

**Gordon Institute  
of Business Science**  
University of Pretoria

**Illiquidity premium in asset returns: An empirical  
analysis of various liquidity measures to determine the  
best measure of liquidity on the Johannesburg Stock  
Exchange**

**Eddy J. Mabuza**  
**16392818**  
**eddym@ndende.co.za**

A research project submitted to the Gordon Institute of Business Science, University of Pretoria, in partial fulfilment of the requirements for the degree of Master of Business Administration.

**6 November 2017**

## Abstract

The choice of a liquidity measure drives the performance of a liquidity-based investment style (Moreira De Sousa, 2015). Various measures of liquidity exist, however, not all measures are applicable in every market. Through an empirical analysis of the various measures of liquidity, the best measure of liquidity in a market can be identified.

The purpose of this study was to determine if liquidity based investment style, using the appropriate liquidity measure, produced profitable returns on the Johannesburg Stock Exchange (JSE) that consistently outperformed returns of the All Share index (J203T). This research project tested, six measures of liquidity; namely, Amihud (ILLIQ), Adjusted Amihud (AdjILLIQ), Relative Change in Volume (RCV), Bid-Ask Spread, Price Reversal and Turnover. A new measure of liquidity, Localized Turnover is proposed and has been tested as the seventh measure. Muller & Ward (2013) graphical time series methodology and improved data set in the style engine was used for the analysis over a period of 20 years from 1997 to 2017.

Relative Change in Volume (RCV) and Localized Turnover are the only measures that produce profitable returns on the JSE. The study provided insight to which liquidity measures are applicable and profitable on the JSE and that not all liquidity measures are applicable to every market.

### Keywords

Illiquidity measure, illiquidity premium, Localized Turnover, Investment style

## Declaration

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorization and consent to carry out this research.

---

Eddy Mabuza

---

Date

# Contents

<b>Abstract .....</b>	<b>i</b>
<b>Keywords.....</b>	<b>ii</b>
<b>Declaration.....</b>	<b>iii</b>
<b>Contents .....</b>	<b>iv</b>
<b>List of Figures .....</b>	<b>v</b>
<b>List of Tables .....</b>	<b>vi</b>
<b>List of Equations .....</b>	<b>vii</b>
<b>List of Acronyms and Definitions .....</b>	<b>viii</b>
<b>Chapter 1: Introduction to Research Problem .....</b>	<b>1</b>
1.1. Research Title.....	1
1.2. Introduction .....	1
1.3. Research Problem .....	2
1.4. Research Purpose .....	4
1.5. Research Importance.....	5
1.5.1. Importance to Academia.....	5
1.5.2. Importance to Business .....	6
1.6. Research outline .....	8
<b>Chapter 2: Literature Review .....</b>	<b>10</b>
2.1. Introduction to the literature review .....	10
2.2. Liquidity as an investment style.....	10
2.3. Measures of illiquidity.....	11
2.3.1. Amihud ILLIQ.....	12
2.3.2. Turnover .....	14
2.3.3. Adjusted Amihud Measure (AjdILLIQ) .....	16
2.3.4. Kyle's Lambda (price impact) .....	17
2.3.5. Bid-Ask Spread .....	18
2.3.6. Relative Change in Volume (RCV).....	20

2.3.7.	Price Reversal.....	21
2.3.8.	Weighted Order Value (WOV).....	22
2.4.	Studies of illiquidity in the South African Market .....	22
2.5.	Other studies on liquidity measure and illiquidity premium .....	24
2.6.	Conclusion on literature reviewed .....	25
<b>Chapter 3: Research Question / Proposition.....</b>		<b>26</b>
3.1.	Main Research Question.....	26
3.2.	Research Question 1: .....	26
3.2.1.	Proposition 1: The use of Amihud illiquidity measure (ILLIQ) .....	27
3.2.2.	Proposition 2: The use of Adjusted Amihud illiquidity measure (AdjILLIQ) 27	
3.2.3.	Proposition 3: The use of Relative Change in Volume (RCV).....	27
3.2.4.	Proposition 4: The use of Bid-Ask Spread .....	27
3.2.5.	Proposition 5: The use of Price Reversal .....	28
3.2.6.	Proposition 6: The use of Turnover .....	28
3.2.7.	Proposition 7: The use of Localized Turnover .....	28
3.3.	Research Question 2: .....	28
3.3.1.	Proposition 8: The low liquidity quintile outperformed benchmark and was dependent on time .....	28
<b>Chapter 4: Research Methodology.....</b>		<b>29</b>
4.1.	Choice of methodology.....	29
4.1.1.	Research philosophy.....	29
4.1.2.	Approaches.....	29
4.1.3.	Time horizons .....	30
4.1.4.	Technique and procedure .....	31
4.2.	Research design .....	31
4.3.	Population.....	32
4.4.	Unit of analysis.....	32
4.5.	Sampling methods and size .....	33

4.6.	Measurement instrument.....	34
4.6.1.	Style engine .....	34
4.6.2.	Quintile construction.....	35
4.6.3.	Liquidity proxy construction .....	35
4.7.	Data gathering process .....	41
4.8.	Data Analysis approach .....	42
4.9.	Limitation.....	42
<b>Chapter 5:</b>	<b>Results.....</b>	<b>44</b>
5.1.	Introduction .....	44
5.2.	Research Question 1: .....	44
5.2.1.	Proposition 1: The use of Amihud illiquidity measure (ILLIQ) .....	46
5.2.2.	Proposition 2: The use of Adjusted Amihud illiquidity measure (AdjILLIQ) 50	
5.2.3.	Proposition 3: The use of Relative Change in Volume (RCV).....	54
5.2.4.	Proposition 4: The use of Bid-Ask Spread .....	59
5.2.5.	Proposition 5: The use of Price Reversal .....	63
5.2.6.	Proposition 6: The use of Turnover .....	67
5.2.7.	Proposition 7: The use of Localized Turnover .....	72
5.2.8.	Synopsis of key Question 1: Which measure of liquidity yield the highest return? 76	
5.3.	Research Question 2: .....	79
5.3.1.	Proposition 8(1): Performance of Relative Change in Volume (RCV) over the period .....	79
5.3.2.	Performance of Localized Turnover over the period .....	81
5.3.3.	Synopsis of Key Question 2 .....	83
5.4.	Chapter summary.....	83
<b>Chapter 6:</b>	<b>Discussion of Results .....</b>	<b>85</b>
6.1.	Introduction .....	85

6.2. Research Question 1: Which measure of liquidity yield the highest returns on the JSE?.....	86
6.2.1. Proposition 1: The use of Amihud illiquidity measure (ILLIQ) .....	86
6.2.2. Proposition 2: The use of Adjusted Amihud illiquidity measure (AdjILLIQ) .....	89
6.2.3. Proposition 3: The use of Relative Change in Volume (RCV).....	91
6.2.4. Proposition 4: The use of Bid-Ask Spread.....	93
6.2.5. Proposition 5: The use of Price Reversal .....	95
6.2.6. Proposition 6: The use of Turnover .....	97
6.2.7. Proposition 7: The use of Localized Turnover .....	99
6.3. Research Question 2: Do returns of liquidity based investment style using the best measure(s) from research question 1 consistently outperform the market over time or is there a time factor in the performance? .....	101
6.3.1. Performance of Relative Change in Volume (RCV) over the period ....	102
6.3.2. Performance of Localized Turnover over the period.....	103
6.4. Chapter summary.....	105
<b>Chapter 7: Conclusion .....</b>	<b>106</b>
7.1. Introduction .....	106
7.2. Principle Findings.....	106
7.3. Implications for management .....	108
7.4. Limitations of the Research.....	108
7.5. Suggestions for future research .....	109
7.6. Conclusion .....	110
<b>Reference List .....</b>	<b>111</b>
<b>Appendix A: List of Liquidity measures .....</b>	<b>117</b>
<b>Appendix B: List of companies listed on the JSE and other markets.....</b>	<b>119</b>
<b>Appendix C: Ethical clearance letter.....</b>	<b>127</b>

## List of Figures

Figure 1: Market Cap vs Volume traded over a period of 20 years (1997-2017) .....	30
Figure 2. Amihud Illiquidity (ILLIQ): Actual ratio over period (1997 – 2017) .....	47
Figure 3. Amihud Illiquidity (ILLIQ): Least liquid to most liquid quintile comparison ....	47
Figure 4: Annualised returns since 1997 on Amihud liquidity ratio .....	48
Figure 5. Amihud Illiquidity (ILLIQ): Returns over period (1997 - 2017) .....	49
Figure 6: Annualised returns Volatility - Amihud liquidity ratio.....	49
Figure 7. Adjusted Amihud Illiquidity (AdjILLIQ): Actual ratio over period (1997 – 2017) .....	51
Figure 8. Adjusted Amihud Illiquidity (AdjILLIQ): Least liquid to most liquid quintile comparison .....	52
Figure 9: Annualised returns since 1997 on Adjusted Amihud liquidity ratio .....	52
Figure 10. Adjusted Amihud Illiquidity (AdjILLIQ): Returns over period (1997 - 2007).	53
Figure 11: Annualised returns Volatility - Adjusted Amihud liquidity ratio .....	54
Figure 12. Relative Change in Volume (RCV): Actual ratio over period (1997 – 2017)	55
Figure 13. Relative Change in Volume (RCV): Least liquid to most liquid quintile comparison .....	56
Figure 14: Annualised returns since 1997 on Relative Change in Liquidity ratio .....	57
Figure 15. Relative Change in Volume (RCV): Returns over period (1997 - 2017) .....	57
Figure 16: Annualised returns Volatility - Relative Change In Volume liquidity ratio....	58
Figure 17. Bid-Ask Spread: Actual ratio over period (1997 – 2017) .....	60
Figure 18. Bid-Ask Spread: Least liquid to most liquid quintile comparison .....	60
Figure 19: Annualised returns since 1997 on Bid-Ask Spread .....	61
Figure 20. Bid-Ask Spread: Returns over period (1997 - 2007) .....	62
Figure 21: Annualised returns Volatility – Bid-Ask Spread liquidity ratio .....	62
Figure 22. Price Reversal: Actual ratio over period (1997 – 2017).....	64
Figure 23. Price Reversal: Least liquid to most liquid quintile comparison .....	65
Figure 24: Annualised returns since 1997 on Price Reversal ratio.....	65
Figure 25. Price Reversal: Returns over period (1997 - 2007).....	66
Figure 26: Annualised returns Volatility - Price Reversal ratio .....	67
Figure 27. Turnover: Actual ratio over period (1997 – 2017).....	68
Figure 28. Turnover: Least liquid to most liquid quintile comparison.....	69
Figure 29: Annualised returns since 1997 on Turnover ratio.....	70
Figure 30. Turnover: Returns over period (1997 - 2007).....	70

Figure 31: Annualised returns Volatility - Turnover .....	71
Figure 32. Localized Turnover: Actual ratio over period (1997 – 2017).....	73
Figure 33. Localized Turnover: Least liquid to most liquid quintile comparison .....	73
Figure 34: Annualised returns since 1997 on Localized Turnover.....	74
Figure 35. Localized Turnover: Returns over period (1997 - 2007).....	75
Figure 36: Annualised returns Volatility – Localized Turnover .....	75
Figure 37. Localized Turnover: Returns over period (1997 - 2017).....	80
Figure 38. Localized Turnover: Returns over period (1997 - 2017).....	82

## List of Tables

Table 1: Research goals .....	4
Table 2: Unit of analysis for each measure of liquidity .....	32
Table 3: Seven Propositions for Research Question One.....	45
Table 4: Summarized output of Amihud Illiquidity (ILLIQ) measure .....	46
Table 5: Summarized output of Adjusted Amihud Illiquidity (AdjILLIQ) measure.....	50
Table 6: Summarized output of Relative Change in Volume (RCV) measure .....	55
Table 7: Summarized output of Bid-Ask Spread measure .....	59
Table 8: Summarized output of Price Reversal measure .....	63
Table 9: Summarized output of Turnover measure.....	68
Table 10: Summarized output of Localized Turnover measure.....	72
Table 11: Summary of returns vs JSE All Share Index (J203T) .....	77
Table 12: Excess Return for each measure.....	77
Table 13: Summary of Standard deviation vs the JSE All Share Index (J203T).....	78
Table 14: Correlation between returns and the liquidity level for each measure .....	78
Table 15: Summary of the best measures of liquidity on the JSE .....	79
Table 16: Relative Change in Volume returns for different time frame .....	80
Table 17: Localized Turnover returns for different time frame.....	82
Table 18: Relative change in liquidity over the period (1997 to 2017) .....	83
Table 19: Summarized performance results for different time frame.....	83
Table 20: Research goal 1 .....	86
Table 21: Bid-Ask Spread as cost for Localised Turnover .....	101
Table 22: Research goal 2 .....	102
Table 23: Research goal 3 .....	103
Table 24: Research goal 3 .....	105

## List of Equations

Equation 1: Amihud Illiquidity measure (ILLIQ) .....	13
Equation 2: Amihud Turnover measure of liquidity .....	14
Equation 3: Muller & Ward (2013) Turnover measure of liquidity .....	15
Equation 4: Adjusted Amihud Amihud Illiquidity .....	17
Equation 5: Zero Trading Volume Measure .....	17
Equation 6: Price Impact measure of liquidity .....	18
Equation 7: Chung & Zhang (2014) Bid-Ask as a measure of liquidity .....	19
Equation 8: Roll (1984) spread as measure of liquidity .....	19
Equation 9: Average trading volume (AVV) .....	20
Equation 10: Relative daily change in volume (RDCV) .....	20
Equation 11: Relative change in liquidity as a measure of liquidity (RCV) .....	20
Equation 12: Price Reversal as measure of liquidity .....	21
Equation 13: Weighted Order Value as measure of liquidity .....	22
Equation 14: Amihud Illiquidity measure (ILLIQ) .....	36
Equation 15: Adjusted Amihud Illiquidity measure (AdjILLIQ) .....	37
Equation 16: Relative Change in Volume (RCV) .....	38
Equation 17: Bid-Ask Spread .....	38
Equation 18: Price Reversal .....	39
Equation 19: Turnover .....	40
Equation 20: Localized Turnover .....	41

## List of Acronyms and Definitions

JSE	Johannesburg Stock Exchange
JSE All Share Index	The All Share index is the largest index in size and value on the JSE consisting of about 160 shares.
J203T	Code for the JSE All Share Index on the Sharenet Financial Database
AMEX	American Stock Exchange
NYSE	New York Stock Exchange
NASDAQ	Nasdaq Stock Market (American stock exchange)
SWIX	Shareholder Weighted Indices
Free Float	Free Float represents only the shares of a Company that is available to the public than to secured stock held by directors, sponsors, controlling-interest shareholders, or government (FTSE/JSE, 2017).
Illiquidity	is a multi-dimensional concept, generally defined as the affluence with which an asset or security is traded promptly at low cost with limited price impact (Pastor & Stambaugh, 2003).

# Chapter 1: Introduction to Research Problem

## 1.1. Research Title

Illiquidity premium in asset returns: An empirical analysis of various liquidity measures to determine the best liquidity measure on the Johannesburg Stock Exchange.

## 1.2. Introduction

The Johannesburg Stock Exchange (JSE) with the listed shares included as part of the JSE All Share Index (J203T) makes 99% of the total market capitalisation (Muller & Ward, 2013) and presents an exciting platform to test the profitability of a liquidity-based investment style to outperform the market returns. The JSE had an average of 380 listed shares of which only about 160 shares are included in the JSE All Share Index, which leaves over 55% of the shares that make 1% of the market capitalisation (IRESS Research Domain, 2017). While various investment styles, including liquidity, were previously tested on the JSE (Muller & Ward, 2013), they remain insufficient to account for the complexity of this platform. There are many ways to measure liquidity. Therefore, there is a need to make available different results obtained through a variety of measures (Aitken & Comerton-Forde, 2003). Moreover, a review of which measure of liquidity outperforms the rest and the market benchmark, such as the JSE All Share Index, when used as a liquidity proxy in a liquidity-based investment strategy will likely help investors select appropriate measures of liquidity to use on the JSE.

Liquidity has a significant role to play in financial markets (Ma, Anderson, & Marshall, 2016), having a direct impact on the pricing of stock and the return for an investor (Marshall, 2006). Investors often require some degree of liquidity to trade securities without experiencing significant losses. In the absence of liquidity, investors would need a premium return on such securities to compensate for the illiquidity risk (Amihud, Hameed, Kang, & Zhang, 2012; Amihud & Mendelson, 1986; Hassan & Javed, 2011).

Pursuing the functioning of stock markets, Zhang, Yang, Su, & Zhang (2014) presented an argument that liquidity should be one of the most significant determinants of an appropriate functioning of a stock market. It is for this reason that financial regulators and market makers dedicate their times to ensure a stock market is liquid (Zhang et al.,

2014). The study of liquidity has historically received more attention in the US markets, but most recently, attention has shifted to studying liquidity on a global market, which includes the emerging markets (Ma et al., 2016). Previous literature adopted a broad range of measures of liquidity over the period and, consequently, the developed markets influenced the development of most of the commonly used measures of liquidity, which are not ubiquitous and transferable within emerging markets (Kang & Zhang, 2014). To date, there are many liquidity measures, which suggests a lack of consensus on the methodology that is required to measure liquidity within the emerging market paradigm (Aitken & Comerton-Forde, 2003; Ali & Boadu, 2016; Vidović, Poklepović, & Aljinović, 2014).

In order to fill the knowledge gap identified above, this research project tests the already adopted broad range of measures as a proxy of (il)liquidity to determine which of the proxies is more applicable and profitable to yielding a superior premium as compensation for lack of liquidity on the Johannesburg Stock Exchange. Six well-developed measures of liquidity are tested together with a proposed new measure on the JSE to gauge whether their performance as part of a liquidity-based investments strategy outperforms the market that is represented by the JSE All Share Index (J203T). In this study, we propose a new measure of liquidity, Value Traded over SWIX Weighting, adapted from Muller & Ward (2013) "Value Traded over Market Cap". The proposed new measure is applicable in a market with multiple listed stocks. The Market Capitalisation of a multiple listed entity includes the value of all listings, therefore to measure returns on the local listed stock, the market capitalisation has to be adjusted taking only local listed stock. The market capitalisation of a multiple listed company may be influenced by factors such as currency fluctuations between locally listed stock and stock listed in other markets.

### **1.3. Research Problem**

The Johannesburg Stock Exchange (JSE) accounts for over fifty percent (50%) of the total investments in South Africa (South Africa Saving Institute, 2017). Therefore, investment returns are necessary for this market. The securities trading industry, portfolio managers, traders, individual investors and investment consultants are continually searching for a superior investment style that persistently outperforms the market and yields higher returns for their investment portfolios (Muller & Ward, 2013).

Due to increased competition in the asset management space, portfolio managers, traders, and investment consultants are continually looking for ways to outperform competitors and the overall market to attract more capital from investors (Amihud & Mendelson, 1986). One of the ways players in the security industry differentiate themselves is through choosing a disciplined and methodical investment style that will ensure maximum returns on the capital deployed (Muller & Ward, 2013).

Literature identified various investment styles which securities managers employ in pursuit of superior performance such as liquidity, size, value/growth, and momentum (Muller & Ward, 2013). Liquidity, arguably, has equal standing with other investment styles (Ibbotson, Chen, Kim, & Hu, 2013). In choosing liquidity as an investment style, the securities trading industry requires an understanding of how to measure illiquidity and how it could affect the stock expected returns.

Aitken & Comerton-Forde (2003), identified that the choice of a liquidity measure might influence the outcome of a study and inconsistent conclusions can be drawn depending on the liquidity proxy selected. Aitken & Comerton-Forde (2003) expressly observed that the absence of correlation between the illiquidity measures suggest that the selection of the measure will affect suppositions regarding the influence of changes in market structure on liquidity. This, in turn, leads to the interrogation of which of the measures of liquidity is more profitable when used as part of a liquidity-based investment strategy.

The commonly used illiquidity measures in the international markets such as trade Volume, Turnover, Bid-Ask Spread and Trading velocity are not always applicable in their current form for every market type and size (Kang & Zhang, 2014). There is a need for testing relative performance of these and other measures in a market with more specific attention to emerging markets such as South Africa. Bekaert, Harvey, & Lundblad (2007) presented an argument that emerging equity markets have an unusually high illiquidity effect, thereby making it a perfect environment to test the influence of liquidity on expected returns.

Emerging markets are synonymous with a high-level of infrequent trading stocks. About 68% of the volumes traded on the JSE in April 2017 was made up of only 10% of the listed companies (IRESS Research Domain, 2017). For the same period, 12% of the listed companies had zero trading volume, some of which was for consecutive days, making it entirely different from the developed markets where most of the stock trades

actively on a daily basis. Bekaert et al. (2007) associate the extended period of consecutive zero trading with high illiquidity effects.

The Johannesburg Stock Exchange as an emerging market presents an excellent platform for testing the various measures of liquidity. Such test will provide a guideline on which measure of liquidity, when used in a liquidity-based investment style produces profitable returns on the JSE. That is, the study tests whether such a measure consistently performs above the market benchmark, represented by the JSE All Share Index (J203T).

#### 1.4. Research Purpose

The purpose of the thesis was to test on the Johannesburg Stock Exchange (JSE) whether liquidity based investment style, using the appropriate liquidity measure, produces superior returns that consistently outperform the market. As noted by Muller & Ward (2011), investment professionals earn a significant portion of their income by employing investment styles that outperform a market benchmark. The purpose of this study, therefore, was to provide guidance on which measure of liquidity to use for liquidity based investment style on the JSE.

Due to the availability of multiple ways to measure liquidity, the intention is to test six of the most commonly used liquidity measures and determine which of them when used as a liquidity proxy produces results of a liquidity-based strategy that outperforms the returns of a market benchmark such as the Allshare index (J203T).

Table 1 below present the specific goals of this research.

*Table 1: Research goals*

GOALS	DESCRIPTION
<b>Goal 1</b>	<p>To examine the selected measures of liquidity and understand how each performs against the market benchmark, typically an index, in this case, the Allshare Index (J203T) as a proxy for the market performance. The selected measures for examinations are:</p> <ul style="list-style-type: none"> <li>• Amihud (2002) ratio of return to a dollar volume (<i>ILLIQ</i>),</li> <li>• Kang &amp; Zhang (2014) modified version of the Amihud return to a dollar volume (<i>AdjILLIQ</i>),</li> </ul>

GOALS	DESCRIPTION
	<ul style="list-style-type: none"> <li>• Amihud &amp; Mendelson (1986) Bid-Ask Spread,</li> <li>• Vayanos &amp; Wang (2013a) Price Reversal,</li> <li>• Muller &amp; Ward (2013) value traded as a percentage of market capitalisation (Turnover),</li> <li>• Vidović et al. (2014) Relative Change in Volume, and</li> <li>• Author's proposed new measure, Value Traded as a percentage of SWIX (Localized Turnover).</li> </ul>
<b>Goal 2</b>	To determine which of the measures of liquidity, as a liquidity proxy in a liquidity-based investment strategy outperforms the market returns on the JSE.
<b>Goal 3</b>	To understand the effect of time on illiquidity (short-term versus long-term) in explaining returns and understand whether the successful measure(s) in goal 2, have consistently outperformed the market over time.

