cycle change as shown by the graph comparing log of trading volume before and after settlement cycle change below.

Figure 4



The graph above plots the data of log trading volume before and after settlement cycle change. The graph remains random and do not follow any consistent pattern as a result of settlement cycle change. The trend line for the data also has a slope coefficient close to zero showing that there is no significant change in trading activity as displayed by log trading volume. The descriptive statistics also remain fairly constant with contrasting changes as depicted below.

Table 4

LOG VOLUME 2016		
STATISTICAL MEASURE	**PRE-SETTLEMENT**	**POST SETTLEMENT**
AVERAGE	9.065596177	9.055965311
STD DEV	0.13646112	0.140284943
VARIANCE	0.018621637	0.019679865

Average log trading volume declines marginally from 9.07 to 9.05 as opposed to the expected increase. Variation of the log of trading volume on the other hand increases as depicted by a rise in standard deviation after settlement cycle change to 0.140 from 0.136 before settlement cycle change. Overall, the results show that there is not much change in trading activity as a result of changing settlement cycle.

4.4 Final Assessment

The results presented show that risk premium decline due to changing settlement cycle. This change can begin to occur before the effective date of the settlement cycle change as the market begins to anticipate and price in the change prior to effective date. The Illiquidity measure that is made up of a component of return or risk and trading volume also shows a declining pattern leading up to the change in settlement cycle. However, the results show that there is no significant change in trading activity either before or after the settlement cycle change. This factor shows that illiquidity measure is mainly declining due to the falling risk of the market and not necessarily due to rising liquidity in the market. Therefore, change in settlement cycle as the JSE has largely impacted on the risk of the market; however, the impact on liquidity of the market was marginal or less.

CHAPTER 5: CONCLUSIONS

This paper assesses the impact of changing settlement cycle on liquidity and risk of capital markets using JSE as a case study. JSE changed its settlement cycle on July 11, 2017 which provided an opportunity to test the effects of institutional reforms such as settlement cycle change on capital micro-structure variables such as liquidity and risk. The main purpose of the paper is to determine the effects of institutional infrastructural reforms such as regulatory frameworks and trading platforms on emerging capital markets.

The literature reviewed clearly shows a relationship between good institutional infrastructure and liquidity, risks and efficiency of stock markets. Capital markets in developing countries are more liquid, less volatile and more efficient than capital markets in emerging and frontier markets owing to developed institutional infrastructures. Therefore, African and emerging stock markets have undergone a series of capital markets reforms such as changing regulations to open up markets, or creation investor protections and improvements of trading platforms which have had positive effects but with results as assessed in the review of literature

The analyzed empirical studies of the effects of reforms, from Ngugi, Murinde and Green (2003), Henry (2000), Jain-Chandra (2002), and many others show that the capital markets reforms have had positive effects on liquidity, risk and sometimes efficiency of emerging capital markets. Similarly, other studies by Li et all (1997) and Jamcharudsri and Jia (2012) also determine that changing settlement cycles positively affects returns and liquidity of capital markets.

The evaluation of the effects of changing settlement cycle on risk and liquidity at JSE also yields the expected results. The study finds that cumulative abnormal returns fall following the change in settlement cycle which shows risk premiums of returns despite other factors that came into effect in South Africa during the sampling period. The study also determines that changing settlement cycle reduces illiquidity of stock markets as determined through Amihund and Mendelson's measure of illiquidity. However, the effects of changing settlement cycle on trading activity are barely recognized in the study. Therefore, in line with literature evaluated, the study concludes that settlement cycle reform like other capital markets reform affects liquidity and risk positively at JSE.

Despite the thoroughness of the study, especially in assessing the abnormal returns, the model used does not control for other factors that can come into effect during the sampling period. For example, the economy in South Africa remained on a negative trajectory throughout 2016 due to low levels of growth and a possibility of the downgrade which coincides with the sampling period of the study. The study does not attempt to control for other factors due to the shorter available data following the settlement cycle change. Better results of the study can be obtained in the future if the same study can replicated with longer term horizon with the analysis comparing monthly data for two to three years before settlement cycle change and two to three years after settlement period. The longer term data can be used to control for other transitory factors that are prevalent in the current study, although they do not necessarily outweigh the effects of the phenomena under assessment.

Finally, JSE like other semi developed emerging capital markets has been determined to exhibit weak form of efficiency. Results obtained from such markets cannot be applicable in all African markets that do not exhibit signs of any form of efficiency. Although, it can be inferred that institutional reforms can have a positive effects on

such markets, studies like this one have to be conducted in such markets to thoroughly determine effects of settlement cycle changes or other capital markets reform on liquidity and risk in other markets with separate and unique features from JSE.

REFERENCES

Acharya, V. V., & Pedersen, L. H. (2003). *Asset Pricing with Liquidity Risk.* New York: New York University Leonard Stern School Of Business.

Admati, A. R., & Pfleiderer, P. (Spring 1988). A Theory of Intraday Patterns: Volume and Price Variability. *The Review of Financial Studies, Vol. 1, No. 1*, 3-40.