## 1.5. Research Importance

### 1.5.1. Importance to Academia

The subject of liquidity has been studied by many researchers internationally with the conclusion that it was a natural term to define but difficult to measure (Aitken & Comerton-Forde, 2003; Kyle, 1985; Vidović et al., 2014). This difficulty is acute in the emerging markets because most illiquidity measures are applicable in the developed markets (Kang & Zhang, 2014; Lischewski & Voronkova, 2012). Less research has been conducted on the links between liquidity and returns on emerging markets, especially in Africa.

While the JSE is one of those markets with fewer studies done on illiquidity, a survey of relevant literature suggest there is no consensus on the most suitable measure of liquidity in the South African market. Goyenko, Holden, & Trzcinka (2009) argues that the lack of consensus extends to all markets and little evidence exists that relates the investor experience with the proposed measures of liquidity. However, the assumption by literature that liquidity proxies measure liquidity still holds.

Measures such as Amihud's (2002) price impact liquidity measure was introduced for all markets looking at the absolute value of stock return to a dollar volume. While confirmed

by other studies such as Fong, Holden, & Trzcinka (2017) and Lesmond (2005), Amihud's (2002) measure is disputed as not applicable in totality in emerging markets (Kang & Zhang, 2014; Vidović et al., 2014).

Vayanos & Wang (2013) found that the absence of an integrated framework and vigorous predictions makes it difficult to propel the hypothetical comprehension of illiquidity and give direction to observational work. This includes, for instance, how to measure illiquidity, what hypothetical expectations to test, and how to translate the empirical findings. Given this limitation on this illiquidity framework, a study on the various measures of illiquidity on the JSE expands the pool of knowledge in this field.

Ali & Boadu (2016) in their assessment of liquidity on all Norwegian stocks suggested a continued research on liquidity and asset pricing and asset allocation, which includes portfolio contraction to check risk and return based on some economic insight and factor models like size, value, momentum, and liquidity. They further suggested an inclusion of the more innovative liquidity measures such as Amihud (2002) illiquidity measure.

This study aims to compare against each other the selected and widely used measures of illiquidity including a proposed new measure and to compare the results using empirical data from the JSE to fill in the prevailing gap in the body of knowledge on illiquidity in the emerging markets. The findings will provide essential insights into the superiority and applicability of some measures over the others and overlay the way for future researchers who will know what measure of illiquidity they can employ, in particular on the JSE.

### **1.5.2. Importance to Business**

The study of a measure of illiquidity on the JSE is expected to have significant implications for the securities trading industry, portfolio managers, traders and investment consultants, exchange control regulators (Acharya & Pedersen, 2005; Cumming, Johan, & Li, 2011), business and academic research.

The recent global financial crisis in 2008 accentuated the need for understanding the drivers of a company's stock liquidity and how it is likely to impact its valuation. In their Stock Liquidity and the Cost of Equity paper, Amihud, Hameed, Kang, & Zhang (2013) observed that a firm's cost of equity capital (hurdle rate for investments) depends on

how illiquid its stock is. The more illiquid a company stock is, the higher the hurdle rate for investment purposes.

It is, therefore, important for businesses to be able to measure how liquid their stock is using the same measures of liquidity used by investors. Once stock liquidity is measured, managers can bring down the cost of capital of their company by embracing liquidity-enhancing policies (Amihud & Mendelson, 1991, 2012). Examples of such policies are more effective disclosure, increasing the investor base of a company and lowering the leverage ratios (Amihud & Mendelson, 1991, 2012). One of the benefits to a company for increasing its stock liquidity is that it can expect to sell all its issued securities at a higher price. Higher stock liquidity is often related to better corporate governance, arguably, the profitability of companies with high liquidity tends to be high (Amihud & Mendelson, 1991, 2012).

The notion of better disclosure to enhance liquidity is reinforced by Lang, Lins, & Maffett (2012), who found that the liquidity of a company's stock positively correlates with its transparency and issuance of shares, while negatively related to the payout of dividends. Banerjee, Gatchev, & Spindt (2007) found a strong correlation between a company dividend policy and the liquidity of its common stock, adding that investors will demand more cash dividends on stock they hold in illiquid markets.

A study by Amihud & Mendelson (1986) proposed that liquidity enhancing related financial strategies can lessen the company's opportunity cost of capital, and give measures to the benefits of enhancing the exchange and trade process. There are frequent suggestions by Amihud (2002), Fang, Noe, & Tice (2009) and Nguyen, Duong, & Singh (2016) that there is a relationship between firm performance, stock liquidity and value discoveries. Companies with high liquid stock have the most active threat to exit by its shareholders due to the simplicity of trading their stock at the lowest cost and putting pressure on company managers to perform (Bharath, Jayaraman, & Nagar, 2013). There is an emphasis that businesses should measure how illiquid is their stock and compare it with the market as well as competitors.

In the securities trading industry, investments consultants and portfolio managers shape portfolios to meet their clients' investment prospects and liquidity goals (Amihud & Mendelson, 1986). These may well result in the employment of liquidity as an investment style, therefore requiring the industry to use a measure of liquidity likely to yield returns

above the market. Stock market regulators have interest in reducing the trading cost and improve the overall liquidity of a stock market through the implementation of various rules and regulations Chung & Zhang (2014), In other words, the efficacy of these rules and regulations can be enhanced by the use of a robust liquidity proxy or measure.

The profitability of a liquidity-based investment style is dependent on how well a liquidity measure is doing in a market. As described in Section 1.3, not all liquidity measures is profitable within one market (Moreira De Sousa, 2015). The lack of autonomy, therefore, suggests that it is imperative for the securities trading industry to know which measures of liquidity performs well in a market like the JSE for use in a liquidity-based investment style. The findings of this study, on which of the tested illiquidity measures yield superior results will contribute to the body of knowledge providing meaningful insights to the industry players.

## **1.6. Research outline**

To achieve the research objective of testing which of the selected measures of liquidity, when used as a liquidity measures in a liquidity-based investment style produces profitable returns on the JSE that consistently outperforms the market benchmark, the rest of this document is structured as follows.

Chapter 1 described that liquidity meets the requirements of being used as an investment style (Ibbotson et al., 2013). The return of a liquidity investment style is influenced by choice of the measure of liquidity selected due to not all measure being applicable in all market (Kang & Zhang, 2014; Vidović et al., 2014). It finally presented a motivation how the academia and business will benefit from the outcome of this study.

The next chapters will provide an overview of the relevant theory and literature concerning liquidity and the expected returns. Chapter Two provides the literature explicitly on why the use of liquidity as an investment style, describing the various measures of liquidity used in literature and how each measure was computed and finally the relevance of liquidity in a South African context.

The primary research question and proposition on measures of liquidity on the JSE are presented in Chapter 3. In Chapter 4 a defence of the methodology used, the definition of the unit of analysis, population and sampling methods, the research instruments,

analysis approach and the limitation of this study are discussed in detail. Chapter 5 presents the result of the empirical analysis on the measure of liquidity which are discussed in-depth in Chapter 6. In Chapter 7, the report is concluded by highlighting the principal findings of the research, implications for management, limitations of the study and suggestions for future research on illiquidity.

## Chapter 2: Literature Review

### 2.1. Introduction to the literature review

The previous chapter introduced the subject of illiquidity, the purpose of the study and how it will contribute to both the academic and business world. This literature review section looks at the use of illiquidity as an investment style and how it compares to other investments styles (Ibbotson et al., 2013; Muller & Ward, 2013; Theart & Niel, 2014). It explores the concept of illiquidity premium and how it is measured both in the international markets and emerging markets (Amihud, 2002; Amihud & Mendelson, 1986). Given the increasing amount of literature on the subject of liquidity, in this literature review section, the focus is mainly on the most influential literature and those introducing the various measure of liquidity.

### 2.2. Liquidity as an investment style

The use of liquidity as an investment style is supported by various studies (Ibbotson et al., 2013; Muller & Ward, 2013; Theart & Niel, 2014). For example, Ibbotson et al. (2013) has revealed that illiquidity is an important barometer for long-term returns. Liquidity is also found to meet the four criteria that characterise a benchmark style developed by Sharpe (1992); namely, (i) recognisable before the fact; (ii) low in cost; (iii) a viable alternative; and (iv) robust against another reference point (Ibbotson et al., 2013).

Ibbotson et al. (2013) argue that liquidity must form part of an investors strategy and must be evaluated amongst the other investment styles such as value, size and momentum. Moreira De Sousa (2015) found that the effectiveness of a liquidity-based investment strategy depends on the chosen liquidity measure and the geographic market that is measured. Since liquidity cannot be observed directly, a proxy is selected instead. The outcome of the effectiveness of liquidity as an investment style in a particular market, such as in an emerging market, is influenced by the relevance of the liquidity proxy selected for that market (Moreira De Sousa, 2015).

Amihud & Mendelson (1986) observed that trading cost, liquidity and marketability are amongst the primary considerations of many financial instruments and investment strategies. They found that usual returns are a cumulative function of spread. This

means that the net returns to an asset holder, increases with the spread after accounting for cost. This suggests that there is a relationship between expected return and illiquidity (Amihud & Mendelson, 1986) as supported later by Amihud (2002). Similarly, Pastor & Stambaugh (2003) noted that cross-sectional expected stock returns are associated with variations in aggregate liquidity and the responsiveness of returns.

### **2.3. Measures of illiquidity**

The measures to estimate illiquidity in the stock market have been covered extensively by literature. Measures of illiquidity such as Turnover, Market depth, Bid-Ask Spread, and Size are seen as more experiential while other proxies such as Price Reversal and Lambda are seen to be driven by theory (Vayanos & Wang, 2013).

Goyenko et al. (2009) ran a comparison for choice probabilities of all commonly used measures of liquidity and asserted to the literature that liquidity proxies measure liquidity. Goyenko et al. (2009) study identified measures that can be calculated from daily or monthly data (low-frequency) and microstructural proxies that can be computed from high-frequency intraday data.

Chung & Zhang (2014) developed a Bid-Ask Spread measure that can be computed by means of daily data; namely, the Closing Percent Quoted Spread. Other low-frequency proxies include Amihud (2002) ILLIQ measure and Kang & Zhang (2014) which added another form of low-frequency liquidity measure accounting for non-trading days or zero volume to the original Amihud measure. Fong et al. (2017) validated the Closing Percent Quoted Spread and the daily version of Amihud measure as among the best liquidity proxies for global research. Pastor & Stambaugh (2003) and Amihud (2002) also developed proxies that can be used for price impact low-frequency measures.

Holden (2009) developed new measures that have three qualities of the low-frequency data, value grouping, serial value covariance representing midpoint costs on no-exchange days, and the cited spread that is accessible on no-exchange days. The performance of the Holden (2009) spread measure was confirmed by Corwin & Schultz (2012).

According to Aitken & Comerton-Forde (2003), there are two broad categories of liquidity measures; namely, (1) order-based measures and (2) trade-based measures. These

authors also found that order-based measures like bid-ask spread, catch the ability to trading instantly. Trade-based measures consist of turnover ratio, trading value, number of trades and trading volume which can easily be calculated from data, mostly available in various markets (Aitken & Comerton-Forde, 2003). While trade base measures are widely accepted primarily by market professionals, Aitken & Comerton-Forde (2003) showed that they are the most problematic measures since these indicate what people have traded in the past which is not always a good indicator of what will be traded in the future, especially in the context of small stock (Marshall, 2006).

Order-based measures, on the other hand, indicate what the market expects the liquidity to be. The measures accurately capture the ability to, and cost associated with, trading instantly (Aitken & Comerton-Forde, 2003). These measures include Bid-Ask Spread, Relative Order Depth and Weighted Order Volume (*WOV*). According to Marshall (2006), An accurate liquidity proxy should categorize an asset as more liquid than the other if it can be traded without loss at short notice.

While the illiquidity measures covered in this literature review section are not exhaustive, the study covers the most common and influential measures of liquidity in the literature (Amihud, 2002; Amihud & Mendelson, 1986; Kyle, 1985; Roll, 1984). The section below describes the various proxies or measure of liquidity in recent literature (Ali & Boadu, 2016; Kang & Zhang, 2014; Vayanos & Wang, 2013; Vidović et al., 2014). (Refer to Appendix One of this report for a comprehensive list of liquidity measures found in the literature and referenced in the study).

### **2.3.1. Amihud *ILLIQ***

Amihud (2002) used a measure of stock illiquidity called *ILLIQ* to test the proposal that asset returns increase in illiquidity. This measure is understood as the daily ratio of absolute stock return to its dollar volume, averaged over some period. Based on the findings from this test, Amihud (2002) presented a compelling argument for the use of the *ILLIQ* as a measure of liquidity. As a result, the *ILLIQ* became widely used to measure illiquidity in the asset market (Chelley-Steeley, Lambertides, & Steeley, 2015).

Amihud (2002) defines the illiquidity of stock *i* in month *t* as (equation 1):

Equation 1: Amihud Illiquidity measure (ILLIQ)

$$ILLIQ_t^i = \frac{1}{D_t^i} \sum_{d=1}^{D_t^i} \frac{|R_{td}^i|}{VOL_{td}^i} \quad (1)$$

Where  $R_{td}^i$  and  $VOL_{td}^i$  are the return and dollar volume (in millions), respectively, on day  $d$  in month  $t$ , and  $D_t^i$  is the number of valid observation days in month  $t$  for stock  $i$ .

Source: (Amihud, 2002)

This measure has been a subject of various studies either testing its validity (Brennan, Huh, & Subrahmanyam, 2013; Kang & Zhang, 2014; Lou & Shu, 2016) or used as a measure of illiquidity (Amihud et al., 2012; Amihud & Mendelson, 2015; Hassan & Javed, 2011; Vidović et al., 2014). The measure is a direct inverse of the liquidity ratio known as the Amivest measure, which is the ratio of the sum of the daily volume to the sum of the absolute return (Acharya & Pedersen, 2005; Amihud, 2002). The Amivest measure is considered in the empirical microstructure literature as a proxy for market depth and a measure of price impact (Acharya & Pedersen, 2005; Banerjee et al., 2007; Goyenko et al., 2009; Lesmond, 2005).

Brennan et al. (2013) found that the Amihud (2002) measure of illiquidity is priced consistently in the cross-section of asset return for NYSE/AMEX and NASDAQ from July 1971 to December 2009. While the ILLIQ measure is widely accepted, there are concerned that, it might not be relevant in emerging markets (Kang & Zhang, 2014; Vidović et al., 2014) and other markets where there are zero trading volumes (Chelley-Steeley et al., 2015).

Emerging markets will have stock with zero trading volume, which will impact the applicability of the Amihud illiquidity measure as the ratio will become undefined (Kang & Zhang, 2014). Mathematical and spreadsheet software packages used in calculating the large volume of data cannot divide by zero, therefore, affecting the used of Ahimud's ratio where there are zero trading volumes (Chelley-Steeley et al., 2015). The JSE is one of those markets which have stock with zero trading volumes, 12% of the listed stock in April 2017 had zero trading volume (IRESS Research Domain, 2017).

The high degree of shares ownership concentration in emerging markets affects the level of Free Float (Shares available for trading) shares in the market to be traded actively by investors (Hamdan, 2017). The Amihud ratio in emerging markets will be affected by the

level of Free Float impacting the volume available for trading. High ownership concentration is also prevalent on the JSE. As a result, in 2002 free float adjustment factor was introduced by the JSE in calculating the weighting of FTSE/JSE indexes so that they only include share that is available to public investors (FTSE/JSE, 2017; Muller & Ward, 2011).

Amihud (2002) main proposition that asset returns increase in illiquidity measured by the *ILLIQ* ratio will be tested on the JSE. The Amihud (*ILLIQ*) measure enables the study of the time series effect of illiquidity, which is not possible to carry out with microstructural data that is only available for a short period (Amihud, 2002).

### 2.3.2. Turnover

Amihud (2002) also developed a turnover version measure of illiquidity (TRNOVER). TRNOVER is defined as the number of shares traded divided by the number of shares outstanding as a proxy for liquidity. His findings were two fold; that the expected market illiquidity positively affects the stock excess return, and that the surplus return on small firm's stock is controlled by the change in market illiquidity.

The Turnover measure shows the ratio of the monthly number of shares traded to with a total number of shares outstanding. It also indicates the number of times a stock changes its owner (Hamdan, 2017). The Turnover ratio measures stock liquidity as (equation 2):

*Equation 2: Amihud Turnover measure of liquidity*

$$TRNOVR_{iy} = \frac{1}{D_{iy}} \sum_{t=1}^{D_{iy}} \frac{VOLSHS_{iyt}}{NSHRS_{iyt}} \quad (2)$$

Where  $VOLSHS_{iyt}$  is the trading volume in shares of stock  $i$  on day  $t$  in year  $y$ , and  $NSHRS_{iyt}$  is the number of shares outstanding of stock  $i$  on that day. The higher the turnover ratio, the more the liquidity.

Source: (Amihud, 2002)

Both the *ILLIQ* and *TRNOVER* measures have been widely confirmed and endorsed by various studies (Acharya & Pedersen, 2005; Brennan et al., 2013; Cheng, Hameed, Subrahmanyam, & Titman, 2017).

Lou & Shu (2016) found that Amihud's measure pricing intended to capture price impact is not because of the contraction of the return-to-volume ratio. The pricing is dependent on the trading volume component. Moreover, in using high-frequency measure of price impact, there is a slight indication projected by the conventional theory that stocks with more significant price impact earn a higher expected return. Lou & Shu (2016) study found little evidence that price influence a significant element of transaction cost using both the high-frequency price impact benchmark and Amihud's low-frequency measure. There is, therefore, a need for further research in the area as their findings contradict the theory.

Muller & Ward (2013) re-examined the style variables on the JSE, which included liquidity measured by turnover, using a significantly improved data set over a more extended period of 27 years from 1985 to 2011, and a better methodology, employing their style engine. A detailed description of what Muller & Ward (2013) style engine does is covered in section 4.6.1. In their methodology, Muller & Ward (2013) included all new companies that are listed on the main board of the JSE . To avoid survivorship bias the researchers included both the new listing and delisted companies, which was consistent with that of Amihud (2002).

Muller & Ward (2013) also traced back companies that unbundled (spin-off) within the sample period and combined their returns with the newly listed subsidiary within the holding period and after that treated them as separate entities. Their turnover version of the liquidity proxy was defined as (equation 3):

*Equation 3: Muller & Ward (2013) Turnover measure of liquidity*

$$\text{Turnover} = \frac{\text{Value of Shares Traded}}{\text{Market Capitalisation}} \quad (3)$$

Source: (Muller & Ward, 2013)

The version of turnover used by Muller & Ward (2013) has also been used by Cumming et al. (2011), Lesmond (2005) and Lecce, Lepone, Mckenzie, & Segara (2012). The Muller & Ward (2013) study observed a significant spread between the best and worst portfolios, with the two least liquid portfolios showing the highest returns. Their results showed a nominal premium of 9.8% per annum for the two least liquid portfolios over the

most liquid portfolio. A survey of relevant literature suggest that Muller & Ward (2013) study is the only study done on the JSE that found the existence of an illiquidity premium. Their use of a robust methodology ensured data accuracy. Similar level of robustness is replicated in this study to arrive at reliable conclusions.

### **2.3.3. Adjusted Amihud Measure (*AjdILLIQ*)**

Kang & Zhang (2014) proposed a modified version of the Amihud illiquidity measure, *AjdILLIQ*. This version performed well in the emerging markets such as China, Brazil, Turkey, and South Africa. According to Kang & Zhang (2014), the emerging markets can be grouped into two types; namely, those that are actively traded with few zero trading days and those that are inactively traded characterised by a high volume of zero volume and non-trading days. The *AdjILLIQ* measure combines the original Amihud ratio and the non-trading-frequency measure. *AdjILLIQ* is the log transformation of the original Amihud ratio multiplied by the sum of One and the proportion of non-trading days in the given month (ZeroVol).

The study of Kang & Zhang (2014) endorsed Amihud illiquidity ratio. It has, however, found that there should mostly be a non-zero trading volume in a market for Amihud's illiquidity measure to hold. On the basis of what they perceived as weakness in the Amihud illiquidity measure.

Kang & Zhang (2014) suggested that future studies should consider using the *AdjILLIQ* measure to study how common liquidity is, the relationship between liquidity and other relevant stock market variables such as the equity risk premium in the framework of the global market, and the pricing of liquidity. The insertion of an adjustment for zero trading volume in *ILLIQ* measure is supported, and it will be an appropriate measure to use in the JSE. As described in section 1.3, the 12% of listed companies in April 2017 had zero trading volumes. Kang & Zhang (2014) calculated the daily turnover rate of various emerging markets and South Africa had a low ratio of 0.159 compared to India (0.429) China (1.310), Brazil (1.21) and Russia (0.146). South Africa together with Russia ranked low amongst the BRICS members.

The analysis of Kang & Zhang (2014) suggested that in many circumstances the Amihud illiquidity measure is better than others, but it is not useful where there are many zero-trading days in a specific market, which is common in the emerging markets. They

suggested a modified Amihud measure, *AdjILLIQ*, which combines the original Amihud *ILLIQ* and *ZeroVol* (as calculated in Equation 5), calculated as follows (equation 4):

*Equation 4: Adjusted Amihud Amihud Illiquidity*

$$AdjILLIQ_{i,t} = \left( \frac{1}{D_t^i} \sum_{d=1}^{D_t^i} \frac{|R_{td}^i|}{VOL_{td}^i} \right) \times (1 + ZeroVol_{i,t}) \quad (4)$$

Where  $R_{td}^i$  is the absolute value of return on stock  $i$  on day  $d$  in month  $t$ ,  $VOL_{td}^i$  is the trading volume in dollar on stock  $i$  on day  $d$  in month  $t$ , and  $ZeroVol_{i,t}$  is the percentage of zero-volume days within month  $t$ .

Source: (Kang & Zhang, 2014)

*ZeroVol* measures the amount of none trading volume days and measures the incidence of the zero-volume occurrences more directly. The *ZeroVol* is defined as (equation 5):

*Equation 5: Zero Trading Volume Measure*

$$ZeroVol = \frac{\text{Number of days with zero volumes in a month}}{\text{Total number of trading days in a month}} \quad (5)$$

Source:(Kang & Zhang, 2014)

The performance of Kang & Zhang (2014) Adjusted Amihud illiquidity measure (*AdjILLIQ*) has been validated to be performing particularly well for relative illiquid markets (Hamdan, 2017; Ma et al., 2016).

#### **2.3.4. Kyle's Lambda (price impact)**

Kyle (1985) identified three aspects affecting the degree of liquidity of the market, (i) resilience, (ii) depth, and (iii) tightness. Ali & Boadu (2016) suggest that the depth and resilience parts of market liquidity are hard to stratagem because of the way that, their estimation requires comprehensive data on each trade in the market which may not be promptly accessible.

According to Kang & Zhang (2014), the price impact proxy (Lambda) highly correlates with Amihud (2002) in many markets. In catching the impact of a price, they argue that

there is support for the convention that the Amihud measure bolsters the tradition that it is planned as the proxy for price.

Vayanos & Wang (2012) characterizes Kyle's Lambda (Price impact) as the cause of the value change between the present and past period on liquidity demanders' marked volume in the present time frame. Vayanos & Wang (2012, 2013) recommend that the supplier-based meaning of Lambda can be simple to actualize experimentally since suppliers in some market are assigned market creators and data on their trades is regularly accessible.

Vayanos & Wang (2012) Lambda or price impact can be expressed in an equation as the coefficient of a regression of the asset's return,  $S_1 - S_0$ , between Period zero and One on the signed volume,  $\pi(\theta_1^S - \bar{\theta})$ , of liquidity demanders in Period One. Where  $\bar{\theta}$  is the equilibrium of aggregate demand and the asset supply, the Market-Clearing,  $\theta_1^S$  being representative of the suppliers of liquidity can purchase the risky asset if its price  $S_1$  in Period One is below the expected payoff and would like to sell differently (equation 6):

*Equation 6: Price Impact measure of liquidity*

$$\lambda \equiv \frac{\text{Cov} [S_1 - S_0, (1 - \pi)(\theta_1^S - \bar{\theta})]}{\text{Var} [(1 - \pi)(\theta_1^S - \bar{\theta})]} \quad (6)$$

Source: (Vayanos & Wang, 2012)

When Lambda ( $\lambda$ ) is significant, trades' price impact is significant price impact and the market is not liquid.

### 2.3.5. Bid-Ask Spread

Research found that illiquidity can be measured by the cost of instant trading and that the ordinary proxy of illiquidity is the spread between the bid and ask prices, which is the summation of the selling concession and buying premium (Amihud & Mendelson, 1986). According to Corwin & Schultz (2012), the easiest way to approximate Bid-Ask Spread is through low and high prices on a daily basis. They suggest that the first day high prices are always "buy" orders, and the daily low price is almost always "sell" orders. Therefore,

they argue that the high-to-low price ratio for a day echoes both its Bid-Ask Spread and the important unpredictability of the stock.

Chung & Zhang (2014) calculated Bid-Ask Spread for the NYSE/AMEX stocks using data from the Centre for Research in Security Prices (CRSP) database which records Ask as “the closing ask price” and Bid as “the closing bid price”. They calculated the Bid-Ask Spread of stock  $i$  on day  $t$  and used the following formula (equation 7):

*Equation 7: Chung & Zhang (2014) Bid-Ask as a measure of liquidity*

$$Spread_{i,t} = \frac{Ask_{i,t} - Bid_{i,t}}{M_{i,t}} \quad (7)$$

Where  $Ask_{i,t}$  is the price of stock  $i$  on day  $t$  from the CRSP daily data,  $Bid_{i,t}$  is the bid price of the price of stock  $i$  on day  $t$  from the CRSP daily data, and  $M_{i,t}$  is the mean of  $Ask_{i,t}$  and  $Bid_{i,t}$ .

Source: (Chung & Zhang, 2014)

In view of the given market efficiency, Roll (1984) observed that the effective Bid-Ask Spread can be estimated by use of serial covariance in price changes (equation 8):

*Equation 8: Roll (1984) spread as measure of liquidity*

$$Spread = 2\sqrt{-cov(\Delta P_t, \Delta P_{t-1})} \quad (8)$$

Where  $cov(\Delta P_t, \Delta P_{t-1})$  is the first-order serial covariance of price changes.

Source: (Roll, 1984)

The potential shortcoming of Roll’s spread is that if the serial covariance sample is positive, then the effective spread is not defined (Ali & Boadu, 2016).

Ali & Boadu (2016) applied the Bid-Ask Spread on all Norwegian stocks using Corwin & Schultz (2012) estimator that relies on high and low prices on a daily basis and they revealed that the portfolio which comprises stocks with the wider Bid-Ask Spread has on average higher returns than all other portfolios. The lowest liquid portfolio outperformed the highest liquid portfolio, which indicates the presence of liquidity premium for the

Norwegian stocks. The stocks of large firms perform above the stocks of small companies for both the lowest and highest liquid deciles. Accordingly the average return variation between these liquid stocks are positive every year.

### 2.3.6. Relative Change in Volume (RCV)

Vidović, Poklepović, & Aljinović (2014) in the paper, “How to Measure Illiquidity on European Emerging Stock Markets?” identified that there is a lack of research dealing with illiquidity in emerging markets. The paper tested the relative performance of two popular illiquidity measures, ILLIQ (Section 2.3.1) and Turnover (Section 2.3.2), on the European emerging stock markets and secondly proposed an enhanced illiquidity measure, Relative Change in Volume (RCV). The measure of Relative Change in Volume is derived from first principles, as follows (using equation 9, equation 10 and equation 11):

*Equation 9: Average trading volume (AVV)*

*Equation 10: Relative daily change in volume (RDCV)*

*Equation 11: Relative change in liquidity as a measure of liquidity (RCV)*

The first step is to calculate the Average trading volume (AVV) for each stock in the observed period:

$$AVV_i = \sum_{t=1}^I V_{it} / I \quad (9)$$

The second step is to calculate Relative Daily Change in Volume (RDCV) as the absolute difference between the traded volume on day t and t-1 over average volume for each stock in the observed period:

$$RDCV_{it} = |V_{it} - V_{i,t-1}| / AVV_i \quad (10)$$

RDCV measures daily illiquidity, and when it is calculated for the whole period, it represents illiquidity measure of a single stock. Relative Change in Volume (RCV) is then measured as:

$$RCV_i = \sum_{t=1}^I RDCV_{it} / I \quad (11)$$

Source: (Vidović et al., 2014)

Vidović et al. (2014) proposed a Relative Change in Volume (RCV) can be easily calculated from the data on stock returns and traded volume within a monitored period. The illiquidity measure attempts to consider the pressure of significant differences in volume on return.

The results of Vidović, Poklepović, & Aljinović (2014) study found that ILLIQ and Turnover are not suitable for the seven observed markets whereas RCV gave acceptable outcomes, clearly differentiating between illiquid and liquid market and between illiquid and liquid stock. While RCV gave relevant evidence about the stock illiquidity for most of the observed stocks, the results were varying in some cases. The researcher suggested future research is carried out to confirm the validity of the proposed illiquidity measure. To this end, the European emerging markets have many similarities with the Johannesburg Stock Exchange. Therefore the study and the measure is deemed relevant in the South African markets contexts.

### 2.3.7. Price Reversal

Vayanos & Wang (2013) defined Price Reversal as the minus autocovariance of return and is based on the idea that trades in illiquidity markets should generate transitory deviations between price and fundamental value. Price Reversal measure relies on the autocovariance of returns where liquidity demanders' trades in Period One affects price deviation from the core value. The two however coincide in Period Two. Returns thus show negative autocovariance when trades have a substantial price impact on the stock (Vayanos & Wang, 2013).

According to Cheng, Hameed, Subrahmanyam, & Titman (2017), return reversals occur in stocks that have high illiquidity. This is consistent with price pressures from non-informational shocks being more significant for illiquid stocks. When framed in this light, it is understood that the withdrawal by market makers and active investors similarly affect illiquidity.

*Equation 12: Price Reversal as measure of liquidity*

$$\gamma \equiv -Cov(S_2 - S_1, S_1 - S_0) \quad (12)$$

Source: (Vayanos & Wang, 2013)

The minus autocovariance is used as a measure of illiquidity (equation 12), where  $S$  is the stock price for the period. Pastor & Stambaugh (2003) propose that the less liquid the stock is, the stronger the reverse is with a specified amount of volume.

### 2.3.8. Weighted Order Value (WOV)

Marshall (2006) developed Weighted Order Value (WOV) as a liquidity proxy specifically for order-driven markets such as China and Australia to show the association between liquidity and return. *WOV* beats the shortcomings of conventional liquidity measures by consolidating both Bid-Ask Spreads and market depth. Not at all like trade-based measures, *WOV* incorporates orders that are accessible for an investor to exchange against, and as opposed to order-based measures, *WOV* represents the profundity scale that is accessible in each quote (Marshall, 2006). The Weighted Order Value (*WOV*) is calculated as (equation 13):

*Equation 13: Weighted Order Value as measure of liquidity*

$$\text{Weighted Order Value} = \sqrt{\text{Weighted Bid Value} \times \text{Weighted Ask Value}} \quad (13)$$

Where *Weighted Bid Value* is calculated by multiplying the Bid Order Value (Bid Price x Bid Volume) by the corresponding Bid Execution Rate (Number of Orders Executed in each Bid Price Band divide by the total number of orders in each Bid Price Band).

Source: (Marshall, 2006)

## 2.4. Studies of illiquidity in the South African Market

Despite being classified as an emerging market, the South African market represented by the JSE, is the best-regulated market, most developed and the largest in Africa (Hearn, Piesse, & Strange, 2010). The market has a sizeable institutional investor participation and highly diversified ownership, unlike the rest of the markets in Africa (Hearn et al., 2010). A study by Assefa & Mollick (2014) observed that liquidity had increased sharply in the South African market between the periods 1995 and 2009 attributing it to the move to electronic trading and South Africa's leading role in the introduction of international levels of corporate governance.

In his study of the African stock market returns and liquidity premia, Assefa & Mollick (2014) found the South African market to be an outlier. When measuring the association between stock returns and liquidity measures of 16 African countries excluding South Africa, is positively correlated. However when South Africa was included in the sample then the correlation was no longer statistically significant (Assefa & Mollick, 2014). It can be deduced from Assefa & Mollick (2014) study that using a single measure of liquidity on the JSE market might yield misleading or inconclusive results. Below is an extract of prior studies in the South African market on liquidity.

Vorster (2008) studied the holding period of securities on the JSE and impact of liquidity on the return. The study tested empirically both the spread return relationship and the clientele effect on the JSE over the period of five and half years from January 2012 to June 2007 using the methods of Fama & MacBeth (1973), the aggregated beta and Marshall (2006) Weighted Order Value (WOV).

Vorster (2008) findings showed no relationship between spread-return contrary to Amihud & Mendelson (1986) proposition and found no clear proof of a liquidity premium on the JSE. The findings of the study were speculated to have been influenced by the short period (five years) used. Thus, a study for a more extended period of at least ten years was suggested. Unlike both Amihud (2002) and Muller & Ward (2013), the study by Vorster (2008) used data provided by I-Net Bridge excluding both the delisted stock (a survivorship bias) and the dividends as returns (incomplete returns).

Reisinger (2012) examined the impact of liquidity on excess stock returns on the JSE from 2003 to 2011. Five liquidity proxies including Bid-Ask spread, Turnover, and two Zero return measures were used in the study. The study revealed that on the JSE liquidity is not a priced factor and as a result, they recommended more investigation to explain this surprising finding.

Reisinger (2012) used a period which consisted mainly of the global financial crisis and European Debt crisis (2003 to 2011) which might have distorted the results. With these limitations in mind, it was suggested the study be repeated using a more extended period. Reisinger (2012) also recommended that other measures of liquidity be included in the repeat study and to test the suitability of the measures employed as proxies for liquidity in the study. This research project takes a cue from Reisinger (2012) recommendations to test the suitability of the selected measures of liquidity.

## 2.5. Other studies on liquidity measure and illiquidity premium

Ben-Rephael, Kadan, & Wohl (2015) found that the sensitivity of liquidity premia and returns to liquidity premia consistently declined drastically to a zero level over the past four decades. Similarly, they observed that strategies for liquidity-based investment style are no longer profitable due to a consistent deterioration in the past forty years. On the other hand, they show that a number of reforms and improvements in technology have had some remarkable improvements in liquidity.

Muller & Ward (2013) analysing data from the JSE also observed that the trend of their most illiquid portfolio was downwards for the initial part of the time series but flat for most of the last nine years of their study. This finding suggests that illiquidity premium no longer exists and that the consequence of lower transaction costs and electronic trading could have impacted the existence of illiquidity on the JSE.

Hassan & Javed (2011) examined how illiquidity premium and equity returns are related in Pakistan by using Fama & French (1992) methodology. They concluded that illiquidity premium negative to equity returns in significant ways. The findings contradicted that of Amihud & Mendelson (1986) who had revealed that illiquid stocks were earning a higher return as compensation for taking illiquidity risk. Because Pakistan is regarded as an emerging market, Hassan & Javed's (2011) study is relevant to the current study on measures of illiquidity on the JSE as an emerging market.

Borcherding & Stein (2016) study uncovered the ability of the liquid stock to generate significantly higher risk-adjusted portfolio returns than their illiquid counterparts. They showed that a significant adverse illiquidity premium could be obtained when accounting for a strong negative correlation between a stocks illiquidity and its market value of equity. Amihud et al. (2015) methodology of working out the averages between the most illiquid and liquid portfolios (illiquid Minus liquid) denoted by *IML* was followed by Borcherding & Stein (2016). Borcherding & Stein (2016) study observed that when neglecting the correlation structure between two common liquidity measures, *ILLIQ* (section 2.3.1) and *Turnover* (2.3.2), illiquid stocks exhibit higher risk-adjusted returns than liquid stocks consistent with existing theory. Further research was suggested on the individual characteristics of stocks dependence of their actual illiquidity level.

## 2.6. Conclusion on literature reviewed

In this chapter, we learned that liquidity meets the criteria for investment style and should be included into investors strategy (Ibbotson et al., 2013; Muller & Ward, 2013; Theart & Niel, 2014). Literature supports the notion that there is an illiquidity premium which serves as compensation for investors to hold illiquid assets versus a liquid one (Amihud & Mendelson, 1986). It has also been shown that illiquidity and returns are related (the more illiquid an assets is, the higher the expected return as compensation for risk) (Amihud, 2002; Amihud & Mendelson, 1986).

In summary, despite the wealth of literature in Illiquidity and stock returns the results of the various studies conducted in this area seemed to vary depending on the measure of liquidity selected. The objectives of this thesis are:

- (i) to examine the selected measures of liquidity and understand how each performs against the market benchmark, typically an index, in this case, the Allshare Index (J203T) as a proxy for the market performance;
- (ii) to determine which of the measures of liquidity, as a liquidity proxy in a liquidity-based investment strategy outperforms the market returns on the JSE; and
- (iii) to understand the effect of time on illiquidity (short-term versus long-term) in explaining returns and understand whether the successful measure(s) have consistently outperformed the market over time.

The studies on the topic of illiquidity premium are either U.S.-centric (Fang et al., 2009), aggregated on an international level (Amihud et al., 2012), aggregated on type of market level, developed or emerging markets (Kang & Zhang, 2014; Vidović et al., 2014), or carried out in other countries or stock markets (Hamdan, 2017; Hassan & Javed, 2011).

Only a few studies were conducted on illiquidity on the JSE. Within the range of the studies performed on the stock exchange, their findings were most significantly affected by choice of data period and less enhanced or robust data set (Reisinger, 2012; Vorster, 2008), or only used a single measure of illiquidity (Theart & Niel, 2014). This paper attempted to bridge this divide by making a comparison between seven measures of illiquidity using a robust data set like Muller & Ward (2013) and for a period of 20 years from 1997 to 2017.

## Chapter 3: Research Question / Proposition

### 3.1. Main Research Question

This paper intends to answer the following primary question:

**Can liquidity based investment style, using the appropriate liquidity measure, produces profitable returns on the JSE that consistently outperforms the market benchmark, as represented by the JSE All Share Index (J203T)?**

As described in the preceding chapter, the use of liquidity as an investment strategy by investors is supported (Ibbotson et al., 2013; Muller & Ward, 2013; Theart & Niel, 2014). This study aims to measure and compare the results of seven selected measures of liquidity noted from the literature on the JSE to determine as to which of the measures produce returns higher than the rest and the market benchmark represented by the Allshare index J203T.

The seven liquidity measures used in this study except for Localized Turnover, are well-established internationally. This study proposes their use as a measure of liquidity on the JSE. The following research questions and propositions are raised as support to the primary research question. The answers to research questions one and two will then result in answer to the primary research question.

### 3.2. Research Question 1:

**Which measure of liquidity yields the highest returns on the JSE?**

From research Question One, seven propositions are raised. A graphical time-series method developed by Muller & Ward (2013) are used in accessing each proposition were returns were plotted against the J203T over a period of 20 years from 1997 to 2017. Each proposition will be tested by firstly, looking at the correlation between returns and the liquidity measure, compare returns amongst the quintiles and finally, compare the performance in returns and risk of the measure against the J203T.

For a proposition to be accepted, first a  $r^2$  coefficient was used to test the association in the returns earned per quintile that was explained by the score of the measure of liquidity. When  $r^2$  lies between 0 and 0.5, it indicates a weak association between the measure of liquidity and returns, but when it lies between 0.5 and 1 a strong association between the measure of liquidity and returns (Wegner, 2016). The proposition will be accepted if there is a strong association between the liquidity measure and returns, that is  $r^2$  above 0.5. Secondly the illiquid quintile of the measure of liquidity should produce returns above the JSE All Share Index (J203T) at the lowest risk as measured by standard deviation of the returns. All accepted propositions will be the answer to research question one and will be carried on to research question two looking at the performance trends.

### **3.2.1. Proposition 1: The use of Amihud illiquidity measure (*ILLIQ*)**

The use of **Amihud illiquidity measure (*ILLIQ*)** (Equation 14), as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).

### **3.2.2. Proposition 2: The use of Adjusted Amihud illiquidity measure (*AdjILLIQ*)**

The use of **Adjusted Amihud illiquidity measure (*AdjILLIQ*)** (Equation 15), as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).

### **3.2.3. Proposition 3: The use of Relative Change in Volume (*RCV*)**

The use of **Relative Change in Volume (*RCV*)** (Equation 16), as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).

### **3.2.4. Proposition 4: The use of Bid-Ask Spread**

The use of **Bid-Ask Spread** (Equation 17), as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).

### **3.2.5. Proposition 5: The use of Price Reversal**

The use of **Price Reversal** (Equation 18), as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).

### **3.2.6. Proposition 6: The use of Turnover**

The use of **Turnover** (Equation 19), as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).

### **3.2.7. Proposition 7: The use of Localized Turnover**

The use of **Localized Turnover** (Equation 20), as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).

## **3.3. Research Question 2:**

**Do returns of a liquidity-based investment style, using the best measure(s) from research question 1, consistently outperform the market, independent of time or is the time a variable in the performance measurement?**

The consistency of the results and the time factor is analysed following Muller & Ward (2013) graphical time-series methods over the period of 20 years from 1997 to 2017. A time series chart is presented with green lines showing the gap between outer quantiles and the gap between the illiquid quantile with the JSE All Share Index (J203T). If the green line flattens or drops, then the illiquidity measure is fading or even reversing.

To support research Question Two, a proposition is raised. the proposition will be tested by analysing the relative to J203T performance line of the time series chart.

### **3.3.1. Proposition 8: The low liquidity quintile outperformed benchmark and was dependent on time**

The low liquidity quintile of the best performing measure (as established in Research Question 1) has consistently outperformed the benchmark and was dependent on time.

## Chapter 4: Research Methodology

The study aimed at running a detailed analysis of the selected liquidity measures on the JSE for a period of 20 years from 1997 to 2017 on a time series approach to identify the best proxies as a measure of liquidity that yields superior results when used in a liquidity-based investment strategy compared to the rest. The best proxy was measured in terms of the returns of portfolios constructed for each measure using Muller & Ward (2013) methodology as described in Section 4.6.2 and employing an excel based style engine as per Section 4.6.1.

### 4.1. Choice of methodology

#### 4.1.1. Research philosophy

The researcher did a scientific inquiry, looking at already existing stock market data to establish the degree to which the market is pricing for illiquidity premium by applying the relevant illiquidity premium theories on how to measure illiquidity. Saunders & Lewis (2012) classify such scientific inquiry as realism, which is defined as a research viewpoint that highlights that the existence of items is not dependent on our knowledge of their existential reality.

Realism was the most appropriate philosophy for this study because of its objective being to logically measure as accurate as possible, without influence, the performance of each selected measure of liquidity on the Johannesburg Stock Exchange (JSE).

#### 4.1.2. Approaches

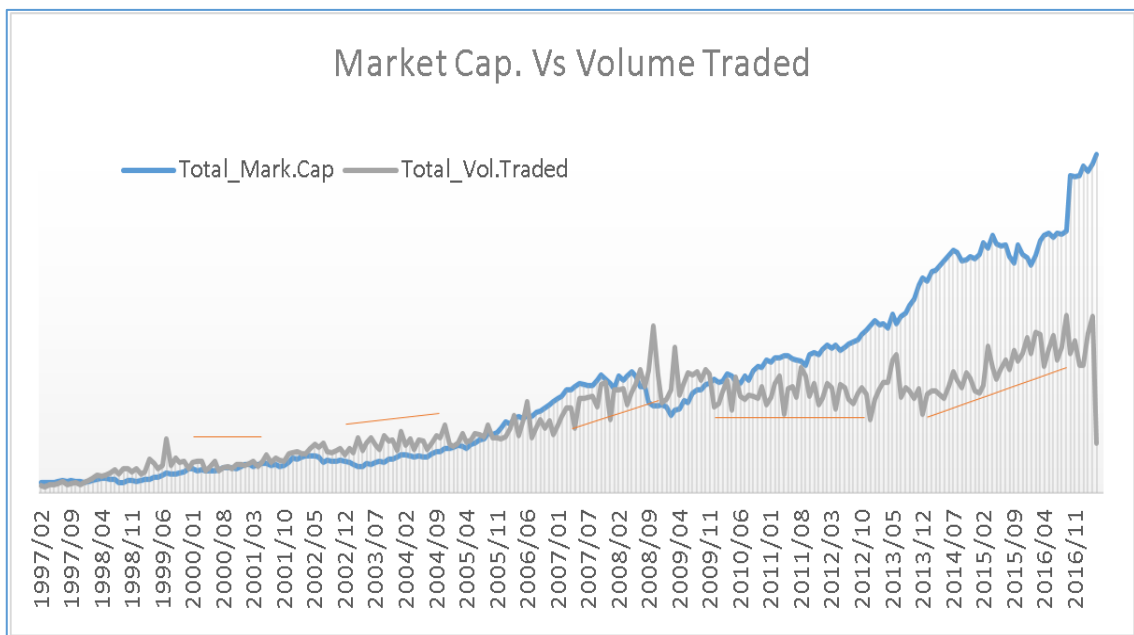
The researcher followed a deduction research plan. Deduction research is defined as a research paradigm which comprises the trying of a theoretical proposal and this happens through the use of strategy that is developed for testing the theory (Saunders & Lewis, 2012). Literature already exists supporting the use of liquidity as an investment style (Ibbotson et al., 2013; Muller & Ward, 2013; Theart & Niel, 2014) and that there is illiquidity premium priced by investors (Amihud & Mendelson, 1986). There also exists a variety of models developed to calculate illiquidity premium (Amihud, 2002; Kang & Zhang, 2014; Vidović et al., 2014).