Allen, F. (2001, Aug). Do Financial Institutions Matter. *The Journal of Finance, LVI*(4), 1165-1175.

Allen, F., & Gale, D. (2000, Jan). Bubbles and Crises. *The Economic Journal, 110*(460), 236-255.

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

Amihud, Y. (August 2000). *ILLIQUIDITY AND STOCK RETURNS: Cross-Section and Time Series Effects.* New York: Stern School of Busines, New York University.

Amihud, Y., & Mendelson, H. (1991). Liquidity, Asset Prices and Financial Policy. *Financial Analysts Journal, Nov-Dec*, 56-66.

Amihud, Y., Lauterbach, B., & Mendelson Haim. (2002). *The Value of Trading Consolidation: Evidence from the Exercise of Warrants.* New York: Stern School of Business, New York University.

Atherfold, C. (2016, June 7). *Johannesburg Stock Exchange.* Retrieved June 26, 2016, from Johannesburg Stock Exchange Web site: www.jse.co.za/articles/settlement-cycle

Banz, R. W. (1981). The Relationship Between Return and Market Value for Common Stocks. *The Journal of Financeial Economics, 9*, 3-18.

Bekaert, G., & Harvey, C. R. (2002). *Research in emerging markets finance: looking to the future.* Cambridge: National Bureau of Economic Research.

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

Black, F. (1972, July). Capital Market Equilibrium with Restricted Borrowing. *The Journal of Business, 45*(3), 444-455.

Brennan, M. j., Chordia, T., & Subrahmanyam, A. (1998). Alternative factor specifications, security characteristics, and the cross-section of expected stock returns. *Journal of Financial Economics, 49*, 345-373.

Brusa, J., Liu, P., & Schulman, G. (2000). The Weekend Effectt, 'Reverse' Weekend Effect, and Firm Size. *Journal of Business Finance & Accounting*, 555-574.

Chen, L., Lesmond, D. A., & Wei, J. (2007, Feb). Corporate Yield Spreads and Bond Liquidity. *The Journal of Finance, LXII*(1), 119-149.

Chordia, T., Sarkar, A., & Subrahmanyam, A. (2005). An Empirical Analysis of Stock and Bond Market Liquidity. *The Review of Financial Studies, 18*(1), 85-129.

Constantinides, G. M. (1983, May). Capital Market Equilibrium with Personal Tax. *Econometrica, 51*(3), 611-636.

Datar, V. T., Naik, N. Y., & Radcliffe, R. (1998). Liquidity and stock returns: An alternative test. *Journal of Financial Markets, 1*, 203-219.

Easley, D., & O'Hara, M. (1987). Price, Trade Size, and Information in Securities Markets. *Journal of Financial Economics, 19*, 69-90.

Fama, E. F., & French, K. R. (1992, Jun). The Cross-Section of Expected Stock Returns. *The Journal of Finance, 47*(2), 427-465.

Glosten, L. R., & Milgrom, P. R. (1985). Bid,Ask and Transaction Prices in a Specialist Market with Heterogeneously Informed Traders. *Journal of Financial Economics, 14*, 71-100.

Greene, J., & Smart, S. (1999). Liquidity Provision and Noise Trading: Evidence from the "Investment Dartboard" Column. *The Journal of Finance*, 1885-1899.

Harris, M., & Raviv, A. (1993). Differences of Opinion Make a Horse Race. *Review of Financial Studies, 6*(3), 473-506.

Hasbruck, J., & Seppi, D. J. (1998). *Common Factors in Prices, Order Flows and Liquidity.* Stern School of Business New York University and Carnegie Mellon University, New York and Pittsburg.

He, H., & Wang, J. (1995). Differential Information and Dynamic Behavior of Stock Trading Volume. *Review of Financial Studies, 8*(4), 919-972.

Henry, P. B. (2000, April). Stock Market Liberalization, Economic Reform, and Emerging Market Equity Prices. *The Journal of Finance*, 529-564.

HSBC. (2014). *T+2 EU Industry wide Shortened settlement cyclefor securities.* Public: HSBC.

Huang, M. (2003). Liquidity shocks and equilibrium liquidity premia. *Journal of Economic Theory, 109*, 104-129.

Jacoby, G., Fowler, D. J., & Gottesman, A. A. (2000). The capital asset pricing model and the liquidity effect: A theoretical approach. *Journal of Financial Markets, 3*, 69-81.

Jain-Chandra, S. (2002). *The Impact of Stock Market Liberalization on Liquidity and Efficiency in Emerging Stock Markets.* New York: Department of Economics, Columbia University.

Jamcharudsri, P., & Jia, Z. (2012). *Shorter Settlement Cycle, Return and Liquidity: A Test Using London Stock Exchange Data.* Stockholm: Stockholm School of Economics.

Johannesburg Stock Exchange. (2014). *Integrated Annual Report for the Year Ended 31 December 2013.* Johannesburg: Johannesburg Stock Exchange.