This study utilised the existing illiquidity theories and models to test their applicability and performance in a South African market. It is a descriptive study, as defined by Saunders & Lewis (2012), as a study that sought to yield a precise illustration of persons, events or situation. Within the context of the study, illiquidity and market returns in the Johannesburg Stock Exchange has been described vividly to provide an accurate picture of the phenomenon. A collection of measurable and quantifiable secondary data has been acquired from McGregor’s BFA-Net, I-NET, and Sharenet databases to meet the research objectives of the study.

#### 4.1.3. Time horizons

The study of a measure of illiquidity was carried over a period of 20 years (from 1997 to 2017) on the JSE. A period of 20 years was selected to cover a period post significant events in the market such as the Asian/Russian financial crises in 1997; Dot-com bubble burst in 2000, the Global financial crisis in 2008, Euro crisis in 2011 and South Africa credit rating downgrade in 2017, allowing for volatility, external market forces, bear/bull markets, and the rest. To give a dynamic landscape that will create a magnitude of analytical variations to study. A total volume traded over the period shows a series of structural trends as indicated in Figure 1 below, thus rendering the period relevant to the analysis of illiquidity measure.

*Figure 1: Market Cap vs Volume traded over a period of 20 years (1997-2017)*



Data Source: (IRESS Research Domain, 2017)

A 20-year period allowed the researcher to construct a time-series to observe over time any patterns in the illiquidity premium. The result of the time series will help understand the effect of time on illiquidity. A longitudinal study had to be followed due to its ability to explore change and development over time as described by Saunders & Lewis (2012). Data was collected, and for each measure of liquidity, the same calculation was repeated quarterly over the 20-year period, thereby allowing for a longitudinal analysis of the results of the measures of liquidity.

#### **4.1.4. Technique and procedure**

A time series quantitative study approach has been followed for reasons outlined from 4.1.1 to 4.1.3 above and that the nature of the study involves analysis of quantitative data. Market data containing trading and financial information has been collected from McGregor's BFA-Net, I-NET, and Sharenet databases and required a quantitative approach to analyse it.

#### **4.2. Research design**

The researcher followed a cross-sectional research design for the analysis of financial and market data over time. A cross-sectional design involved gathering of information from more than one case and at a single point in time. The goal was to collect a representative sample of quantitative data in linking with two or more variables examined in order to spot forms of relationships (Bryman & Bell, 2014).

The study of the measure of illiquidity meets the elements that characterise a cross-sectional design, adapted from (Bryman & Bell, 2014); namely:

- *More than one case* - researcher studied variation between illiquidity measure and returns from equity stock;
- *At a single point in time* – researcher analysed daily, monthly and yearly illiquidity looking at variables such as the value of shares traded, market capitalisation, return on the stock, amongst others;
- Quantitative data – the study analysed numerical (financial) data; and
- Patterns of Association – the Association amongst illiquidity premium and performance yields of various classes of assets are to be explored.

#### 4.3. Population

The target population is the whole collection of items or foundations applicable to the research project which is applicable since they hold the evidence required for the study purpose (Hair, Wolfinbarger, Money, Samouel, & Page, 2011: 165). The targeted population for this study consisted of all equity stock listed since 1997 to 2017 on the Johannesburg Stock Exchange, which included new listing and delisted stock.

#### 4.4. Unit of analysis

In this study, multiple objects are being measured, counted or observed. Therefore, there are multiple units of analysis (Wegner, 2016). Table 1 below provides a list of each unit of analysis against each measure of liquidity used.

Table 2: Unit of analysis for each measure of liquidity

Measure of liquidity	Unit of Analysis
Amihud illiquidity measure ( <i>ILLIQ</i> )	Daily closing volume traded, Daily closing value traded in Rand, Daily closing stock price in Rand; and Previous day closing stock price in Rand  Refer to Equation 14 for the application.
Adjusted Amihud illiquidity measure ( <i>AdjILLIQ</i> )	Daily closing volume traded, Daily closing value traded in Rand, Daily closing stock price in Rand, Previous day closing stock price in Rand, Days stock traded in a month, and Number of trading days in a month  Refer to Equation 15 for the application.
Relative Change in Volume ( <i>RCV</i> )	Rand value traded at the end of each quarter, where the end of the quarter is defined as the 31 March, 30 June, 30 September and 31 December, or the nearest previous trading day.

Measure of liquidity	Unit of Analysis
	Refer to Equation 16 for the application.
Turnover	Rand value traded and Market capitalisation of Firm on the last trading day of the month.  Refer to Equation 19 for the application.
Bid-Ask Spread	Rand value of daily closing stock Ask price and Offer price  Refer to Equation 17 for the application.
Price Reversal	Daily closing stock price  Refer to Equation 18 for the application.
Localized Turnover	Rand value traded and the SWIX weight of stock on the last trading day of the month  Refer to Equation 20 for the application.

#### 4.5. Sampling methods and size

Similar to Muller & Ward (2013), the analysis was conducted on all listed companies, but constructed portfolios/quantiles using only the top 160 companies ranked by market capitalisation after making sure that there were no missing variables in the sample of companies selected. The data set used for analysis was obtained from Muller & Ward (2013) Style Engine, which included all companies that were listed on the main board of the JSE from 1997 to 2017. This included new listings and delisted companies in order to eliminate survival biases in the dataset. Changes in share price due share splits were adjusted backwards in the Style Engine (Muller & Ward, 2013).

Amihud et al. (2015) in their study that examined illiquidity premium in stock markets in 45 countries included stocks that ceased to exist in their sample of stock. To reduce the data error influence, they applied several filters to the data obtained from the Thomson Reuters DataStream Financial Database. Amihud et al. (2015) approach are consistent with that used by Muller & Ward (2013) in the style engine. A similar approach has been followed in this study. To avoid survivorship bias, a stock that no longer existed at the time of the study was included in the relevant portfolio.

Similar to Muller & Ward (2013), companies that unbundled or spins-of a subsidiary were tracked back. These included the returns from the holding company to those of the recently listed subsidiary for the rest of the quarter under review. At the beginning of the following quarter then treat both entities as separate companies.

The top 160 shares ranked by market capitalisation are mostly part of the JSE All Share Index (J203T). The All Share Index makes up 99% of the Market Capitalisation of the JSE; therefore, it was a representative of the market. The shares were divided into equally weighted quantiles consisting of five portfolios ranked using the appropriate liquidity proxy under consideration. The JSE had an average of about 380 listed equity stock out of which about 160 were included in the Allshare Index (Muller & Ward, 2013).

#### **4.6. Measurement instrument**

The following seven measures of illiquidity were employed in this study; namely Amihud Illiquidity measure, Adjusted Amihud Illiquidity measure, Relative Change in Volume, Bid-Ask Spread, Price Reversal, Turnover, and Localized Turnover using the corresponding equations as stated in section 4.6.3. Each constructed quantile was tested using each of the equations representing the illiquidity measure. The researcher used secondary data from McGregor's BFA-Net, I-NET, and Sharenet databases. Data was accessed via online database platform employing Muller & Ward (2013) Style Engine.

##### **4.6.1. Style engine**

For data analysis, Muller & Ward (2013) Style Engine was used. The Style Engine is an Excel tool using VBA code to manipulate data from Access database. This engine allows for parameterization of inputs, definition and selection of the various illiquidity measures to be employed in the study, and construction of the portfolios for analysis (Muller & Ward, 2013).

Inputs into the style engine were parameterised allowing the selection of date ranges for data analysis such as the start date (31 December 1997), end date (31 July 2017), the number of portfolios (Quintiles for this study), the portfolio holding period after contraction (used three months) and whether to apply any exclusions.

The style engine ignored transaction cost that related to the quarterly re-balancing in each portfolio because these will be about the same between portfolios and immaterial. The engine's ability to define and select for analysis individual and combinations of the more than 30 style characteristics enabled the researcher to for example apply Bid-Ask Spread percentage as a form of cost when looking at the "Localized Turnover" measure.

Same as the recommendation by Vorster (2008), the style engine included dividends in share returns. According to Muller & Ward (2013), dividend receipts constitute a large part of the return received by investors. Thus they were included in the style engine dividends share returns that used the INET historical time series of dividend payouts.

#### **4.6.2. Quintile construction**

For the analysis, each measure was divided into quantiles of equal weighted number of shares ranging from the most liquid quintile (Quintile One) to the illiquid quintile (Quintile Five). The quintiles were constructed by ranking the results calculated on each measure of liquidity and only taking the top 160 shares ranked by market capitalisation. Each quintile was formulated using calculations from data at the start of each quarter, all shares included in each portfolio were held for the following period of three months similar to an approach used by Muller & Ward (2013). At the beginning of each quarter, the process was repeated for the entire period starting from 31 December 1997.

The logic followed in these study is that at the commencement of each quarter based on an illiquidity measure selected a quintile will be formulated and all shares included in it will be held for the next three months then review the returns earned from each quintile. Cumulative quarterly results were then aggregated for the full period under consideration to see the total returns for the period having used a measure of illiquidity as an investment style. This method of contracting quintiles is similar to that used by Muller & Ward (2011, 2013).

#### **4.6.3. Liquidity proxy construction**

The below seven proxies were selected to for testing as a measure of liquidity on the JSE, and this section explains how each measure was calculated. Each of the measures was added to Muller & Ward (2013) Style Engine as style characteristics.

#### 4.6.3.1. Amihud illiquidity measure (*ILLIQ*)

The Amihud measure of liquidity has been cited by many papers as the measure of liquidity to be used (Amihud et al., 2012; Asparouhova, Bessembinder, & Kalcheva, 2010; Bongaert Joost Driessen Frank de Jong, 2012; Bortolotti, De Jong, Nicodano, & Schindele, 2007; Chelley-Steeley et al., 2015; Easley, Hvidkjaer, & O'hara, 2010; Fong et al., 2017; Korajczyk & Sadka, 2008; Mahanti, Nashikkar, Subrahmanyam, Chacko, & Mallik, 2008). This measure has dominated illiquidity research internationally and in the US markets (Fang et al., 2009) and therefore, testing its applicability on the JSE will contribute to the body of existing knowledge. Amihud (2002) paper is considered the pinnacle in the liquidity space and is widely cited (with over 6000 citations) in the academic world.

The Amihud illiquidity measure was calculated following the equations as defined by Amihud (2002) as described in section 2.3.1. Similar to Amihud (2002) the result after dividing the equity return by value traded was multiplied by  $10^{12}$  to reduce the number of decimals. The formula is defined as (equation 14):

*Equation 14: Amihud Illiquidity measure (ILLIQ)*

$$ILLIQ_t^i = 10^{12} \times \left( \frac{|R_{td}^i|}{VOL_{td}^i} \right) \quad (14)$$

Where  $R_{td}^i$  and  $VOL_{td}^i$  are the return and Rand volume (Value Traded) (in millions), respectively, on day  $d$  in month  $f$ .

Source: (Amihud, 2002)

The highest value from this formula indicates stock illiquidity. The variable of the equation will affect the final value through either an increase in return or a reduction in volume which will result in an increase in illiquidity. A higher degree of illiquidity will be obtained through adjusting either the return (proportional) or the volume (reciprocal).

#### 4.6.3.2. Adjusted Amihud illiquidity measure (*AdjILLIQ*)

Kang & Zhang (2014), claimed that their modified version of the Amihud illiquidity measure performs well in different types of emerging markets. Included in their selection

of emerging markets was South Africa. Therefore this study tested the suggested superiority of the measure against others.

The Adjusted Amihud illiquidity measure was calculated following the equations as defined by Kang & Zhang (2014), given the number of decimal after dividing the equity return by value traded the answer was also multiplied by  $10^{12}$  as (equation 15):

*Equation 15: Adjusted Amihud Illiquidity measure (AdjILLIQ)*

$$ILLIQ_t^i = 10^{12} \times \left( \frac{|R_{td}^i|}{VOL_{td}^i} \right) \times \left( 1 + \frac{\text{Zero trading days}}{\text{total trading days in month}} \right) \quad (15)$$

Where  $R_{td}^i$  and  $VOL_{td}^i$  are the return and Rand volume (Value Traded) (in millions), respectively, on day  $d$  in month  $t$ .

Source: (Kang & Zhang, 2014)

The most significant Adjusted Amihud Illiquidity (*AdjILLIQ*) ratio implies lower liquidity (Hamdan, 2017). The variable of the equation will affect the final value through either an increase in return or a reduction in volume which will result in an increase in illiquidity. A higher degree of illiquidity will be obtained through adjusting either the return (proportional) or the volume (reciprocal).

#### 4.6.3.3. Relative Change in Volume (*RCV*)

Vidović et al. (2014) proposed the Relative Change in Volume (*RCV*) as an improved illiquidity measure and appropriate for emerging stock markets as it addresses the problem of infrequent trading. Relative Change in Volume is a trade-based measure similar to Amihud Illiquidity measure (*ILLIQ*) and Turnover (Vidović et al., 2014). Relative Change in Volume can be calculated from daily trading data readily available in most markets, looking at volume traded for the specific period. Relative change in volume differs with *ILLIQ* and Turnover in that it only looks at the changes in volume irrespective of what the share price is.

The formula used to calculate Relative Change in Volume (*RCV*) is defined as (equation 16):

*Equation 16: Relative Change in Volume (RCV)*

$$RCV_i = \frac{t_q - t_{q-1}}{\text{Average } tq \text{ for the year}} \quad (16)$$

Where  $t_q$  is the value traded at the beginning of the quarter  $q$ ,  $t_{q-1}$  as the value traded at the beginning of the previous quarter and  $tq$  as the average trade per quarter.

Source: (Vidović et al., 2014)

The most significant positive value produced by the formula represents the illiquid stock while the smallest value represents a highly liquid stock (Vidović et al., 2014). The logic is that a highly liquid and frequent trading stock will always produce a smaller change in volume than the average volume traded, therefore resulting in a smaller RCV ratio.

**4.6.3.4. Bid-Ask Spread**

The Bid-Ask Spread is a widely used measures of stock market liquidity in prior research. Fong et al. (2017) proposed the Closing Percent Quoted Spread as the best monthly percent-cost measure if available. Fong et al. (2017) measured is closely related to that of Chung & Zhang (2014). The Bid-Ask spread of stock  $i$  on day  $t$  is therefore adopted from Chung & Zhang (2014) formula as by replacing the dominator with the closing transaction value of the day (equation 17):

*Equation 17: Bid-Ask Spread*

$$Spread_{i,t} = \frac{Ask_{i,t} - Bid_{i,t}}{TsValue_{i,t}} \quad (18)$$

Were  $Ask_{i,t}$  is the price of stock  $i$  on day  $t$ ,  $Bid_{i,t}$  is the bid price of the price of stock  $i$  on day  $t$ , and  $TsValue_{i,t}$  is the value of the closing transaction for the day  $t$ .

Source: (Fong et al., 2017)

The lower the gap between the bid price and the ask price the lower the spread will be. A higher degree of illiquidity will be obtained through a more significant difference between the bid price and ask price. However, bid-ask spread is also some form of cost. Therefore a higher spread will result in stock not selling as buyers will not be willing to

pay a higher price and so are sellers at a lower price. Sellers desiring to sell the stock immediately will have to give a more significant discount.

#### 4.6.3.5. Price Reversal

Cheng, Hameed, Subrahmanyam, & Titman (2017) argue that return reversals is synonymous with high illiquidity and find that the vast decline in stock price over the past quarter is connected with Institutional Investor involvement during that period. In a market such as JSE dominated by a sizeable Institutional Investor participation (Hearn et al., 2010), this measure is therefore relevant for inclusion in the comparisons.

Vayanos & Wang (2013) defined Price Reversal as minus the autocovariance of return and is based on the idea that trades in illiquidity markets should generate transitory deviations between price and fundamental value. The formula used in the calculation defined as (equation 18). The results of the formula were multiplied by  $10^4$  to reduce the number of decimals:

*Equation 18: Price Reversal*

$$Price\ Reversal = Covariance\left(\log\left(\frac{SP_t}{SP_{t-1}}\right), \log\left(\frac{SP_{t-1}}{SP_{t-2}}\right)\right) \times 10^4 \quad (19)$$

Where  $SP$  is the share price for the day  $t$ .

Source: (Vayanos & Wang, 2013)

#### 4.6.3.6. Turnover (Value Traded as percentage of Market Capitalisation)

Muller & Ward (2013) version of the turnover measure of liquidity has been selected as one of the measures to compare. The same data set and parameters used by Muller & Ward (2013) in their style engine were available to the research with updated data until July 2017. Therefore including it in the selected measures ensured continuity of the work already done by Muller & Ward (2013) using the same updated data set, methodology and style engine in comparing the results with the other selected measures.

The variables of the equation will affect the final value through either an increase in stock price and/or volume or a reduction in market capitalisation which will result in an increase

in illiquidity. A higher degree of illiquidity will be obtained through adjusting either the stock price or the volume (proportional).

Their turnover version of the liquidity proxy was defined as (equation 19):

*Equation 19: Turnover*

$$\text{Turnover} = \frac{\text{Value of Shares Traded}}{\text{Market Capitalisation}} \quad (17)$$

Source: (Muller & Ward, 2013)

#### **4.6.3.7. Proposed Localized Turnover (Value Traded over SWIX Weight)**

About 81 out of the 382 (21.2%) companies listed on the JSE were also listed in other stock markets, see Appendix 2. Multiple listed companies have an impact in the market capitalisation of a company due to it calculated as the sum of share price multiply by total shares outstanding. Shares listed in other markets are most often is a different currency than the domestic currency. Therefore, the market capitalisation value will also be affected by currency fluctuations and exchange rate differences. Fong, Holden, & Trzcinka (2017) suggested the elimination of exchange rate effects when measuring liquidity on a domestic market. A share of a multiple listed company may trade frequency in one market but not in the other markets where it is also listed. Therefore, to measure the exact liquidity of the share listed on the domestic market, other listings must be excluded from the workings.

The JSE has created a Shareholder Weighted Indices (SWIX) which has been developed to signify the results of companies listed on the JSE while providing the investors with indices that exclude foreign shareholding. The SWIX provides investors with a close view of the available investible universe within a market, thereby giving an indication of how much of a company stock is trading on the domestic market. All stock is weighted in the SWIX indices by applying a SWIX free float which signifies the amount of a resident's share capital that is held in dematerialised form and registered on the South African share register (FTSE/JSE, 2014).

A new measure of liquidity is therefore proposed to remove the effect of multiple listing on the liquidity test of a stock listed on the market by only dividing the value traded by the weighting of the local listing (SWIX). The formula for the new measure is (equation 20). The results are divided by  $10^{12}$  to reduce the number of digits:

*Equation 20: Localized Turnover*

$$\text{Localised Turnover} = \frac{\text{Value Traded for the previous 12 months}}{\text{SWIX weight of the share code at the date}} / 10^{12} \quad (20)$$

Source: Own (Adapted from Muller & Ward (2013))

The variables of the equation will affect the final value through either an increase in stock price and/or volume or an increase in the percentage of locally listed stock compared to listed in other markets which will result in an increase in illiquidity. A higher degree of illiquidity will be obtained through adjusting either the stock price, volume or increase the portion of locally listed stock (proportional).

#### **4.7. Data gathering process**

Secondary data collection method was used in collecting data. Secondary data refers to data used for research that was initially collected for another resolution (Saunders & Lewis, 2012). Given the size of data that was required for this study, secondary data allowed the researcher access to vast variety of large, high-quality, data sets that were readily available in formats ready for comparative and longitudinal analysis.

Daily trading data was obtained from I-NET, and Sharenet Databases, Financial Information from McGregor's BFA-Net Data Base, I-NET and the JSE monthly bulletin were used to track new listing, delisting, name changes, share split or amalgamation, all which had been done to get data into the style engine.

Data integrity was checked over the period under review to ensure consistency. The robustness of the integrity of stock return data in the style engine used for analysis was tested by Muller & Ward (2013) through constructing a market capitalisation weighted index and comparing it to the relative index such as J203T. Muller & Ward Style Engine was the primary tool used to extract data from the various databases and to prepare data for analysis.

#### **4.8. Data Analysis approach**

In testing the related proposition formulated, the selected illiquidity proxies as stated in 4.6.3 above were used to calculate the returns yielded by each measure. A graphical time series approach designed by Muller & Ward (2013) was utilized to deduce the results of each measure. Each measure is benchmarked against the JSE All Share Index (J203T) therefore the output compares returns of the most liquid quintile versus the illiquid quintile but also compare the illiquid with the J203T. No adjustments were made in the J203T. Therefore, it adheres to the rules of the JSE in what constitutes entry or removal from the index. The J203T index also includes all quarterly revisions to the index, changes or adjustment as made by the JSE.

#### **4.9. Limitation**

- 4.9.1. Data Sample - The data sample of the study was limited to stocks listed on the main board of the Johannesburg Stock Exchange and, therefore, inference in this study is restricted to the listed stocks. Most illiquid stock and assets are not listed; as a result, having access to the relevant data could have been challenging. Shares in a privately-owned company, for example, will qualify as illiquid assets/investment. Data of the sale of shares in privately owned companies is not readily available. That is why these companies were excluded from the design.
- 4.9.2. Choice of liquidity measures - The selected measures of illiquidity were not exhaustive, and the list of measures used has been reduced to only seven given the amount of time available for analysis. The selection of which measure to use was mostly based on the most common or highest literature count, measures used in South Africa before and measures used in recent studies on other emerging markets.
- 4.9.3. Intra-day trading data (high-frequency measures) - Only low-frequency measures (daily/month) were selected for this study given the time limit allocated to complete this project. High-frequency (intra-day) liquidity proxies would require more computational time, with a large size of data over the period of analysis (20 years). High-frequency data would have allowed for market macrostructural analysis to be performed. However, the data required is not readily available, and as a result, measures of liquidity using high-frequency data was excluded from

the selection. Excluding high-frequency measures from the study had no effect on the research objectives.

- 4.9.4. Delimitations - The delimitations refers to the scope and defining the boundaries of the study (Leedy & Ormrod, 2010). This study consists of the selection of liquidity proxies and stocks that excluded over 55% of listed stock, which only makes 1% of the market capitalisation on the JSE.

## Chapter 5: Results

### 5.1. Introduction

The purpose of this research was to test if liquidity based investment style, using the appropriate liquidity measure, produces profitable returns on the JSE that consistently outperforms the market benchmark, as represented by the JSE All Share Index (J203T). This was achieved through identifying two research questions each supported by propositions (as outlined in Chapter Three). Also through a comprehensive literature review (as outlined in Chapter Two) and utilising an inclusive data collection process (as described in Chapter Four), this research identified key evidence to support the main objective of this thesis.

The study applied a quantitative research methodology, with the construction of five quintiles of equal weighted shares by ranking the results calculated on each measure of liquidity and only taking the top 160 shares ranked by market capitalisation using data obtained from secondary data source (as described in Chapter Four) employing Muller & Ward (2013) Style Engine. Quintile One represents the high liquid shares, and Quintile Five represents the low liquid quintile of shares.