Johannesburg Stock Exchange. (2016, February). *Johannesburg Stock Exchange.* Retrieved June 19, 2016, from Johannesburg Stock Exchange Web site: www.jse.co.za/services/post-trade-services/t3settlement

Jones, C. M. (2002). *A Century of Stock Market Liquidity and Trading Costs.* Columbia University, Graduate School of Business, New York.

Jordan, B. D., Miller, T. W., & Dolvin, S. D. (2012). *Fundamentals of Investments: Valuation and Management.* New York: McGraw-Hill/Irwin.

Kim, H. E., & Singal, V. (2000). Stock Market Openings. *Journal of Business, 73*(1), 25 - 66.

Kothari, S. P., Shanken, J., & Sloan, R. G. (1995, Mar). Another Look at the Cross-Section of Expected Stock Returns. *The Journal of Finance, 50*(1), 185-224.

Kyle , A. S. (1985, Nov). Continuous Auctions and Insider Trading. *Econometrica, 53*(6), 1315-1335.

Lesmond, D. A. (2002). *Liquidity of Emerging Markets.* A.B. Freeman School of Business. New Orleans: Tulane University.

Levine, R., & Demirguc-Kunt, A. (1996). Stock Market Development and Financial Intermediaties: Stylized Facts. *The World Bank Economic Review*, 291-321.

Li, D., Lin, S.-K., & Lu, C. (1997). The impact of settlement time on the volatility of stock Markets. *Applied Financial Economics*, 689-694.

Lintner, J. (1965, Feb). The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets. *The Review of Economics and Statistics, 47*(1), 13-37.

Lynch, A. W., & Tan, S. (2011, Aug). Explaining the Magnitude of Liquidity Premia: The Roles of Return Predictability, Wealth,Shocks, and State-Dependent Transaction Costs. *The Journal of Finance, LXVI*(4), 1329-1368.

Marshall, J. (2003). Time for a settlment. *Euromoney*, 46.

Ngugi, R. W., Murinde, V., & Green, C. J. (2003). How Have the Emerging Stock Exchanges in Africa Responded to Market Reforms? *Jounal of African Business*, 89-127.

PricewaterhouseCoopers LLP (PwC). (n.d.). *Sifma.* Retrieved June 22, 2016, from Sifma web site: www.sifma.org/issues/operations-and-technology/shortened-settlement-cycle/overview

Roell, A., & Pagano, M. (1996, June). Transparency and Liquidity: A Comparision of Auction and Dealer Markets with Informed Trading. *The Journal of Finance*, 579 - 611.

Schmukler, S. L., & Levine, R. (2006). Intrnationalization and Stock Market Liquidity. *Review of Finance*, 153-187.

Schmukler, S. L., De la Torre, A., & Gozzi, J. C. (2006, November 2006). *Stcok Market Development under Globalization: Whither the Gains from Reforms?* Retrieved August 19, 2017, from The World Bank: Office of the Chief Economist Latin America & th Carribbean: http://www.worldbank.org\laccapitalmarkets

Schwert, W. G. (2003). Anomalies and Market. In G. M. Constantinides, M. Harris, & R. Stulz, *Handbook of the Economics of Finance* (pp. 937-972). Chicago: North Holland.

Sharpe, W. F. (1964, Sept). A Theory of Market Equilibrium under Conditions of Risk. *The Journal of Finance, 19*(3), 425-442.

Subrahmanyam, A., & Brennan, M. J. (1996). Market microstructure and asset pricing: On the compensation for illiquidity in stock returns. *Journal of Financial Economics, 41*, 441-464.

The Boston Consulting Group. (2012). *Cost benefit analysis of shortening the settlement cycle.* Boston: The Depository Trust and Clearing Corporation.

Tsetsekos, G. P., & Kumar, P. C. (1999). The differentiation of 'Emerging' Equity Markets. *Applied Financial Economics*, 443-453.

Wang, A. W. (2003). *Institutional Equity Flows, Liquidity Risk and Asset Pricing.* The Anderson Graduate School of Management, Department of Finance. Los Angeles: University of California.

Zervos, S., & Ladekarl, J. (2004). Housekeeping and plumbing: The investibility of emerging markets. *Researcg Working Papers*, 1-32.

APPENDIX 1

JSE List of top 40 companies by Price/Earnings Ratio

COMPANY TICKER	P/E Ratio over 2 years 2014 - 2016
CSB SJ	17.69047962
OCE SJ	17.93200573
DSY SJ	18.00028025
REM SJ	18.28149299
PPC SJ	18.29620892
AVI SJ	18.47426624
BTI SJ	18.47490318
CPI SJ	18.51245987
RMI SJ	18.8261
CLH SJ	19.05761847
AIP SJ	19.38939682
CVH SJ	20.23488408
NTC SJ	20.32352739
SPP SJ	20.56620318
SUR SJ	20.59479618
SHP SJ	21.37331146
LHC SJ	21.69149427
DST SJ	22.3441172
MRP SJ	22.37599045
PSG SJ	22.76892484
PFG SJ	23.3079879
CLS SJ	23.37749618
EOH SJ	24.11295924
SGL SJ	24.19712357
ADH SJ	24.34017962
MSM SJ	24.45092548
FBR SJ	24.48069236
AFX SJ	26.82730446
ZED SJ	27.76462293
TDH SJ	27.91686051
RFG SJ	27.94385705
ASC SJ	30.84515541
APN SJ	32.60251083
PIK SJ	33.99137643
NIV SJ	45.38992675
NPN SJ	80.21593567
COH SJ	168.4554439

HDC SJ	341.5062089
ATT SJ	376.1618338
IMP SJ	387.9514675

APPENDIX 2

JSE List of lowest 40 companies by Price/Earnings Ratio

COMPANY TICKER	P/E Ratio over 2 years 2014 - 2016
FFA SJ	4.783672611
TTO SJ	7.6265
LEW SJ	7.642727389
AEL SJ	7.64378535
MUR SJ	8.052310828
LBH SJ	8.531371338
IPF SJ	9.001054777
SOL SJ	9.031714013
HYP SJ	9.313712739
ITU SJ	9.613680255
RBX SJ	9.824065605
VKE SJ	10.07781923
PGR SJ	10.27922866
BGA SJ	10.27925096
NED SJ	10.32710637
REB SJ	10.37379682
BAW SJ	10.63598599
EXX SJ	10.96182548
WBO SJ	10.99826815
SAC SJ	11.09368408
ARI SJ	11.15005541
IPL SJ	11.23056306
RLO SJ	11.25099873
SBK SJ	11.6487
OCT SJ	11.65688854
HSP SJ	11.65928025
RMH SJ	12.26569873
TKG SJ	12.30336051
CLR SJ	12.30667325
IVT SJ	12.39415096
FSR SJ	12.75248854
ACT SJ	12.80572994
RDF SJ	12.83427516
MPT SJ	12.92454076
RES SJ	12.92830573
MTA SJ	13.01913822
INL SJ	13.01975669

SPG SJ	13.05829618
ARL SJ	13.14581019
TCP SJ	13.21617006

APPENDIX 3

Data for Estimating Abnormal Returns

DATE	JSE ALL SHARE INDEX	MRKT Excess Returns	SML	HML	Model Results
1/3/2014	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	NA
1/10/2014	-0.014239249	-0.009380758	-0.01752947	0.001004	-0.008664
1/17/2014	0.024759074	0.015228366	0.016644902	0.003606	0.018224
1/24/2014	-0.004579239	0.000866045	0.00041308	-0.00141	0.000767
1/31/2014	-0.028626318	-0.011044045	0.000571469	0.001175	-0.003346
2/7/2014	0.004623317	-0.005912379	-0.00586805	0.001335	-0.002612
2/14/2014	0.02840667	0.002650538	0.016819837	-0.00026	0.00821
2/21/2014	0.017660782	0.007072857	0.012585816	0.000128	0.009497
2/28/2014	-0.002598824	-0.010753895	-0.00153786	-0.00073	-0.005539
3/7/2014	0.009673789	-0.001849019	-0.00088511	-0.00251	-0.002074
3/14/2014	-0.028760471	-0.027729262	-0.03078379	-0.00951	-0.031992
3/21/2014	0.002065612	0.019531229	0.000591145	-0.00081	0.011356
3/28/2014	0.030570047	0.0200444	0.022804835	0.006728	0.025556
4/4/2014	0.008715204	0.012772017	0.003050063	-0.00041	0.008898
4/11/2014	-0.00652233	0.014105004	-0.0085287	0.000675	0.006667
4/18/2014	0.006866405	-0.00973243	-0.00483784	-0.00074	-0.006098
4/25/2014	0.011345219	-0.006611542	0.002828968	0.000165	-0.00108
5/2/2014	0.003685477	-0.005495345	-0.00320463	-0.00053	-0.003103
5/9/2014	-0.004862586	-0.00263978	-0.02041998	-0.00044	-0.007259
5/16/2014	0.00629078	0.022393449	-0.00083057	-0.00127	0.012021
5/23/2014	0.016129449	0.005832745	0.021218651	-0.00352	0.008585
5/30/2014	-0.006405861	0.000713753	-0.0104443	-0.00032	-0.002011
6/6/2014	0.006070393	0.014346855	0.013703027	0.003339	0.016536
6/13/2014	0.016616337	0.013037426	0.023008801	0.002215	0.017984
6/20/2014	0.011011016	-0.006532391	0.006113862	-0.00662	-0.005776
6/27/2014	-0.013586589	-0.003377531	-0.01355999	0.002666	-0.002684
7/4/2014	0.028338756	0.022267803	0.028205454	-0.00229	0.020804
7/11/2014	-0.017262764	-	-0.01876495	0.000477	-0.006078