The objective of Chapter Five is to present the results of each of the seven measures of liquidity in answering the two research questions and corresponding propositions. The results of this chapter support the findings of the study. Chapter Five is structured with the following process flow: (1) First a short introduction is made, which gives a summarised review of each proposition. (2) This is followed by the comprehensive reflection of the test results. (3) Finally, a précis is presented of the results with a short conclusion. The chapter is concluded with a synopsis and overall arc which determined the outcome and solved the main question.

### 5.2. Research Question 1:

#### **Which measure of liquidity yield the highest returns on the JSE?**

To answer Research Question One, seven propositions (as per in Table 3) were tested, as to determine which of the measures of liquidity yield the highest returns on the JSE.

Table 3: Seven Propositions for Research Question One

Proposition Number	Description
Proposition 1	The use of Amihud illiquidity measure ( <i>ILLIQ</i> ) (Equation 14), as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).
Proposition 2	The use of Adjusted Amihud illiquidity measure ( <i>AdjILLIQ</i> ) (Equation 15), as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).
Proposition 3	The use of Relative Change in Volume ( <i>RCV</i> ) (Equation 16), as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).
Proposition 4	The use of Bid-Ask Spread (Equation 17), as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).
Proposition 5	The use of Price Reversal (Equation 18), as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).
Proposition 6	The use of Turnover (Equation 19), as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).
Proposition 7	The use of Localized Turnover (Equation 20), as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).

For a proposition to be accepted, two criteria need to be met: (1) first an  $r^2$  of determination, which determine the degree of variation in the dependent variable (return), that can be explained by the independent variable (measure of liquidity) was calculated. The coefficient was used to test the association in the returns earned per quintile that is explained by the score of the measure of liquidity. When  $r^2 \leq 0.5$ , it indicates a weak association between the measure of liquidity and returns, but when  $r^2 > 0.5$ , a strong association between the measure of liquidity and returns will be indicated (Wegner, 2016). The proposition was accepted if there was a strong association between the liquidity measure and returns, that is  $r^2 > 0.5$ . (2) Secondly, the illiquid quintile of the measure of liquidity should have to produce returns above the JSE All Share Index (J203T) benchmark, under the auspices of the lowest possible risk, as defined by the deviation of the returns, in question.

### 5.2.1. Proposition 1: The use of Amihud illiquidity measure (*ILLIQ*)

The use of Amihud illiquidity measure (*ILLIQ*), as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).

#### 5.2.1.1. Introduction

To test the proposition that Amihud illiquidity measure (*ILLIQ*) be used as a measure of liquidity on the JSE when liquidity is selected as an investment strategy, a graphical time series is used. This section presents results of the Amihud ratio as a measure of liquidity, where the lowest ratio represents the high liquidity quintile, while the highest ratio represents the illiquid quintile. The actual ratio per quintile, returns per quintile and performance against the J203T index are summarised in Table 4 and further described in sections 5.2.1.2. to 5.2.1.3.

Table 4: Summarized output of Amihud Illiquidity (*ILLIQ*) measure

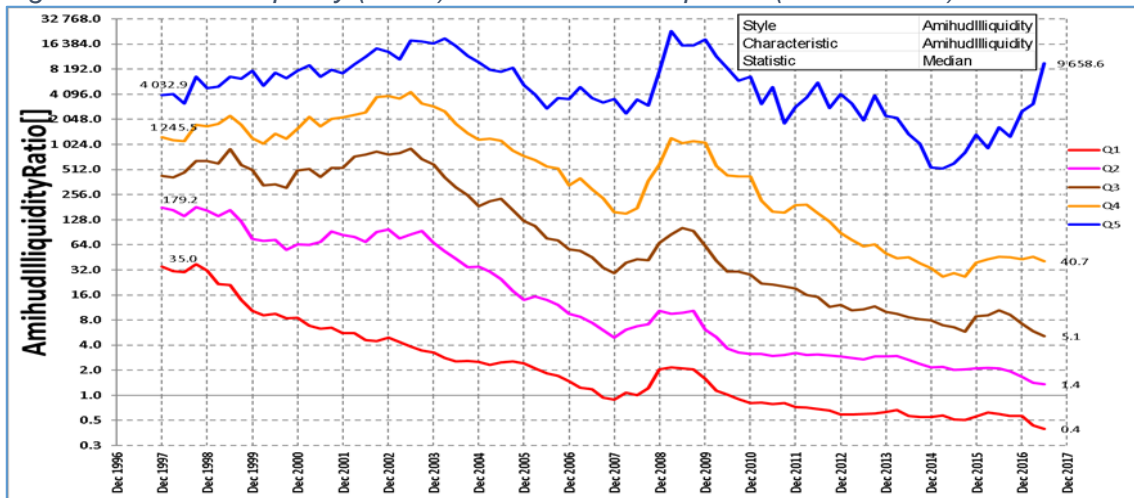
	Quintile 1 High liquidity	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Low liquidity	J203T
Mean of measure	5.0	38.7	229.5	981.9	6 651.3	
Annualised return	14.2%	16.0%	12.8%	19.2%	13.9%	15.8%
Standard deviation	18.5%	20.7%	18.6%	16.3%	15.0%	19.2%
Observations	237	237	237	237	237	

Source: own research

#### 5.2.1.2. Results

The Amihud ratio as a measure of illiquidity for the top 160 companies ranked by Market Capitalisation and grouped into quintiles are presented in Figure 2 below. The quintile with the high liquidity companies (Quintile One) had the lowest mean of the Amihud illiquidity ratio of 5.0 lower than the mean of the second most liquid quintile with a ratio of 38.7. The illiquid quintile (Quintile Five) had a ratio mean of 6,651.3. The Amihud ratio has been declining over the period under consideration (1997 - 2017) for all quintiles, except Quintile Five. For example, the mean for Quintile Four with the second illiquid shares was as high as a ratio of 1,245.5 in 1997 and dropped down to a mean of 40.7 in 2017. Unlike quintile one to quintile four, quintile five mean of the ratio increased from December 2014 up to 9,658.6 higher than the 4,032.9 in 1997.

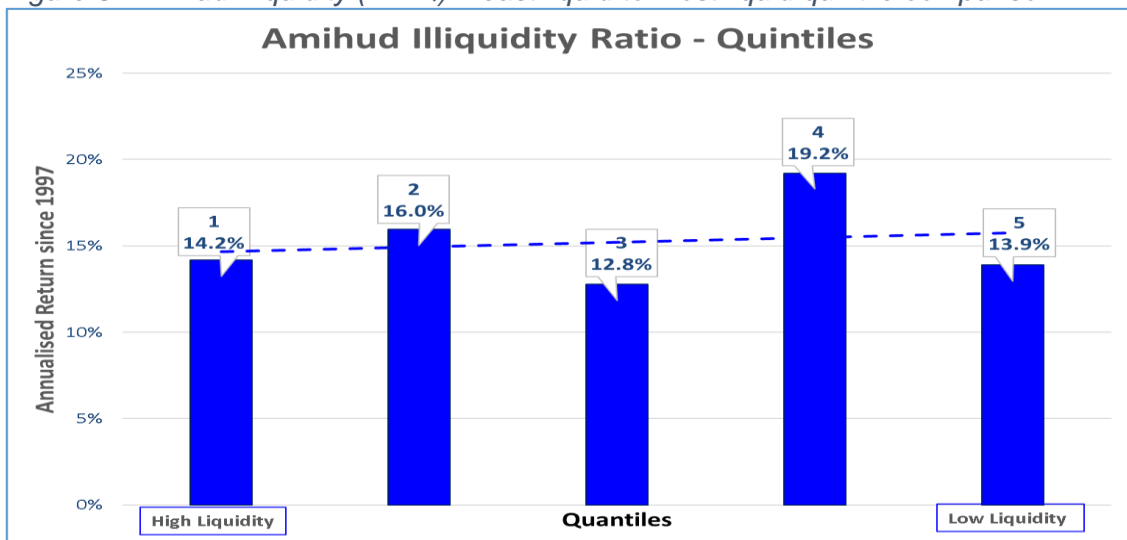
Figure 2. Amihud Illiquidity (ILLIQ): Actual ratio over period (1997 – 2017)



Source: own research

Figure 3 shows the performance, represented by the annualised returns, of the high liquidity quintile trend to the illiquid quintile over the period of assessment (1997 to 2017). The results show that the illiquid quintiles (Quintile Four and Quintile Five) on average performed better than the high liquid quintiles (Quintile One and Quintile Two).

Figure 3. Amihud Illiquidity (ILLIQ): Least liquid to most liquid quintile comparison

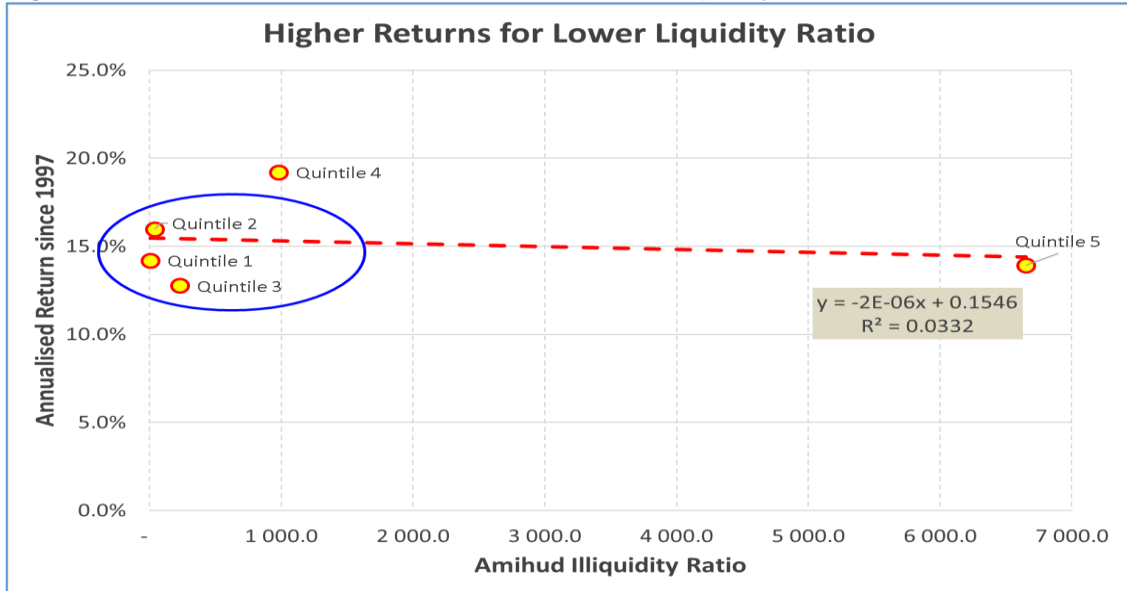


Source: own research

Figure 4 indicates the association between the returns earned by the style,  $y$ , and the level of a firm liquidity as measured by the Amihud illiquidity ( $ILLIQ$ ) ratio,  $x$ . The results indicate a weak association between the returns and the level of a firm liquidity with an

$r^2$  coefficient of 0.0332 less than 0.5 (Wegner, 2016). The Amihud illiquidity (*ILLIQ*) measure,  $x$ , explains only 3.32% of the returns earned by the style,  $y$ . The Amihud illiquidity (*ILLIQ*) measure, therefore, have a weak impact on returns. The quintiles with the lowest illiquidity score are as indicated by a circle.

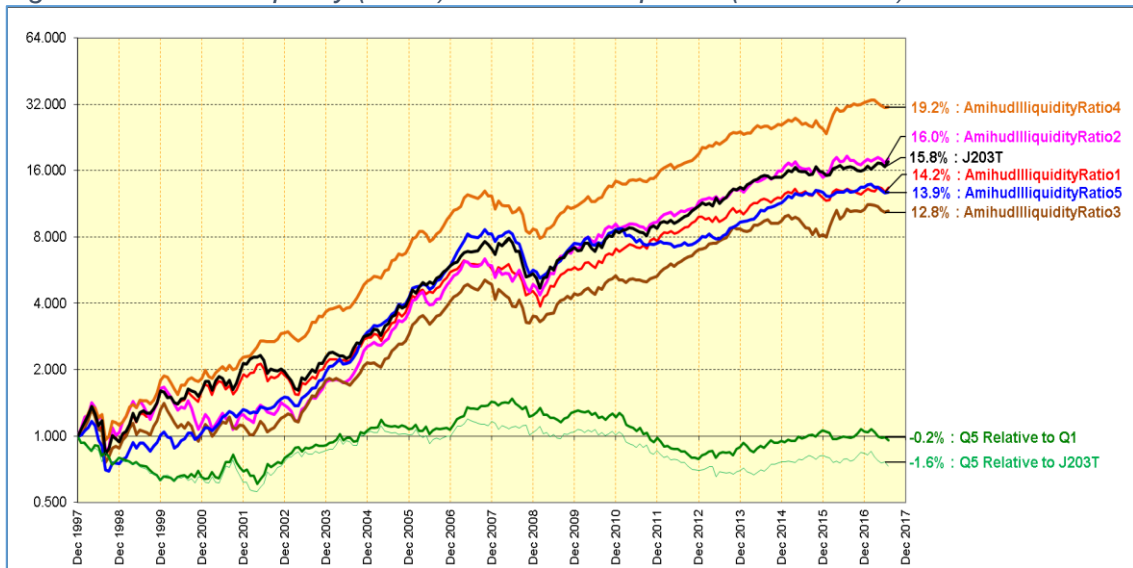
Figure 4: Annualised returns since 1997 on Amihud liquidity ratio



Source: own research

Figure 5 shows the performance of quintiles one to five compared with the performance of the JSE All Share Index (J203T). The returns of the quintiles ranked in descending performance indicating both Quintile Four (19.2%) and Quintile Two (16.0%) performed above the J203T index (15.8%) while Quintile One (14.2%), Quintile Five (13.9%) and Quintile Three (12.8%) performed below the index. Relatively the performance of the highly liquid quintile (Quintile One) against the illiquid quintile (Quintile Five) is -0.2%, while the performance of the illiquid quintile (Quintile Five) against the J203T index was -1.6%.

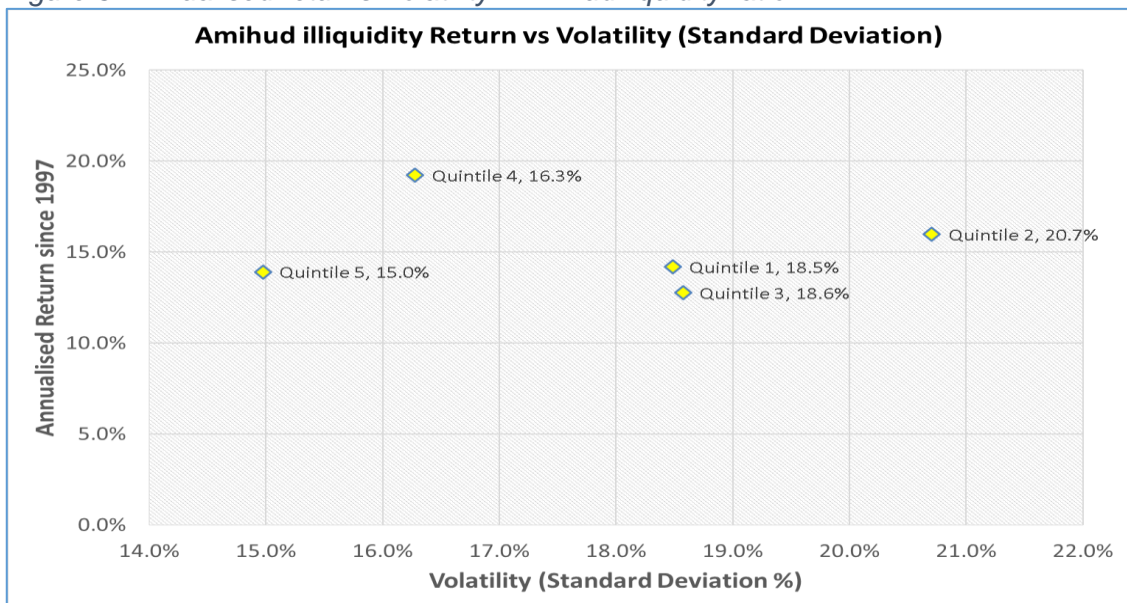
Figure 5. Amihud Illiquidity (ILLIQ): Returns over period (1997 - 2017)



Source: own research

Returns of the illiquid quintiles (Quintile One, Two and Three) are more volatile (as measured by standard deviation) compared to returns of the illiquid quintiles (Quintile Four and Five). As indicated in Figure 6, Quintile Two is highly volatile with a standard deviation of 20.7% followed by Quintile Three with 18.6% then Quintile One with 18.5%. The lowest standard deviation is Quintile Five with 15%.

Figure 6: Annualised returns Volatility - Amihud liquidity ratio



Source: own research

### 5.2.1.3. Conclusion

The test results of the proposition that the Amihud illiquidity (*ILLIQ*) ratio be used on the JSE as a liquidity measure where a liquidity-based investment style is elected indicates a weak association between the returns and the level of a firm liquidity (as measured by the Amihud illiquidity (*ILLIQ*) ratio). With an  $r^2$  coefficient of 0.0332 less than 0.5 (Wegner, 2016), the Amihud illiquidity (*ILLIQ*) measure,  $x$ , explains only 3.32% of the returns earned by the style,  $y$ . The Amihud illiquidity (*ILLIQ*) measure, therefore, have a weak impact on returns. The illiquid quintile (Quintile Five) returns of 13.9% performed below the JSE All Share Index (J203T) returns of 15.8%. The results can, therefore, not substantiate the premise of the proposition, and hence Proposition One is rejected.

### 5.2.2. Proposition 2: The use of Adjusted Amihud illiquidity measure (*AdjILLIQ*)

**The use of Adjusted Amihud illiquidity measure (*AdjILLIQ*) as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).**

#### 5.2.2.1. Introduction

To test the proposition that the Adjusted Amihud illiquidity measure (*AdjILLIQ*) be used as a measure of liquidity on the JSE when liquidity is selected as an investment strategy, a graphical time series is used. This section presents results of the Adjusted Amihud ratio as a measure of liquidity, where the lowest ratio represents the high liquidity quintile, and the highest ratio represents the illiquid quintile. The return of the lowest ratio is not the highest as expected. The actual ratio per quintile returns per quintile and performance against the JSE All Share Index (J203T) are summarised in Table 5 and further described in sections 5.2.2.2 to 5.2.2.3.

*Table 5: Summarized output of Adjusted Amihud Illiquidity (*AdjILLIQ*) measure*

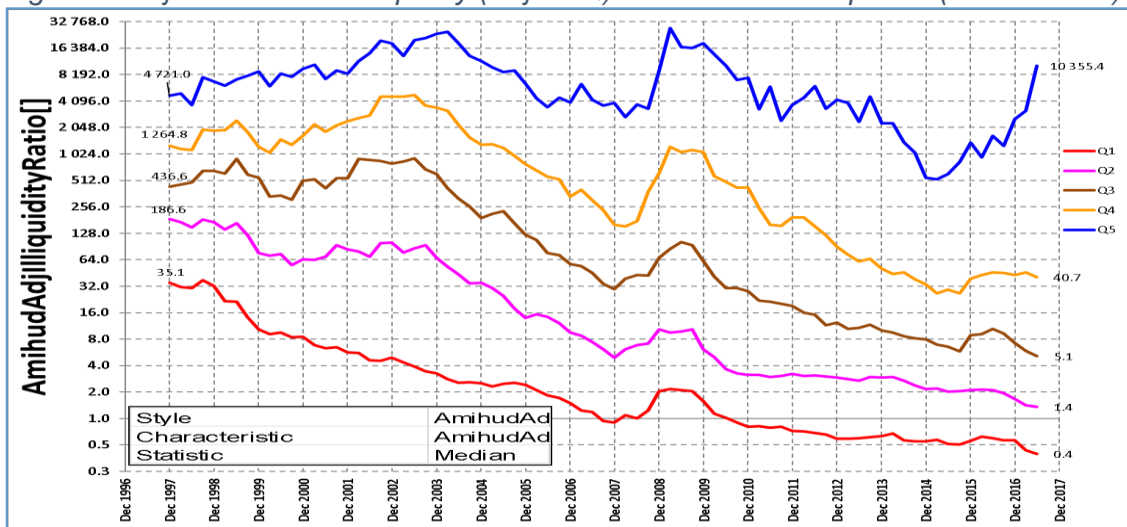
	Quintile 1 High liquidity	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Low liquidity	J203T
Mean of measure	5.0	39.3	236.6	1 083.2	7 825.5	
Annualised return	14.4%	15.5%	13.2%	18.7%	14.3%	15.8%
Standard deviation	18.6%	20.5%	19.0%	16.1%	14.7%	19.2%
Observations	237	237	237	237	237	

Source: own research

### 5.2.2.2. Results

The Adjusted Amihud ratio as a measure of illiquidity for the top 160 companies ranked by Market Capitalisation and grouped into quintiles are presented in Figure 7 below. The quintile with the high liquidity companies (Quintile One) had the lowest mean of the Adjusted Amihud illiquidity ratio of 5.0 lower than the mean of the second most liquid quintile with a ratio of 39.3. The illiquid quintile (Quintile Five) had a ratio mean of 7,825.5. The Adjusted Amihud ratio has been declining over the period under consideration (1997 - 2017) for all quintiles, except Quintile Five. For example, the mean for Quintile 4 with the second illiquid shares, was as high as a ratio of 1,264.8 in 1997 and dropped down to 40.7 in 2017. Unlike quintile one to quintile four, quintile five mean of the ratio increased from December 2014 (545.9) up to 10,355.4 higher than the 4,721 in 1997.

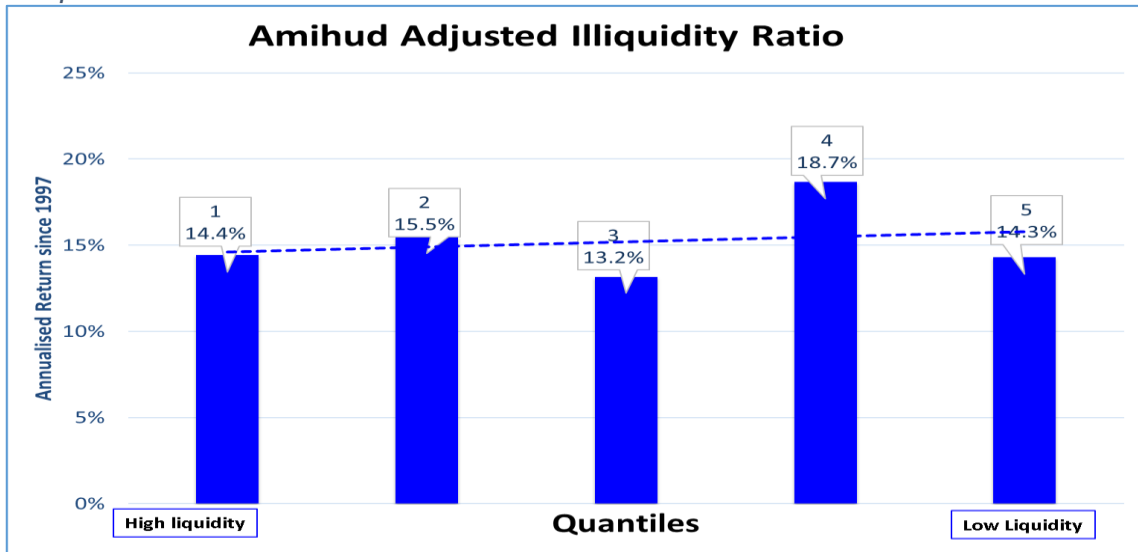
Figure 7. Adjusted Amihud Illiquidity (AdjILLIQ): Actual ratio over period (1997 – 2017)



Source: own research

Figure 8 shows the performance, represented by the annualised returns, of the high liquidity quintile trend to the illiquid quintile over the period of assessment (1997 to 2017). The results show that the high liquidity quintiles (Quintile One and Quintile Two) on average performed lower than the illiquid quintiles (Quintile Four and Quintile Five).