		0.002943754			
7/18/2014	0.010432098	-0.001827261	0.007307663	-0.0025	0.000692
7/25/2014	-0.002802589	0.003980694	-0.00344688	0.006581	0.008018
8/1/2014	-0.012267467	0.003224495	-0.01957306	0.004178	0.000144
8/8/2014	-0.004867259	-0.01679805	0.003631045	-0.00436	-0.010172
8/15/2014	0.011599972	0.019156897	0.002916227	0.003271	0.015444
8/22/2014	-0.001181481	0.011029408	-0.0095572	0.002425	0.006178
8/29/2014	-0.00465143	-1.98969E-05	-0.01362427	0.000149	-0.00307
9/5/2014	0.016295054	0.011131574	0.00600612	0.001105	0.010311
9/12/2014	-0.010459476	-0.00886486	-0.01147731	-0.00685	-0.013115
9/19/2014	0.004189651	-0.003066993	0.01463054	-0.00338	0.001729
9/26/2014	-0.034953273	-0.015184895	-0.02349437	-0.00102	-0.015513
10/3/2014	-0.021151289	-0.016846854	-0.02431977	-0.0021	-0.017614
10/10/2014	-0.031286776	-0.020705337	-0.0260475	-0.00042	-0.018816
10/17/2014	0.015808337	-0.009737682	0.02432241	0.001775	0.005828
10/24/2014	0.000893875	-0.011346491	-0.0183724	-0.00047	-0.01127
10/31/2014	0.038501487	0.033976742	0.010996051	0.003368	0.026184
11/7/2014	0.007170944	-0.012644951	0.026398268	-0.00325	0.000645
11/14/2014	0.010355148	-0.008914827	-0.01869731	-0.00222	-0.011577
11/21/2014	0.005080634	0.000352924	-0.00855972	-0.00264	-0.003569
11/28/2014	-0.018557041	0.007674692	-0.01158995	-0.00478	-0.002502
12/5/2014	-0.008109976	-0.001011624	-0.01625092	-0.00157	-0.005961
12/12/2014	-0.029559701	-0.023533858	-0.0065233	-0.006	-0.018594
12/19/2014	0.027964837	0.000513442	0.007375234	-0.00108	0.003192
12/26/2014	0.001860015	0.004319562	-0.00071778	0.000943	0.004264
1/2/2015	0.000806612	0.011344649	-0.00877588	-0.0036	0.001428
1/9/2015	-0.011470061	-0.00622402	-0.02053866	-0.00213	-0.010673
1/16/2015	-0.010056077	0.00500754	-0.00924883	0.001396	0.002165
1/23/2015	0.028030727	0.020114706	0.001896623	-0.00402	0.009345
1/30/2015	0.029111599	-0.007281883	0.018880026	-0.00297	0.001241
2/6/2015	0.014268686	0.002541018	0.012550238	0.002069	0.008723

2/13/2015	0.018641179	0.011514964	0.024929162	0.001199	1.69E-02
2/20/2015	0.001276818	-0.004333524	0.006467183	0.001828	0.002791
2/27/2015	0.005825181	0.010857535	-0.00720996	-0.00349	0.001782
3/6/2015	5.23018E-05	0.008503566	0.004114107	-0.00618	0.002
3/13/2015	-0.029022256	-0.004827182	-0.00440739	0.002521	-0.000521
3/20/2015	0.016082244	-0.002896999	0.029005717	0.002234	0.01146
3/27/2015	-0.01561072	-0.006813189	-0.02622473	-0.00203	-0.01281
4/3/2015	0.008090305	0.017707108	-0.00217432	-0.00814	0.003142
4/10/2015	0.022812091	0.054746404	0.014888729	0.001759	0.037246
4/17/2015	0.00586401	0.014780552	0.000822409	0.000441	0.009961
4/24/2015	0.027064781	0.018834189	0.026408968	-0.00033	0.020042
5/1/2015	-0.013551957	-0.017552157	-0.02954532	-0.00013	-0.018046
5/8/2015	-0.011937084	-0.021296633	-0.01178446	0.004316	-0.010283
5/15/2015	0.004417131	-0.003002146	-0.00260293	0.002659	0.001182
5/22/2015	0.000503626	0.001601102	-0.00330617	-0.00575	-0.003819
5/29/2015	-0.03301281	-0.013126038	-0.01372664	-0.00561	-0.015086
6/5/2015	-0.011031194	0.00658749	0.010190927	0.001941	0.009994
6/12/2015	0.00260203	-0.015213833	0.00196602	0.00124	-0.00506
6/19/2015	-0.000425439	-0.021368935	-0.00043062	-0.00426	-0.013893
6/26/2015	0.016658846	0.009946225	0.026190812	-0.00343	0.012535
7/3/2015	-0.013341054	-0.005823027	-0.01235143	-0.00239	-0.00794
7/10/2015	-0.003201642	-0.020820583	0.001707792	0.000737	-0.008586
7/17/2015	0.017818678	-0.005040406	0.009872911	-0.00148	0.000705
7/24/2015	-0.025939748	-0.009605166	-0.01584463	-0.00344	-0.012044
7/31/2015	0.013575608	-0.010446805	0.021000416	-0.00695	-0.003174
8/7/2015	-0.000735977	-0.018615499	-0.01115253	0.002778	-0.009956
8/14/2015	-0.022950705	-0.015237257	-0.01499126	-0.00108	-0.01275
8/21/2015	-0.035277024	-0.039426183	-0.03326857	-0.00237	-0.032956

8/28/2015	0.019140759	0.030747766	0.030513837	-0.0016	0.026718
9/4/2015	-0.017297486	3.62758E-05	-0.01403283	0.001367	-0.002128
9/11/2015	-0.003500025	-0.004555257	0.011067745	-0.00294	0.000116
9/18/2015	0.043202787	0.017196628	0.03178739	0.000703	0.021854
9/25/2015	-0.013977194	-0.012586592	-0.00645066	0.00491	-0.003313
10/2/2015	0.012413195	0.011746457	0.023209109	-0.00411	0.011916
10/9/2015	0.045917165	0.034800536	0.012035456	-0.00216	0.022218
10/16/2015	-0.006577086	-0.010667062	-0.00126114	-0.00742	-0.01115
10/23/2015	0.025560434	0.034653073	0.021141304	-0.00231	0.025061
10/30/2015	-0.009294379	-0.014438016	-0.01250156	0.001586	-0.009192
11/6/2015	-0.01542317	0.024733394	-0.00382773	-0.00974	0.004983
11/13/2015	-0.03331938	-0.018240788	0.011590382	-0.007	-0.010543
11/20/2015	0.020336981	-0.003980172	0.027116744	-0.0028	0.005918
11/27/2015	-0.011548494	0.002577471	-0.07064884	-0.00641	-0.026421
12/4/2015	-0.045563786	-0.020380044	0.048145198	-0.00239	0.004513
12/11/2015	-0.024692555	0.034717802	0.051328957	-0.00861	0.029788
12/18/2015	0.013517441	0.023174327	0.002046027	0.004659	0.018502
12/25/2015	0.053507298	0.017339062	0.001850054	0.001354	0.012462
1/1/2016	-0.012279828	0.002280849	-0.02314608	0.005848	-0.000123
1/8/2016	-0.051072953	-0.022421387	-0.02278198	-0.00982	-0.026727
1/15/2016	-0.023787914	-0.008486352	-0.00498387	0.007652	0.001736
1/22/2016	0.014938128	-0.015560523	0.05759202	-0.00249	0.010178
1/29/2016	0.031053544	0.011785043	-0.01856578	0.00762	0.008034
2/5/2016	0.012440494	0.005992156	-0.02965021	0.006577	0.000316
2/12/2016	-0.023387398	-0.043551866	-0.04709008	-0.00166	-0.039192
2/19/2016	0.007218404	0.013714744	0.008211228	0.004242	0.015133
2/26/2016	0.009991126	0.038314453	-0.01361107	-0.00636	0.011902
3/4/2016	0.056066025	0.013508442	4.97784E-05	0.004739	0.012716
3/11/2016	-0.008828999	0.008857061	-0.01341943	0.000775	0.0023
3/18/2016	0.040287144	0.029215723	0.031728934	-0.00228	0.025714
3/25/2016	-0.027877753	-0.007518233	-0.02463221	-0.00176	-0.012425

4/1/2016	-0.01413602	-0.029047751	-0.02646543	0.001741	-0.021574
4/8/2016	-0.003094944	0.009986561	-0.01101522	-0.00755	-0.003447
4/15/2016	0.031394192	0.009867896	0.005830239	0.001735	0.010116
4/22/2016	-0.002133528	-0.010502216	-0.02335298	0.005945	-0.006967
4/29/2016	0.000596496	-0.01318943	-0.00788989	4.03E-05	-0.008307
5/6/2016	-0.029078888	-0.006481072	-0.00407292	-0.00962	-0.011739
5/13/2016	0.003601311	0.013374708	0.013845818	-0.00204	0.011438
5/20/2016	0.020070714	0.001243745	0.018886162	0.006479	0.013943
5/27/2016	0.027871747	0.025568105	0.033949448	-0.00496	0.022203
6/3/2016	0.002846113	-0.016469554	0.008936435	-0.00254	-0.006652
6/10/2016	-0.01998199	0.010925544	-0.01635612	0.00165	3.18E-03
6/17/2016	-0.019455328	-0.018041277	-0.01330193	0.004184	-0.009159
6/24/2016	-0.008840518	-0.002562269	-0.00437206	-0.00355	-0.004518
7/1/2016	0.013116185	0.009545398	-0.00342476	-0.00615	5.84E-05
7/8/2016	-0.020648427	-0.019577925	-0.01588034	-0.0033	-0.017281
7/15/2016	0.035339064	0.034072661	0.019883417	0.005186	0.030776
7/22/2016	-0.001567949	0.000273008	-0.00853783	-0.00142	-0.002562
7/29/2016	-0.00391735	-0.020171637	-0.0178403	-0.00397	-0.018834
8/5/2016	-0.008508345	0.004850934	-0.01031398	-0.00257	-0.001683
8/12/2016	0.008751755	0.013840033	-0.01293386	0.000753	0.005116
8/19/2016	-0.000654276	0.000310049	0.00541366	0.003727	0.006562
8/26/2016	0.0139216	0.028669525	0.023250554	-0.0056	0.019726
9/2/2016	-0.000122415	0.014220537	0.004633011	-0.00505	0.006218
9/9/2016	-0.00285551	0.014893208	-0.02030654	0.005727	0.00749
9/16/2016	-0.028394127	-0.03789733	-0.02952804	5.68E-05	-0.028796
9/23/2016	0.003219984	0.000572541	0.003168252	0.005171	0.007193
9/30/2016	-0.000954241	-0.012241644	0.00597039	-0.00141	-0.004405
10/7/2016	-0.00553919	0.024120031	-0.0238618	0.005957	0.011446
10/14/2016	-0.009974242	-0.000587769	0.005074042	-0.00154	0.001433
10/21/2016	0.009432656	0.003654939	0.016535189	-0.00129	0.007764
10/28/2016	-0.016105799	-0.017263067	-0.00759962	0.005737	-0.005495
11/4/2016	-0.021882881	-0.03702511	-0.01744309	0.005086	-0.019954
11/11/2016	0.012249301	-	0.02885135	0.008677	0.01795