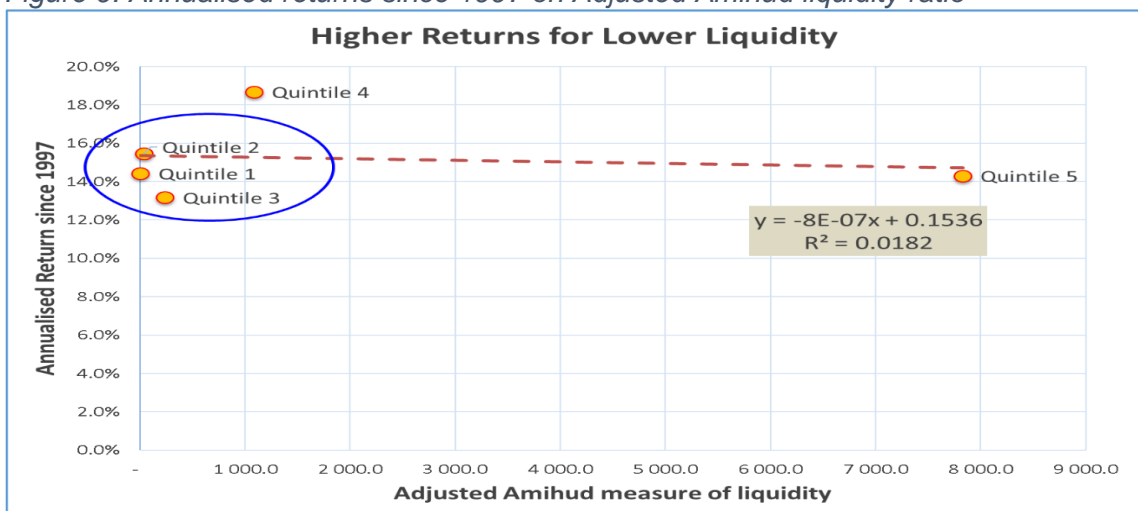
Figure 8. Adjusted Amihud Illiquidity (*AdjILLIQ*): Least liquid to most liquid quintile comparison



Source: own research

Figure 9 indicates the association between the returns earned by the style,  $y$ , and the level of a firm liquidity as measured by the Adjusted Amihud illiquidity (*AdjILLIQ*) ratio,  $x$ . The results indicate a weak association between the returns and the level of a firm liquidity with an  $r^2$  coefficient of 0.0182 less than 0.5 (Wegner, 2016). The Adjusted Amihud illiquidity (*AdjILLIQ*) measure,  $x$ , explains only 1.82% of the returns earned by the style,  $y$ . The Adjusted Amihud illiquidity (*AdjILLIQ*) measure, therefore, have a weak impact on returns. The quintiles with the lowest illiquidity score are as indicated by a circle.

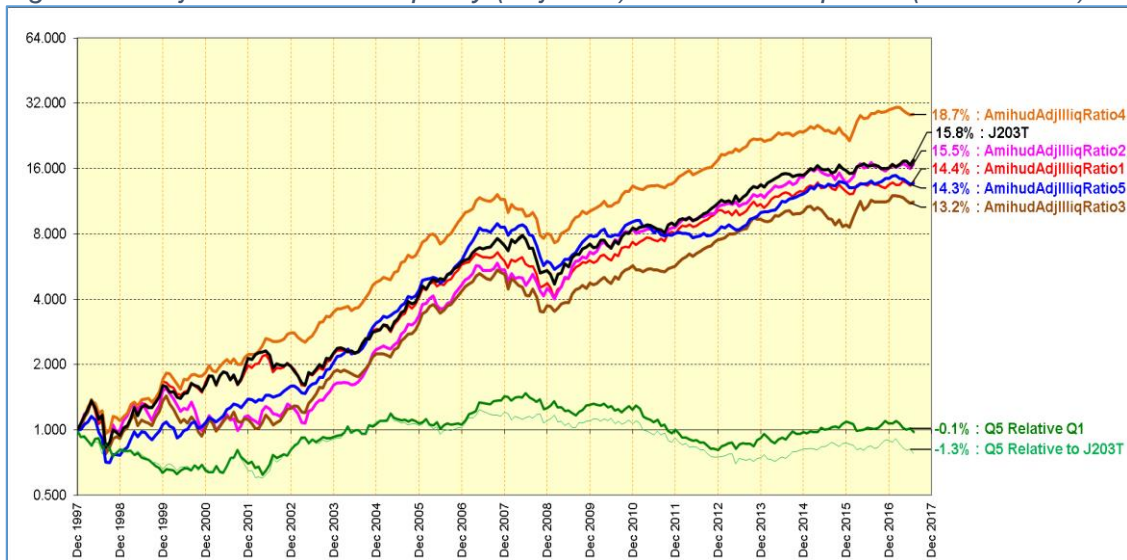
Figure 9: Annualised returns since 1997 on Adjusted Amihud liquidity ratio



Source: own research

Figure 10 shows the performance of Quintile One to Quintile Five compared with the performance of the JSE All Share Index (J203T). The returns of the quintiles ranked in descending performance indicates Quintile Four (18.7%) performed above the JSE All Share Index (J203T) (15.8%) while Quintile Two (15.5%), Quintile One (14.4%), Quintile Five (14.3%) and Quintile Three (13.2%) performed below the index. Relatively the performance of the low liquidity quintile (Quintile Five) against the high liquidity quintile (Quintile One) is -0.1%, while the performance of the illiquid quintile (Quintile Five) against the JSE All Share Index (J203T) was -1.3%.

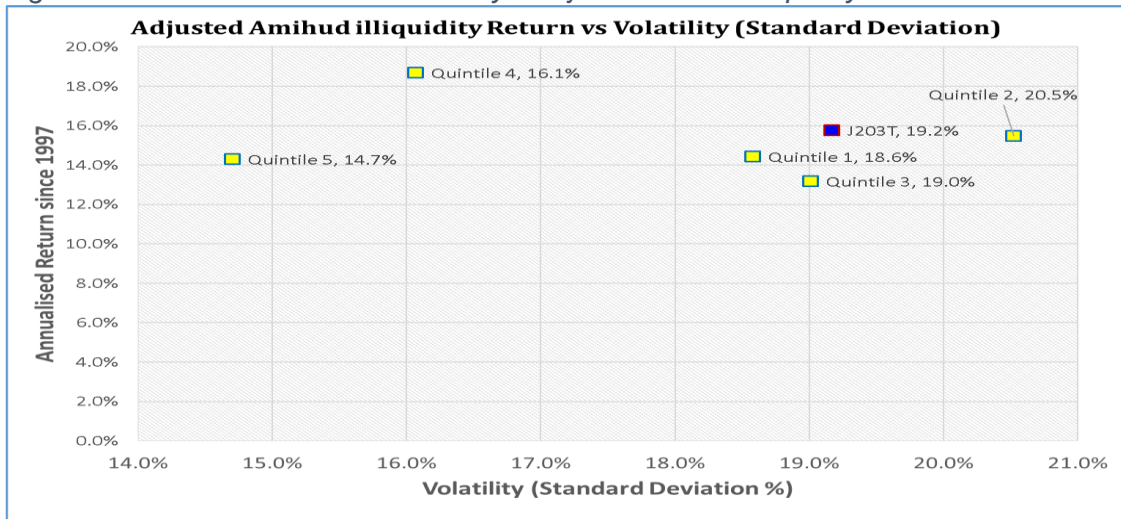
Figure 10. Adjusted Amihud Illiquidity (AdjLLIQ): Returns over period (1997 - 2007)



Source: own research

Returns of the high liquidity quintiles (Quintile One, Two and Three) are more volatile (as measured by standard deviation) compared to returns of the low liquidity quintiles (Quintile Four and Five). As indicated in Figure 11, Quintile Two is highly volatile with a standard deviation of 20.5% followed by Quintile Three with 19% then Quintile One with 18.6%. The lowest standard deviation is Quintile Five with 14.7%.

Figure 11: Annualised returns Volatility - Adjusted Amihud liquidity ratio



Source: own research

### 5.2.2.3. Conclusion

The test results of the proposition that the Adjusted Amihud illiquidity (*AdjILLIQ*) ratio be used on the JSE as a liquidity measure where a liquidity-based investment style is elected indicates a weak association between the returns and the level of a firm liquidity (as measured by the Adjusted Amihud illiquidity (*AdjILLIQ*) ratio). With an  $r^2$  coefficient of 0.0182 less than 0.5 (Wegner, 2016), the Adjusted Amihud illiquidity (*AdjILLIQ*) measure,  $x$ , explains only 1.82% of the returns earned by the style,  $y$ . The Adjusted Amihud illiquidity (*AdjILLIQ*) measure, therefore, have a weak impact on returns. The illiquid quintile (Quintile Five) returns of 14.3% performed below the JSE All Share Index (J203T) returns of 15.8%. The results can, therefore, not substantiate the premise of the proposition, and hence Proposition Two is rejected.

### 5.2.3. Proposition 3: The use of Relative Change in Volume (RCV)

**The use of Relative Change in Volume (RCV) as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).**

#### 5.2.3.1. Introduction

To test the proposition that the Relative Change in Volume measure (RCV) be used as a measure of liquidity on the JSE when liquidity is selected as an investment strategy, a graphical time series is used. This section presents results of the Relative Change in

Volume test as a measure of liquidity, where the lowest change represents the high liquidity quintile, while the highest change represents the illiquid quintile. The return of the highest change is not the highest as expected. The actual ratio per quintile, returns per quintile and performance against the J203T index are summarised in Table 6 and further described in Section 5.2.3.2 to 5.2.3.3.

*Table 6: Summarized output of Relative Change in Volume (RCV) measure*

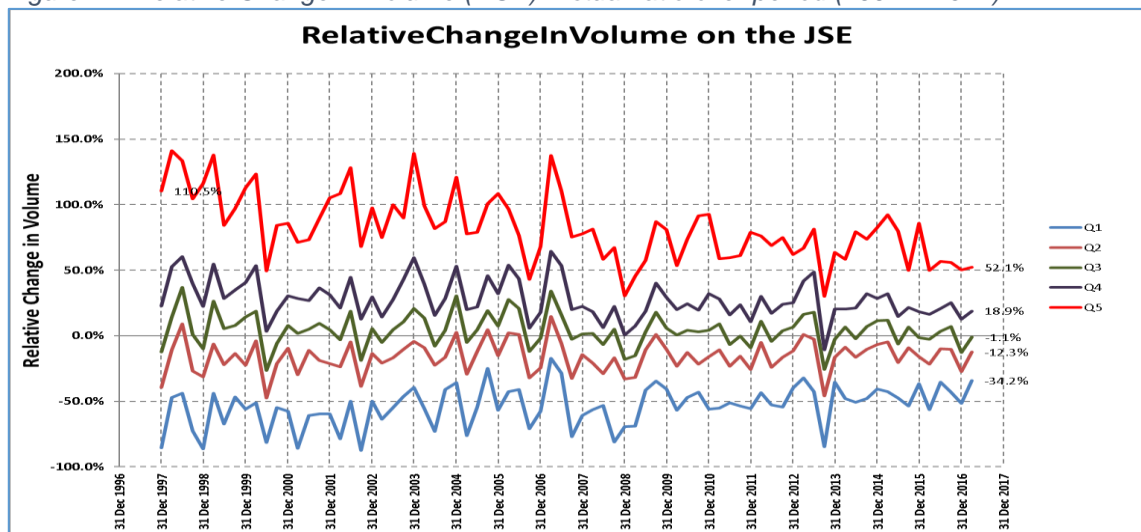
	Quintile 1 High liquidity	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Low liquidity	J203T
Mean	-53.7%	-16.0%	4.2%	27.8%	82.5%	
Annualised return	11.8%	15.2%	15.5%	15.1%	18.3%	15.8%
Standard deviation	17.9%	18.1%	17.1%	17.3%	16.4%	19.2%
Observations	234	234	234	234	234	

Source: own research

### 5.2.3.2. Results

The Relative Change in Volume percentage as a measure of illiquidity for the top 160 companies ranked by Market Capitalisation and grouped into quintiles are presented in Figure 12 below. The quintile with the high liquidity companies (Quintile One) had the lowest Relative Change in Volume percentage of -53.7% lower than that of the second most liquid quintile (-16%). The illiquid quintile (Quintile Five) had 82.5%. The Relative Change in Volume percentage has been consistent over the period under consideration (1997 - 2017) for all quintiles.

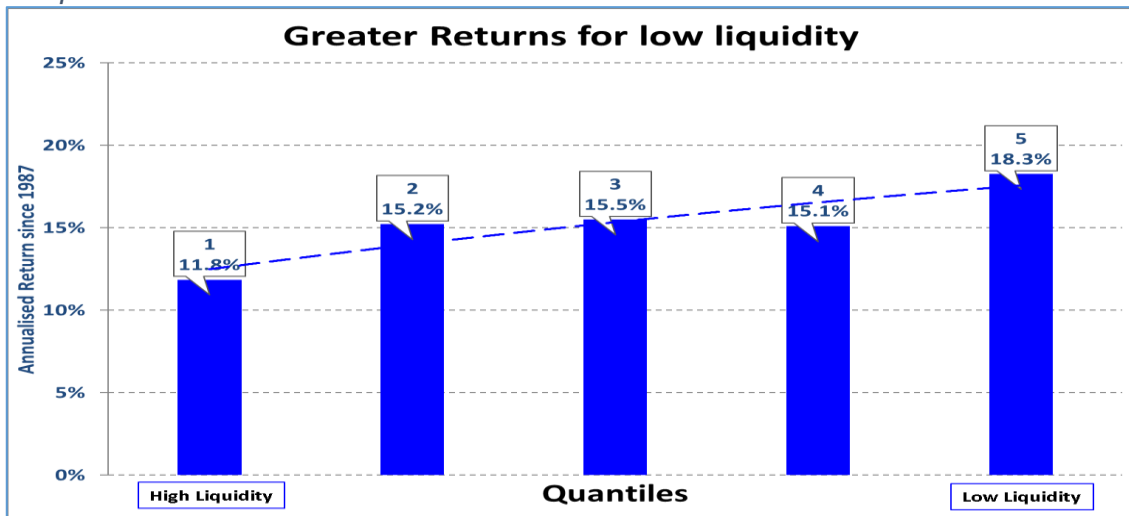
*Figure 12. Relative Change in Volume (RCV): Actual ratio over period (1997 – 2017)*



Source: own research

Figure 13 shows the performance, represented by the annualised returns, of the high liquidity quintile trend to the illiquid quintile over the period of assessment (1997 to 2017). The results show that the low liquidity quintiles (Quintile Four and Quintile Five) on average performed better than the high liquidity quintiles (Quintile One and Quintile Two).

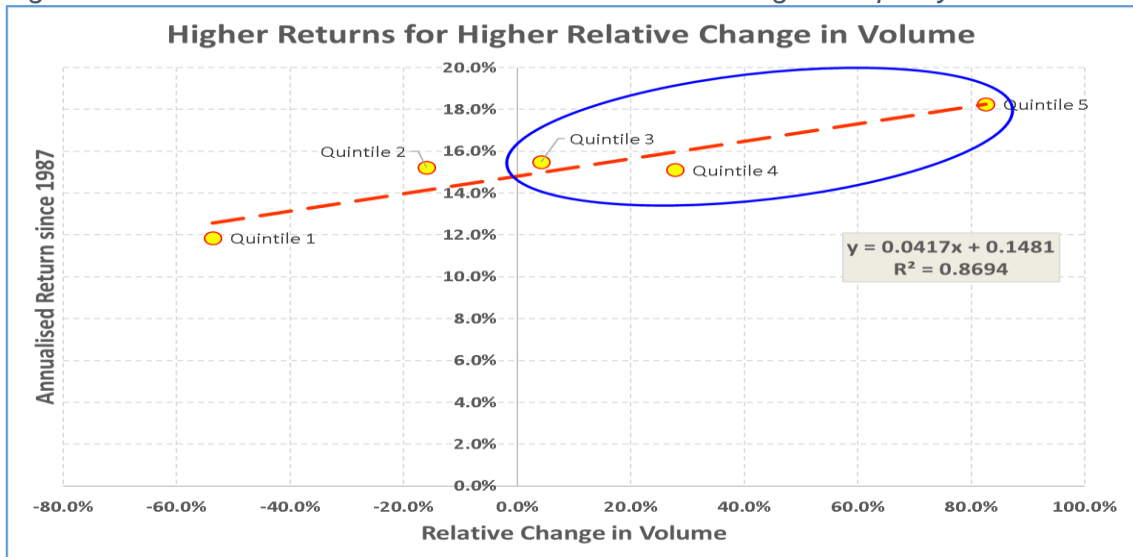
Figure 13. Relative Change in Volume (RCV): Least liquid to most liquid quintile comparison



Source: own research

Figure 14 indicates the association between the returns earned by the style,  $y$ , and the level of a firm liquidity as measured by the Relative Change in Volume (RCV) ratio,  $x$ . The results indicate a strong association between the returns and the level of a firm liquidity with an  $r^2$  coefficient of 0.8694 greater than 0.5 (Wegner, 2016). The Relative Change in Volume (RCV) measure,  $x$ , explains 86.94% of the returns earned by the style,  $y$ . The Relative Change in Volume (RCV) measure, therefore, have a strong impact on returns. The quintiles with the lowest illiquidity score are as indicated by a circle.

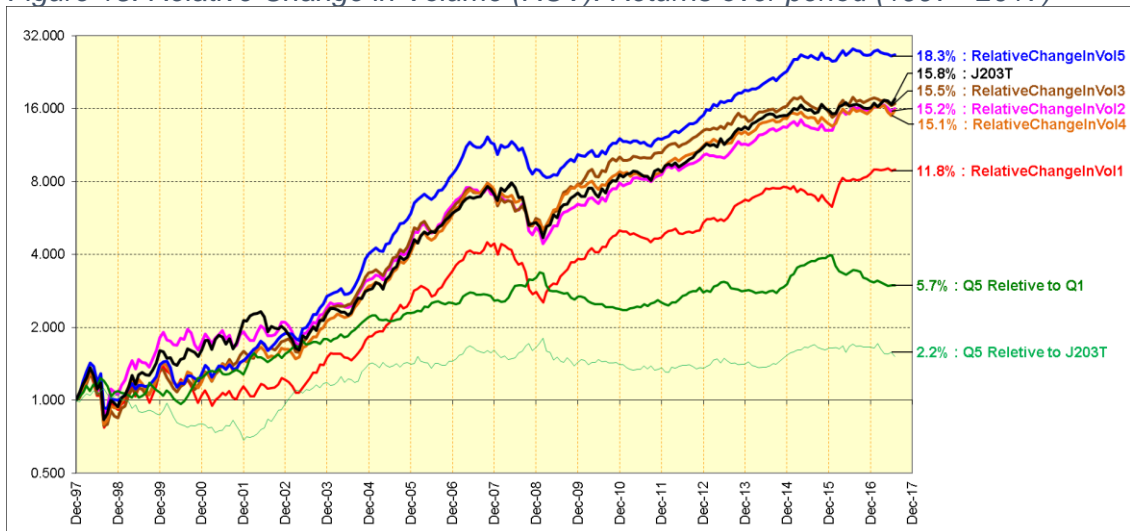
Figure 14: Annualised returns since 1997 on Relative Change in Liquidity ratio



Source: own research

Figure 15 shows the performance of Quintile One to Quintile Five compared with the performance of the JSE All Share Index (J203T). The returns of the quintiles are ranked in descending performance indicating Quintile Five (18.3%) performed above the JSE All Share Index (J203T)(15.8%). Quintile Three (15.5%), Quintile Two (15.2%), Quintile Four (15.1%) and Quintile One (11.8%) performed below the index. Relatively the performance of the low liquid quintile (Quintile Five) against the high liquidity quintile (Quintile One) was 5.7%, while the performance of the illiquid quintile (Quintile Five) against the JSE All Share Index (J203T) was 2.2%.

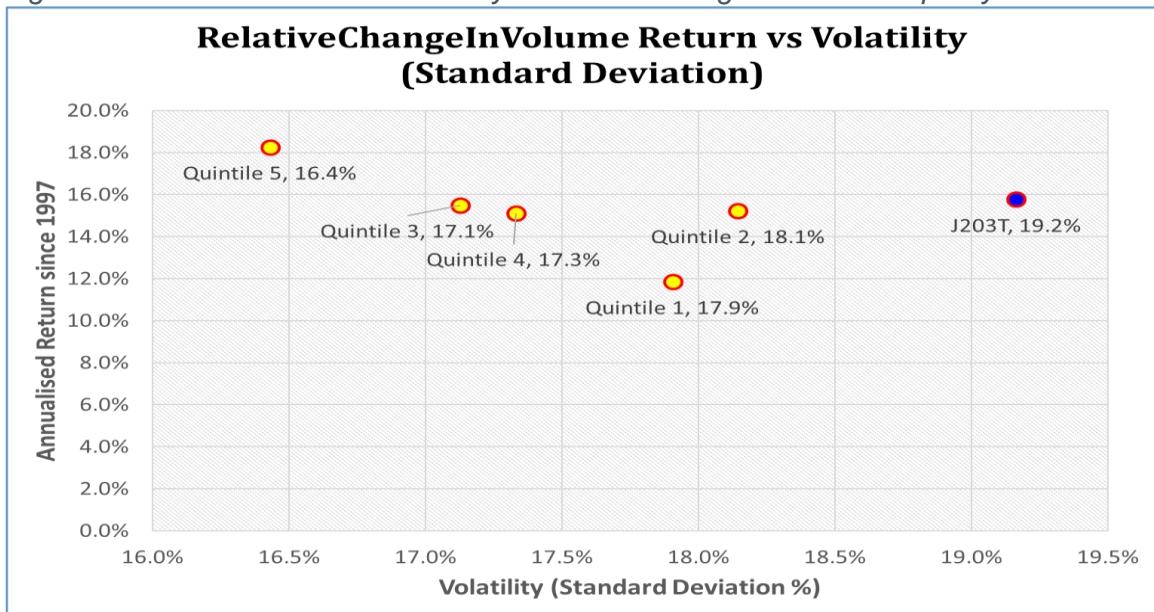
Figure 15. Relative Change in Volume (RCV): Returns over period (1997 - 2017)



Source: own research

Returns of the high liquid quintiles (Quintile One and Two) are more volatile (as measured by standard deviation) compared to returns of the illiquid quintiles (Quintile One, Three and Two). As indicated in Figure 16, Quintile Two is highly volatile with a standard deviation of 18.1% followed by Quintile One with 17.9% then Quintile Three with 17.3%. The lowest standard deviation is Quintile Five with 16.4%.