		0.001034472			
11/18/2016	0.006587968	-0.000781958	-0.01386548	0.000924	-0.002893
11/25/2016	0.001383477	-0.005730147	0.014288289	0.003111	0.005765
12/2/2016	-0.028404552	-0.018132533	-0.02729272	0.004781	-0.01338
12/9/2016	0.033372922	0.02159946	0.015950112	0.012307	0.028892
12/16/2016	-0.023744831	-0.010138438	-0.00407029	0.002084	-0.003633
12/23/2016	-0.005851124	-0.020363195	-0.01958263	0.004082	-0.012596
12/30/2016	0.02536368	0.012232271	0.006496921	-0.00316	0.007394
1/6/2017	0.011104061	0.015795239	0.014488126	0.002057	0.016472
1/13/2017	0.0308265	0.003428005	0.031367153	0.000231	0.013922
1/20/2017	-0.004973027	0.005729593	-0.01034584	-0.00361	-0.00212
1/27/2017	0.008405692	0.015209837	8.65316E-05	-0.00247	0.007442
2/3/2017	-0.013377738	-0.012483633	-0.02619971	-0.004	-0.017535
2/10/2017	0.0080767	0.018688584	-0.0053423	0.001783	0.011146
2/17/2017	-0.008801933	-0.009798394	-0.03653399	0.004188	-0.012516
2/24/2017	-0.011751023	-0.007445417	0.00523435	-0.00568	-0.005747
3/3/2017	0.001913394	-0.003662207	-0.0013502	0.003517	0.001985
3/10/2017	-0.008491236	0.001163954	-0.00116659	0.00055	0.002084
3/17/2017	0.024994373	0.01254233	0.002960564	-0.00066	0.008528
3/24/2017	-0.013980327	-0.011049934	-0.00466016	-0.00226	-0.008058
3/31/2017	0.004626922	0.048515811	0.021615426	-5.1E-05	0.0346
4/7/2017	0.01531618	0.028328603	0.039270786	-0.00517	0.025279
4/14/2017	0.012427971	-0.019942582	0.013114821	0.00101	-0.004059
4/21/2017	-0.024586518	-0.016311822	-0.0057278	0.000673	-0.008714
4/28/2017	0.031089812	0.02812806	0.023738637	0.001596	0.025791
5/5/2017	-0.004427943	0.005719486	0.014376836	6.26E-05	0.009315
5/12/2017	0.009039547	0.020593471	-0.00437716	0.001173	0.011967
5/19/2017	0.006732103	-0.015873376	0.03129661	0.002978	0.005907
5/26/2017	-0.00792176	-0.006508157	-0.00520645	0.000693	-0.003263
6/2/2017	-0.020491094	-0.00638764	-0.01200485	0.002283	-0.004108
6/9/2017	-0.012720246	0.006490032	-0.00762152	-0.00315	-0.000404

6/16/2017	-0.026524731	-0.017328632	-0.03180203	0.004851	-0.0144
6/23/2017	0.013212769	0.014832141	0.04662324	-0.0061	0.019704
6/30/2017	0.002087042	0.008918604	-0.00309916	0.00589	0.010189
7/7/2017	0.005604424	0.010883932	0.008710709	0.000592	0.010643
7/14/2017	0.032710819	0.019116023	0.026226724	0.002864	0.02288
7/21/2017	0.010536782	0.005153541	0.005163938	7.63E-05	0.005937
7/28/2017	0.01330251	0.007490549	0.020856022	0.002797	0.014787
8/4/2017	0.019343256	0.02990023	0.012123096	-0.00211	0.019663
8/11/2017	-0.014115692	-0.020261407	0.002282527	0.002715	-0.006392
8/18/2017	0.002703284	0.000918506	0.001810903	0.001663	0.003907
8/25/2017	0.024440264	0.013228316	0.015959251	-0.00808	0.006867
9/1/2017	-0.002513773	-0.002553649	-0.02434939	0.005241	-0.003642
9/8/2017	-0.01395756	0.001418825	-0.01547781	-0.00054	-0.003508
9/15/2017	-0.001427016	0.022749448	0.00328535	-0.00034	0.014386
9/22/2017	0.003496801	0.003221546	0.004214221	0.005576	0.009313

APPENDIX 4

Data for Estimating Liquidity

DATE	DATE	Return Data	Absolute Return	Log volume	Illiquidity Measure
1/1/2016	-27	-0.012279828	0.012279828	8.50378295	0.001444
1/8/2016	-26	-0.051072953	0.051072953	9.00439371	0.005672
1/15/2016	-25	-0.023787914	0.023787914	9.150351075	0.0026
1/22/2016	-24	0.014938128	0.014938128	9.123942341	0.001637
1/29/2016	-23	0.031053544	0.031053544	9.183658656	0.003381
2/5/2016	-22	0.012440494	0.012440494	9.138578659	0.001361
2/12/2016	-21	-0.023387398	0.023387398	9.114846019	0.002566
2/19/2016	-20	0.007218404	0.007218404	9.136776894	0.00079
2/26/2016	-19	0.009991126	0.009991126	9.122406761	0.001095
3/4/2016	-18	0.056066025	0.056066025	9.196697521	0.006096
3/11/2016	-17	-0.008828999	0.008828999	9.147848302	0.000965
3/18/2016	-16	0.040287144	0.040287144	9.22464487	0.004367
3/25/2016	-15	-0.027877753	0.027877753	8.851768671	0.003149
4/1/2016	-14	-0.01413602	0.01413602	8.993206227	0.001572
4/8/2016	-13	-0.003094944	0.003094944	9.05536258	0.000342
4/15/2016	-12	0.031394192	0.031394192	9.079284856	0.003458
4/22/2016	-11	-0.002133528	0.002133528	9.046350797	0.000236
4/29/2016	-10	0.000596496	0.000596496	8.918481777	6.69E-05
5/6/2016	-9	-0.029078888	0.029078888	9.077257369	0.003203
5/13/2016	-8	0.003601311	0.003601311	9.02236004	0.000399
5/20/2016	-7	0.020070714	0.020070714	9.063387228	0.002214
5/27/2016	-6	0.027871747	0.027871747	9.052818939	0.003079
6/3/2016	-5	0.002846113	0.002846113	9.148364428	0.000311
6/10/2016	-4	-0.01998199	0.01998199	9.069898083	0.002203
6/17/2016	-3	-0.019455328	0.019455328	9.121997692	0.002133
6/24/2016	-2	-0.008840518	0.008840518	9.099822752	0.000972
7/1/2016	-1	0.013116185	0.013116185	9.145597287	0.001434
7/8/2016	0	-0.020648427	0.020648427	9.042806478	0.002283
7/15/2016	1	0.035339064	0.035339064	9.049966176	0.003905
7/22/2016	2	-0.001567949	0.001567949	9.00858126	0.000174
7/29/2016	3	-0.00391735	0.00391735	9.083264102	0.000431
8/5/2016	4	-0.008508345	0.008508345	9.00518398	0.000945
8/12/2016	5	0.008751755	0.008751755	8.97332578	0.000975
8/19/2016	6	-0.000654276	0.000654276	9.051546851	7.23E-05
8/26/2016	7	0.0139216	0.0139216	9.088125532	0.001532
9/2/2016	8	-0.000122415	0.000122415	9.136385211	1.34E-05
9/9/2016	9	-0.00285551	0.00285551	9.128832494	0.000313

9/16/2016	10	-0.028394127	0.028394127	9.236957838	0.003074
9/23/2016	11	0.003219984	0.003219984	9.101644051	0.000354
9/30/2016	12	-0.000954241	0.000954241	9.166533541	0.000104
10/7/2016	13	-0.00553919	0.00553919	9.064411502	0.000611
10/14/2016	14	-0.009974242	0.009974242	9.164116502	0.001088
10/21/2016	15	0.009432656	0.009432656	9.009447279	0.001047
10/28/2016	16	-0.016105799	0.016105799	8.992399014	0.001791
11/4/2016	17	-0.021882881	0.021882881	9.116021159	0.0024
11/11/2016	18	0.012249301	0.012249301	9.12034954	0.001343
11/18/2016	19	0.006587968	0.006587968	9.08920286	0.000725
11/25/2016	20	0.001383477	0.001383477	9.025214218	0.000153
12/2/2016	21	-0.028404552	0.028404552	9.170861688	0.003097
12/9/2016	22	0.033372922	0.033372922	9.082959932	0.003674
12/16/2016	23	-0.023744831	0.023744831	9.156843858	0.002593
12/23/2016	24	-0.005851124	0.005851124	8.885973307	0.000658
12/30/2016	25	0.02536368	0.02536368	8.490985101	0.002987