Figure 16: Annualised returns Volatility - Relative Change In Volume liquidity ratio



Source: own research

### 5.2.3.3. Conclusion

The test results of the proposition that the Relative Change in Volume (*RCV*) ratio be used on the JSE as a liquidity measure where a liquidity-based investment style is elected indicates a strong association between the returns and the level of a firm liquidity (as measured by the Relative Change in Volume (*RCV*) ratio). With an  $r^2$  coefficient of 0.8694 greater than 0.5 (Wegner, 2016), the Relative Change in Volume (*RCV*) measure,  $x$ , explains 86.94% of the returns earned by the style,  $y$ . The Relative Change in Volume (*RCV*) measure, therefore, have a strong impact on returns. The illiquid quintile (Quintile Five) returns of 18.3% performed above the JSE All Share Index (J203T) returns of 15.8%. The results can, therefore, substantiate the premise of the proposition, and hence Proposition Three is accepted.

#### 5.2.4. Proposition 4: The use of Bid-Ask Spread

**The use of Bid-Ask Spread as a measure of liquidity on the JSE will yield a higher return on the JSE compared to the JSE All Share Index (J203T).**

##### 5.2.4.1. Introduction

To test the proposition that the Bid-Ask Spread measure to be used as a measure of liquidity on the JSE when liquidity is selected as an investment strategy, a graphical time series is used. This section presents results of the Bid-Ask Spread ratio as a measure of liquidity, where the highest spread represents the illiquid quintile, while the lowest spread represents the high liquidity quintile. The return of the highest spread is not the highest as expected. The actual ratio per quintile returns per quintile and performance against the JSE All Share Index (J203T) are summarised in Table 7 and further described in Section 5.2.4.2 to 5.2.4.3.

*Table 7: Summarized output of Bid-Ask Spread measure*

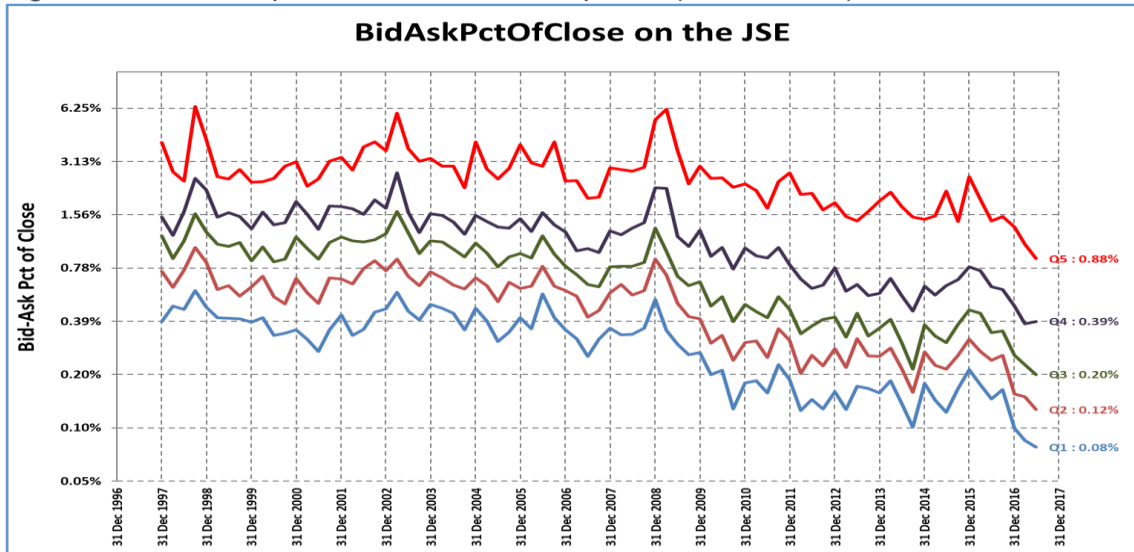
	Quintile 1 High liquidity	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Low liquidity	J203T
Mean	0.3%	0.5%	0.8%	1.2%	2.7%	
Annualised return	16.7%	21.1%	17.6%	15.5%	13.3%	15.8%
Standard deviation	18.3%	20.6%	19.3%	17.8%	17.3%	19.2%
Observations	237	237	237	237	237	

Source: own research

##### 5.2.4.2. Results

The Bid-Ask Spread ratio as a measure of illiquidity for the top 160 companies ranked by Market Capitalisation and grouped into quintiles are presented in Figure 17 below. The quintile with the high liquidity companies (Quintile One) had the lowest mean of the spread of 0.03% significantly lower than the mean of the most illiquid quintile (Quintile Five) having a spread of 2.7%. The bid-ask spread percentage has been improving over the period under consideration (1997 - 2017) for all quintiles.

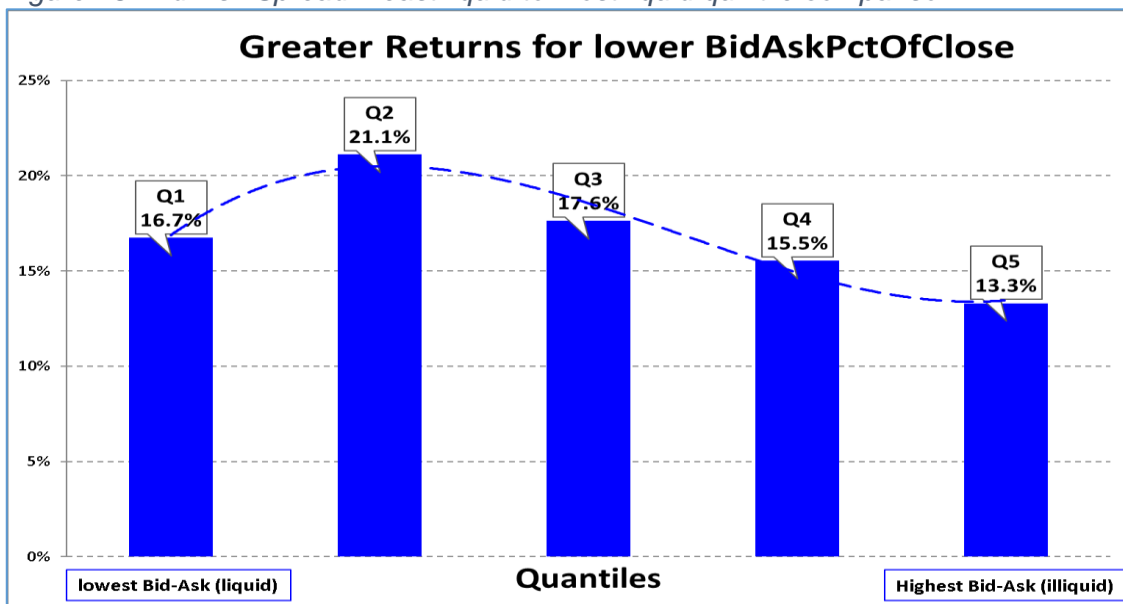
Figure 17. Bid-Ask Spread: Actual ratio over period (1997 – 2017)



Source: own research

Figure 18 shows the performance, represented by the annualised returns, of the illiquid quintile trend to the high liquidity quintile over the period of assessment (1997 to 2017). The results show that the high liquidity quintiles (Quintile One and Quintile Two) on average performed better than the illiquid quintiles (Quintile Four and Quintile Five). The second highest liquid quintile (Quintile Four) is the highest performing quintile with returns of 21.1%.

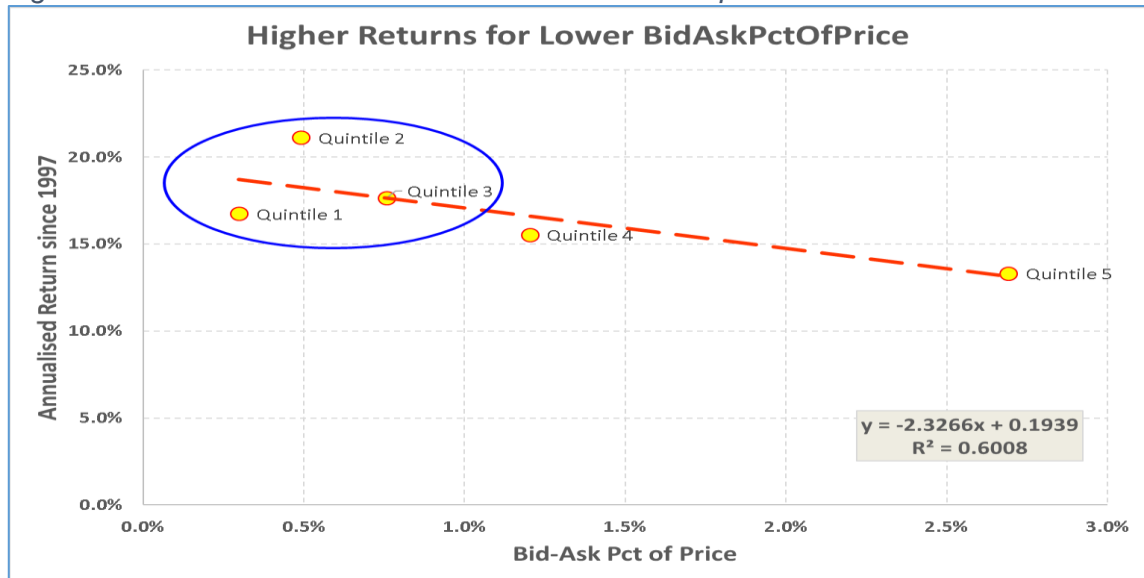
Figure 18. Bid-Ask Spread: Least liquid to most liquid quintile comparison



Source: own research

Figure 19 indicates the association between the returns earned by the style,  $y$ , and the level of a firm liquidity as measured by the Bid-Ask Spread ratio,  $x$ . The results indicate a moderate to a strong association between the returns and the level of a firm liquidity with an  $r^2$  coefficient of 0.6008 greater than 0.5 (Wegner, 2016). The Bid-Ask Spread measure,  $x$ , explains 60.08% of the returns earned by the style,  $y$ . The Bid-Ask Spread measure, therefore, have a moderate to strong impact on returns. The quintiles with the lowest illiquidity score are as indicated by a circle.

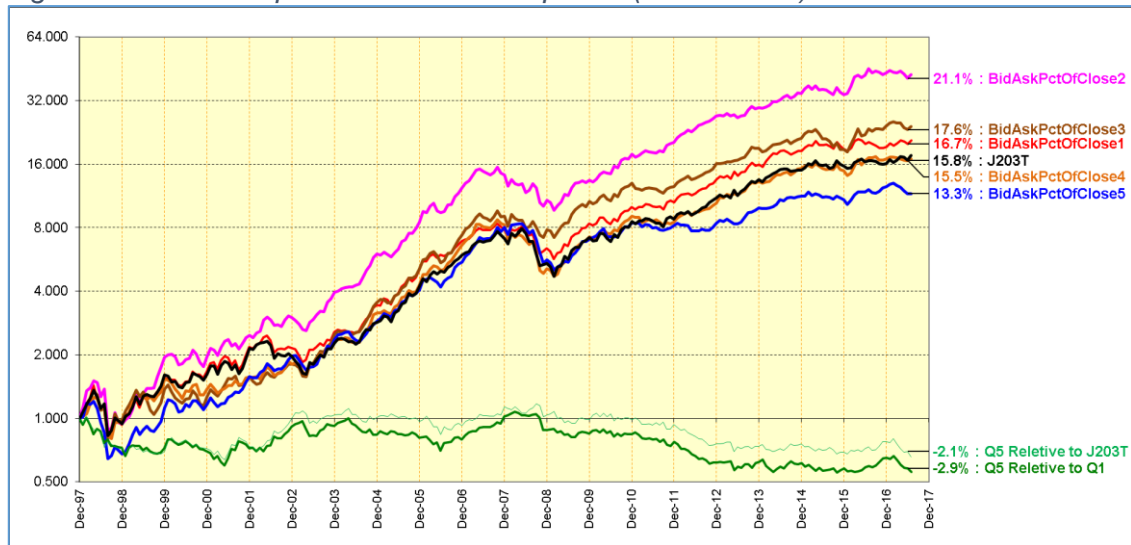
Figure 19: Annualised returns since 1997 on Bid-Ask Spread



Source: own research

Figure 20 shows the performance of Quintile One to Quintile Five compared with the performance of the JSE All Share Index (J203T). The returns of the quintiles are ranked in descending performance indicating Quintile Two (21.1%), Quintile Three (17.6%) and Quintile One (16.7%) performed above the J203T index (15.8%) while Quintile Four (15.5%) and Quintile Five (13.3%) underperformed the index. Relatively the performance of the highly liquid quintile (Quintile One) against the illiquid quintile (Quintile 5) was -2.9%, while the relative performance of the illiquid quintile (Quintile 5) against the JSE All Share Index (J203T) was -2.1%.

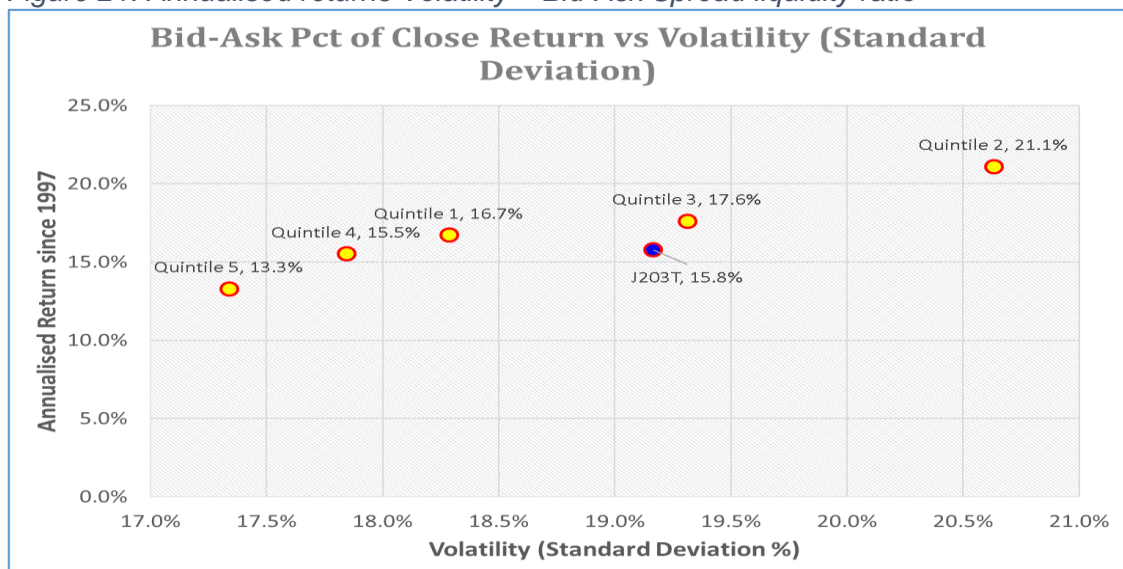
Figure 20. Bid-Ask Spread: Returns over period (1997 - 2007)



Source: own research

Returns of the high liquid quintiles (Quintile Two, Three and One) are more volatile (as measured by standard deviation) compared to returns of the illiquid quintiles (Quintile Four and Five). As indicated in Figure 21, Quintile Two is highly volatile with a standard deviation of 20.6% followed by Quintile Three with 19.3% then Quintile One with 18.3%. The lowest standard deviation is quintile one with 17.3%.

Figure 21: Annualised returns Volatility – Bid-Ask Spread liquidity ratio



Source: own research

### 5.2.4.3. Conclusion

The test results of the proposition that the Bid-Ask Spread ratio is used on the JSE as a liquidity measure where a liquidity-based investment style is elected indicates moderate to a strong association between the returns and the level of a firm liquidity (as measured by the Bid-Ask Spread ratio). With an  $r^2$  coefficient of 0.6008 greater than 0.5 (Wegner, 2016), the Bid-Ask Spread measure,  $x$ , explains only 60.08% of the returns earned by the style,  $y$ . The Bid-Ask Spread measure, therefore, have a weak impact on returns. The illiquid quintile (Quintile Five) returns of 13.3% performed below the JSE All Share Index (J203T) returns of 15.8%. The results can, therefore, do not substantiate the premise of the proposition, and hence Proposition Four is rejected.

### 5.2.5. Proposition 5: The use of Price Reversal

**The use of Price Reversal, as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).**

#### 5.2.5.1. Introduction

To test the proposition that the Price Reversal measure is used as a measure of liquidity on the JSE when liquidity is selected as an investment strategy, a graphical time series is used. This section presents results of the Price Reversal ratio as a measure of liquidity, where the highest ratio represents the high liquidity quintile, while the lowest ratio represents the illiquid quintile. The return of the lowest ratio is not the highest as expected. The actual ratio per quintile returns per quintile and performance against the JSE All Share Index (J203T) are summarised in Table 8 and further described in sections 5.2.5.2 to 5.2.5.3.

*Table 8: Summarized output of Price Reversal measure*

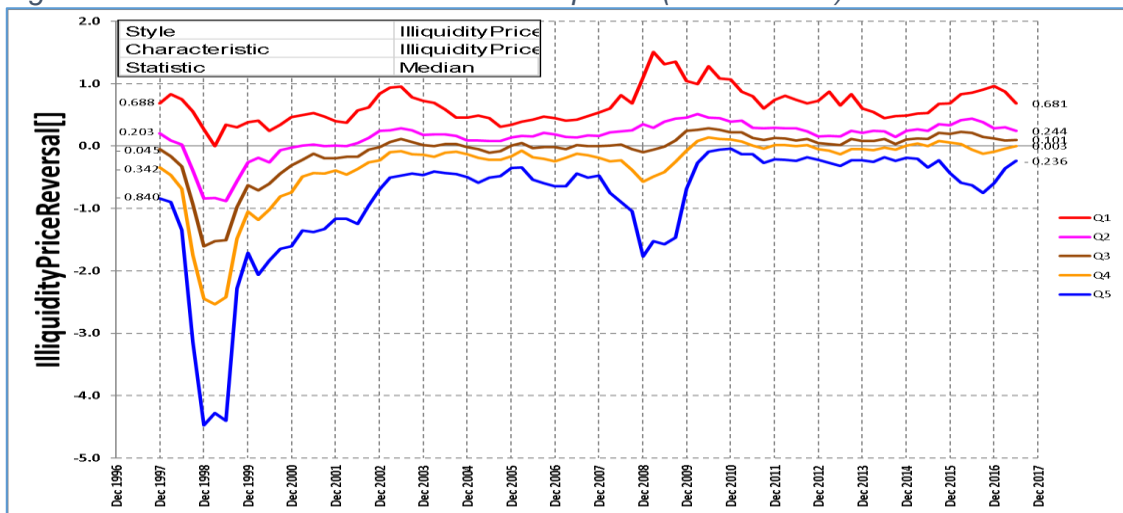
	Quintile 1 High liquidity	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Low liquidity	J203T
Mean	0.657	0.145	-0.084	-0.326	-0.855	
Annualised return	14.9%	17.2%	16.8%	16.5%	10.2%	15.8%
Standard deviation	16.1%	15.6%	16.3%	17.3%	22.9%	19.2%
Observations	237	237	237	237	237	

Source: own research

### 5.2.5.2. Results

The Price Reversal ratio as a measure of illiquidity for the top 160 companies ranked by Market Capitalisation and grouped into quintiles are presented in Figure 22 below. The quintile with the high liquidity companies (Quintile One) had the highest mean of the Price Reversal ratio of 0.657 higher than the mean of the second most liquid quintile of 0.145. The illiquid quintile (Quintile Five) had -0.855. The Price Reversal ratio has been consistent over the period under consideration (1997 - 2017) for all quintiles except for noted bubbles in December 1998, December 2008 and December 2016.

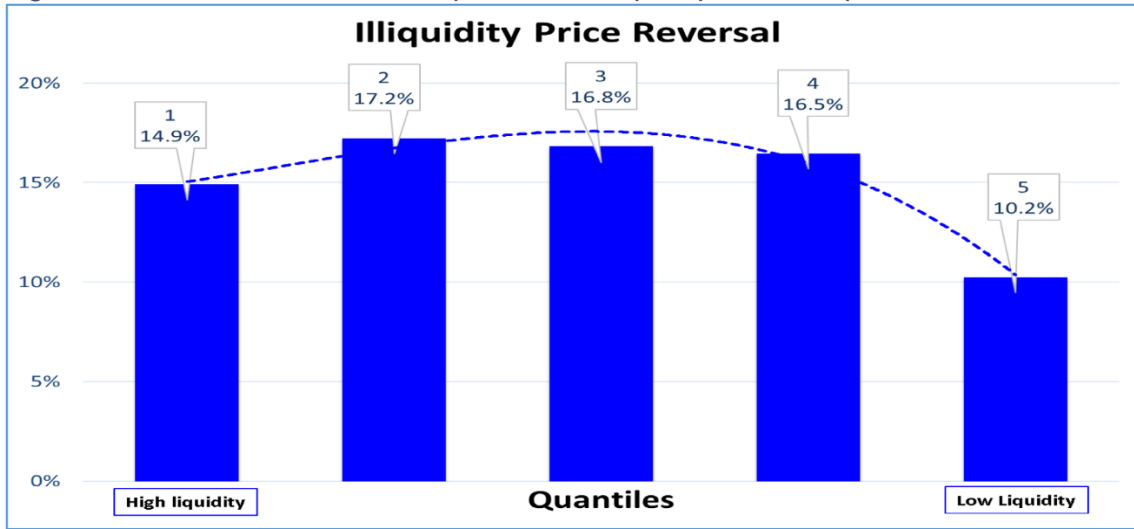
Figure 22. Price Reversal: Actual ratio over period (1997 – 2017)



Source: own research

Figure 23 shows the performance, represented by the annualised returns, of the high liquidity quintile trend to the illiquid quintile over the period of assessment (1997 to 2017). The results show that the high liquidity quintiles (Quintile One and Quintile Two) on average performed better than the illiquid quintiles (Quintile Four and Quintile Five).

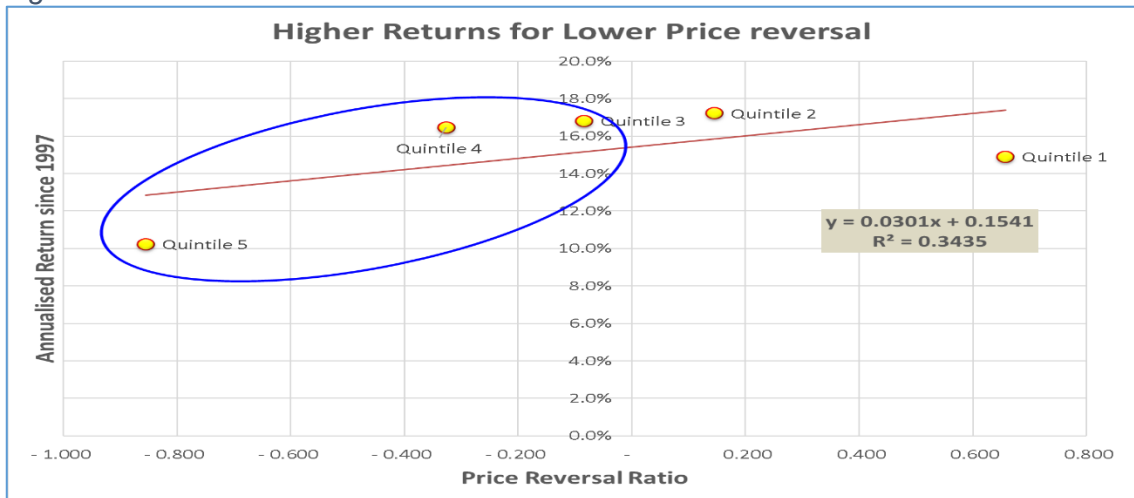
Figure 23. Price Reversal: Least liquid to most liquid quintile comparison



Source: own research

Figure 24 indicates the association between the returns earned by the style,  $y$ , and the level of a firm liquidity as measured by the Price Reversal ratio,  $x$ . The results indicate a weak association between the returns and the level of a firm liquidity with an  $r^2$  coefficient of 0.3435 less than 0.5 (Wegner, 2016). The Price Reversal measure,  $x$ , explains only 34.35% of the returns earned by the style,  $y$ . The Price Reversal measure, therefore, has a weak impact on returns. The quintiles with the lowest illiquidity score are as indicated by a circle.

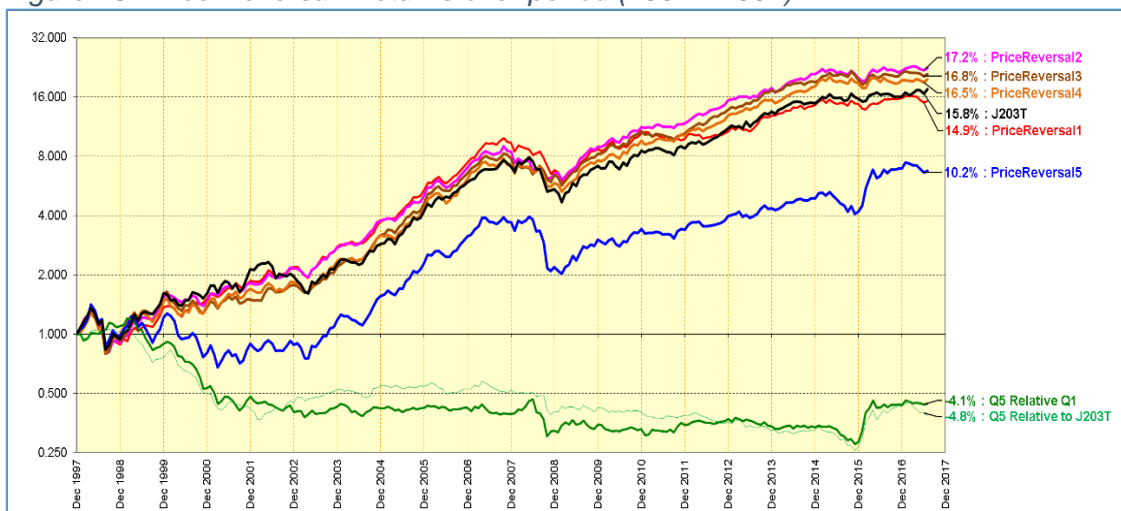
Figure 24: Annualised returns since 1997 on Price Reversal ratio



Source: own research

Figure 25 shows the performance of Quintile One to Quintile Five compared with the performance of the JSE All Share Index (J203T). The returns of the quintiles are ranked in descending performance indicating Quintile Two (17.2%), Quintile Three (16.8%) and Quintile Four (16.5%) performed above the JSE All Share Index (J203T) (15.8%) while Quintile One (14.9%) and Quintile Five (10.2%) underperformed the index. Relatively the performance of the low liquidity quintile (Quintile Five) against the high liquidity quintile (Quintile One) was -4.09%, while the performance of the illiquid quintile (Quintile Five) against the JSE All Share Index (J203T) was -4.80%.

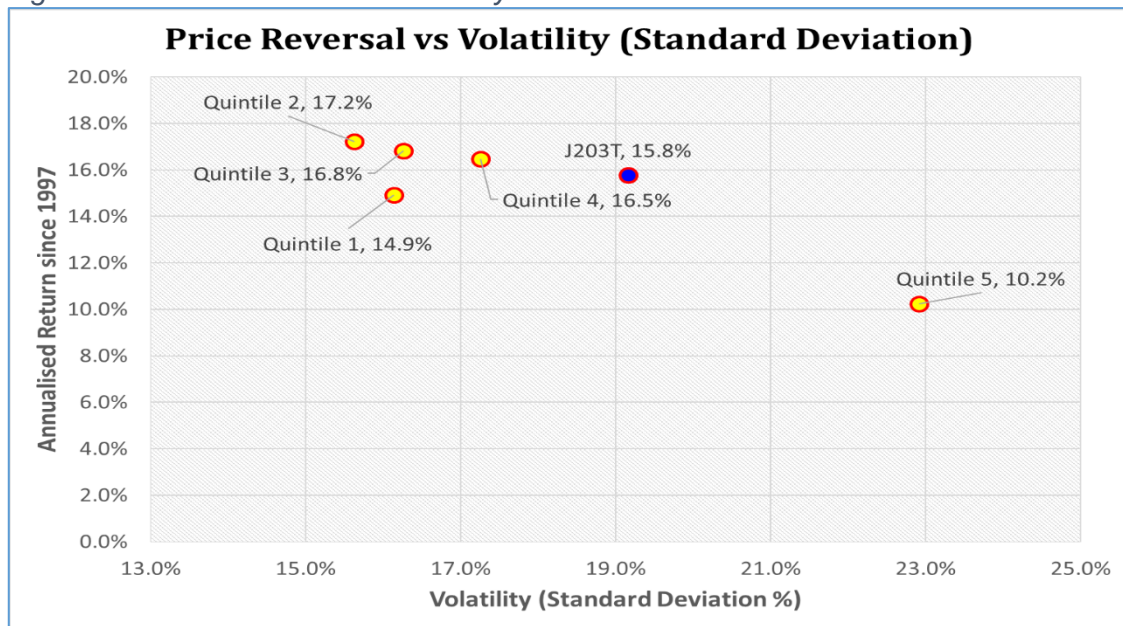
Figure 25. Price Reversal: Returns over period (1997 - 2007)



Source: own research

Returns of the illiquid quintiles (Quintile Four and Five) are more volatile (as measured by standard deviation) compared to returns of the high liquidity quintiles (Quintile One, Two and Three). As indicated in Figure 26, Quintile Five and Quintile Four are highly volatile with a standard deviation of 23% and 17%, respectively followed by Quintile Three with 16.3% then Quintile One with 16.1%. The lowest standard deviation is quintile two with 15.6%.

Figure 26: Annualised returns Volatility - Price Reversal ratio



Source: own research

### 5.2.5.3. Conclusion

The test results of the proposition that the Price Reversal ratio is used on the JSE as a liquidity measure where a liquidity-based investment style is elected indicates a weak association between the returns and the level of a firm liquidity (as measured by the Price Reversal ratio). With an  $r^2$  coefficient of 0.3435 less than 0.5 (Wegner, 2016), the Price Reversal measure,  $x$ , explains only 34.35% of the returns earned by the style,  $y$ . The Price Reversal measure, therefore, has a weak impact on returns. The illiquid quintile (Quintile Five) returns of 10.2% performed below the JSE All Share Index (J203T) returns of 15.8%. The results can, therefore, do not substantiate the premise of the proposition, and hence Proposition Five is rejected.

### 5.2.6. Proposition 6: The use of Turnover

**The use of Turnover, as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to JSE All Share Index (J203T).**

#### 5.2.6.1. Introduction

To test the proposition that the Turnover measure to be used as a measure of liquidity on the JSE when liquidity is selected as an investment strategy, a graphical time series

is used. This section presents results of the Turnover as a measure of liquidity, where the highest Turnover represents the high liquidity quintile, while the lowest Turnover presents the illiquid quintile. The return of the highest Turnover ratio is not the highest as expected. The actual ratio per quintile returns per quintile and performance against the JSE All Share Index (J203T) are summarised in Table 9 and further described in sections 5.2.6.2 to 5.2.6.3.

*Table 9: Summarized output of Turnover measure*

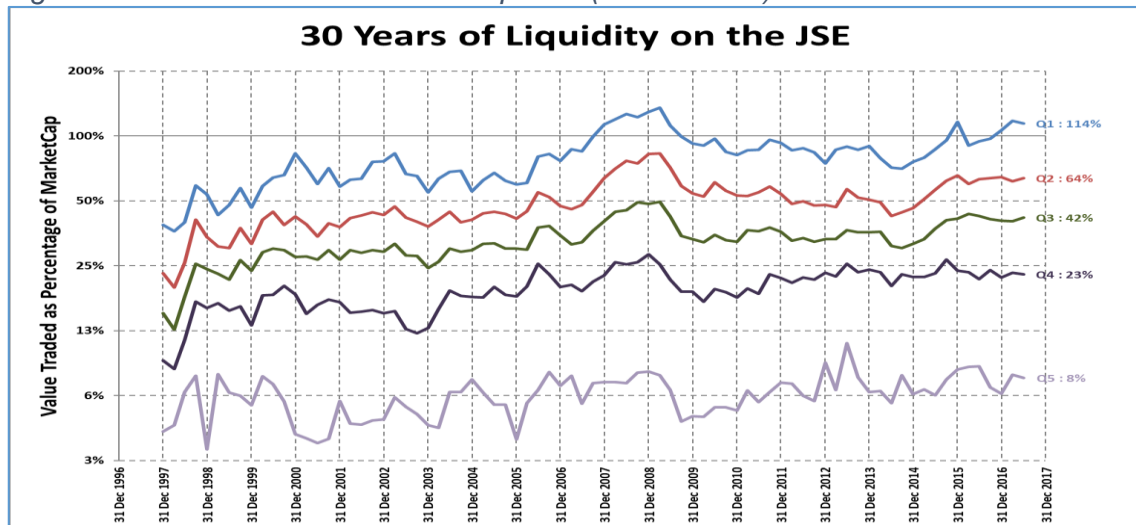
	Quintile 1 High liquidity	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Low liquidity	J203T
Mean	80%	49%	33%	20%	6%	
Annualised return	12.4%	17.2%	15.2%	17.0%	13.4%	15.8%
Standard deviation	22.0%	17.8%	17.6%	15.7%	15.5%	19.2%
Observations	237	237	237	237	237	

Source: own research

#### 5.2.6.2. Results

The Turnover ratio as a measure of illiquidity for the top 160 companies ranked by Market Capitalisation and grouped into quintiles are presented in Figure 27 below. The quintile with the high liquidity companies (Quintile One) had the highest mean of the Turnover of 80% significantly higher than the mean of the most illiquid quintile (Quintile Five) having a Turnover ratio mean of 6%. The Turnover percentage has been improving over the period under consideration (1997 - 2017) for all quintiles.

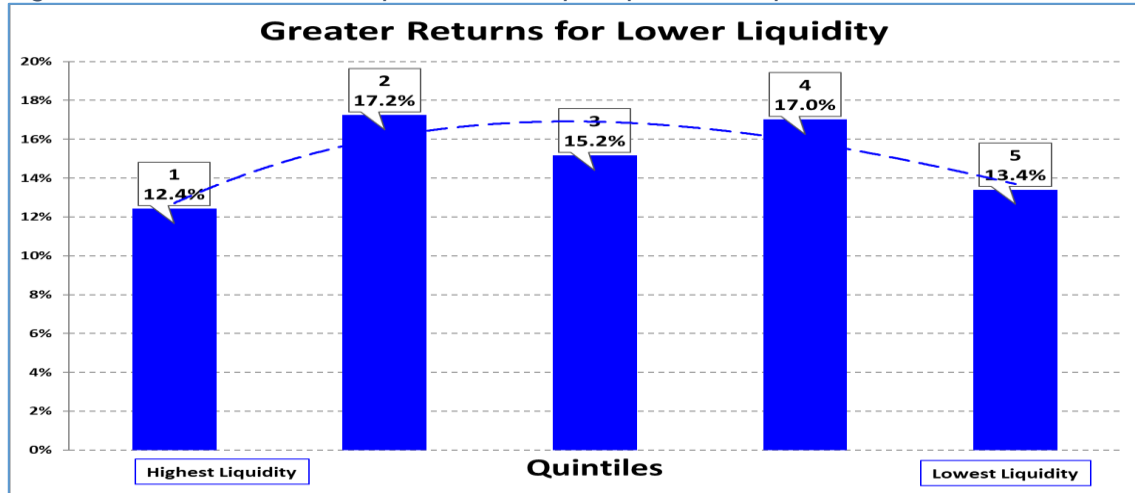
*Figure 27. Turnover: Actual ratio over period (1997 – 2017)*



Source: own research

Figure 28 shows the performance, represented by the annualised returns, of the high liquidity quintile trend to the illiquid quintile over the period of assessment (1997 to 2017). The results show that the high liquidity quintiles (Quintile One and Quintile Two) on average performed poorly than the illiquid quintiles (Quintile Four and Quintile Five).

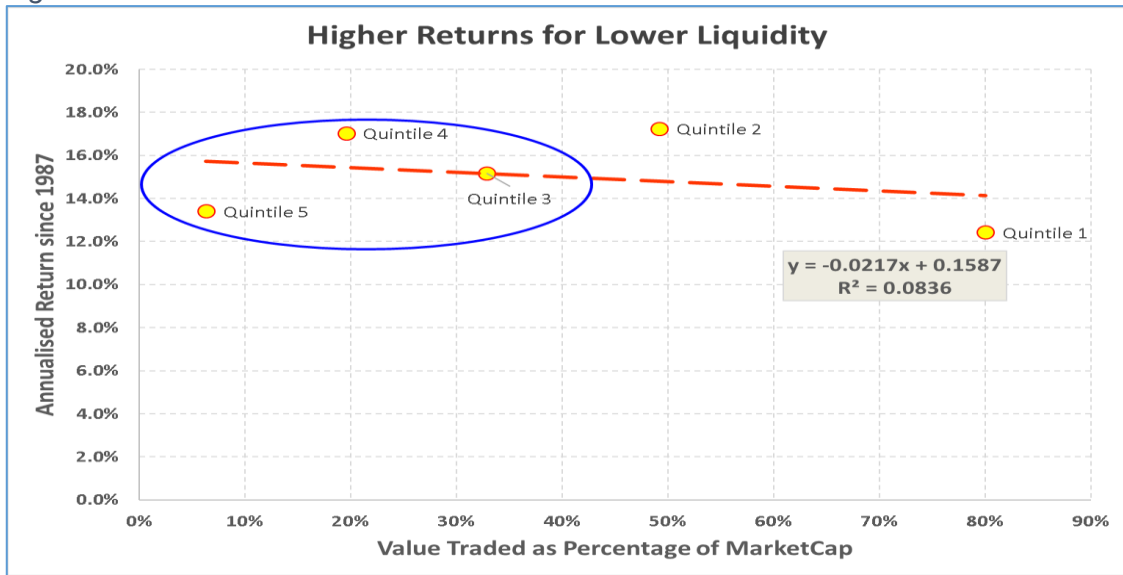
Figure 28. Turnover: Least liquid to most liquid quintile comparison



Source: own research

Figure 29 indicates the association between the returns earned by the style,  $y$ , and the level of a firm liquidity as measured by the Turnover ratio,  $x$ . The results indicate a weak association between the returns and the level of a firm liquidity with an  $r^2$  coefficient of 0.0829 less than 0.5 (Wegner, 2016). The Turnover measure,  $x$ , explains only 8.29% of the returns earned by the style,  $y$ . The Turnover measure, therefore, has a weak impact on returns. The quintiles with the lowest illiquidity score are as indicated by a circle.

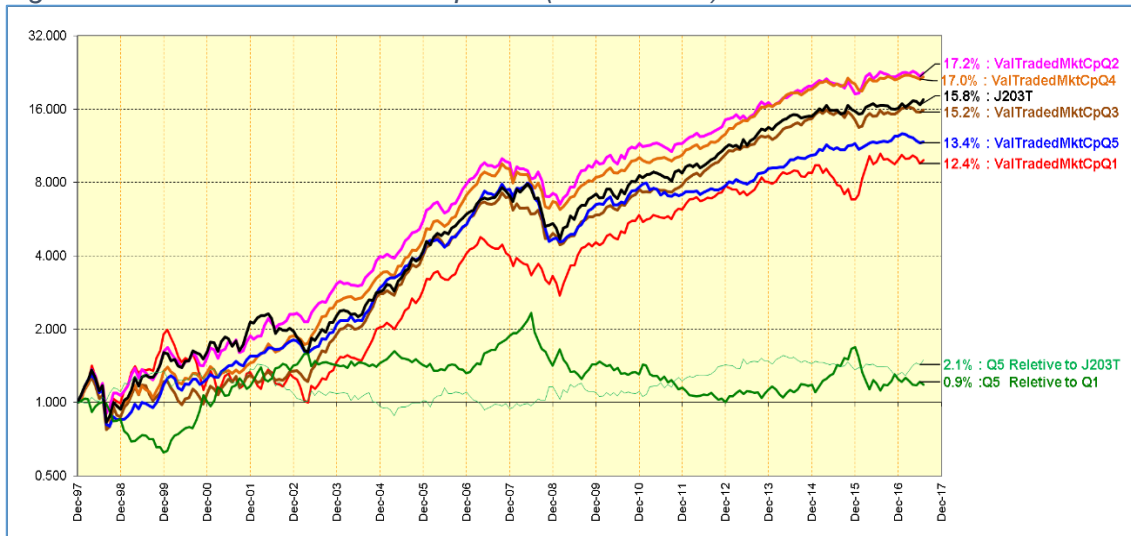
Figure 29: Annualised returns since 1997 on Turnover ratio



Source: own research

Figure 30 shows the performance of Quintile One to Quintile Five compared with the performance of the JSE All Share Index (J203T). The returns of the quintiles are ranked in descending performance indicating Quintile Two (17.2%) and Quintile Four (17.0%) performed above the JSE All Share Index (J203T) (15.8%) while Quintile Three (15.2%), Quintile Four (13.4%) and Quintile One (12.4%) underperformed the index. Relatively the performance of the low liquidity quintile (Quintile Five) against the high liquidity quintile (Quintile One) was 0.9%, while the performance of the illiquid quintile (Quintile Five) against the JSE All Share Index (J203T) was 2.1%.

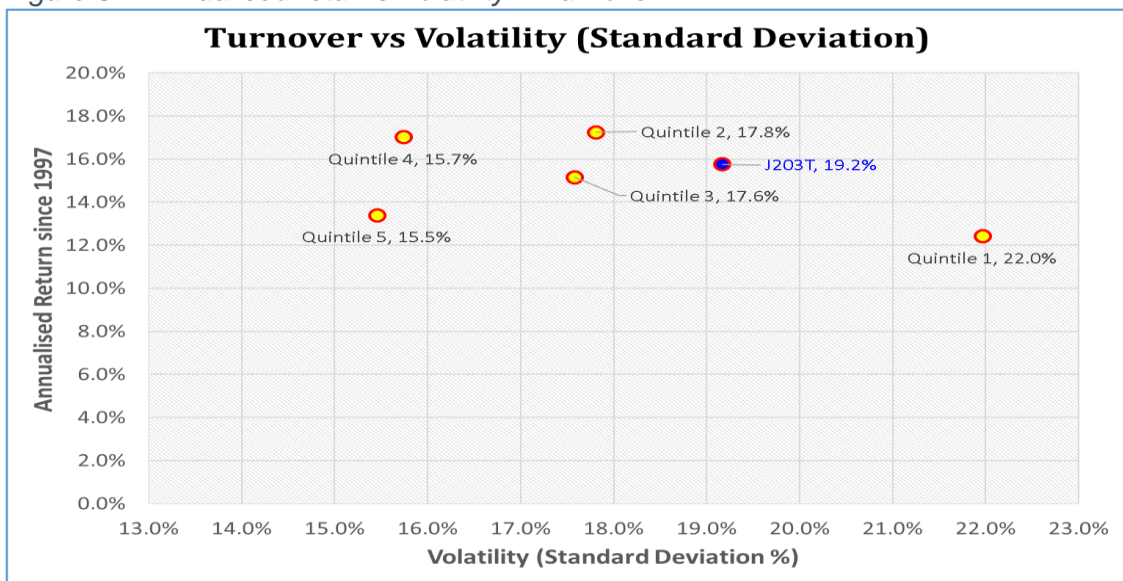
Figure 30. Turnover: Returns over period (1997 - 2007)



Source: own research

Returns of the illiquid quintiles (Quintile Four and Five) are less volatile (as measured by standard deviation) compared to returns of the high liquidity quintiles (Quintile One, Two and Three). As indicated in Figure 31, Quintile Five and Quintile Four are the lowest volatile with a standard deviation of 15.5% and 15.7%, respectively followed by Quintile Three with 17.6% then Quintile Two with 17.8%. The highest standard deviation is Quintile One with 22.0%. The circle indicates the quintiles with the highest standard deviation.

Figure 31: Annualised returns Volatility - Turnover



Source: own research

### 5.2.6.3. Conclusion

The test results of the proposition that the Turnover ratio is used on the JSE as a liquidity measure where a liquidity-based investment style is elected indicates a weak association between the returns and the level of a firm liquidity (as measured by the Turnover ratio). With an  $r^2$  coefficient of 0.0829 less than 0.5 (Wegner, 2016), the Turnover measure,  $x$ , explains only 8.29% of the returns earned by the style,  $y$ . The Turnover measure, therefore, has a weak impact on returns. The illiquid quintile (Quintile Five) returns of 13.4% performed below the JSE All Share Index (J203T) returns of 15.8%. The results can, therefore, do not substantiate the premise of the proposition, and hence Proposition six is rejected.

### 5.2.7. Proposition 7: The use of Localized Turnover

**The use of Localized Turnover, as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).**

#### 5.2.7.1. Introduction

To test the proposition that the Localized Turnover measure to be used as a measure of liquidity on the JSE when liquidity is selected as an investment strategy, a graphical time series is used. This section presents results of the Localized Turnover proxy as a measure of liquidity, where the highest Localized Turnover ratio represents the high liquidity quintile (Quintile One), while the lowest Localized Turnover ratio presents the illiquid quintile (Quintile Five). The return of the lowest Localized Turnover proxy is the highest as expected. The actual ratio per quintile returns per quintile and performance against the JSE All Share Index (J203T) are summarised in Table 10 and further described in sections 5.2.7.2 to 5.2.7.3.

*Table 10: Summarized output of Localized Turnover measure*

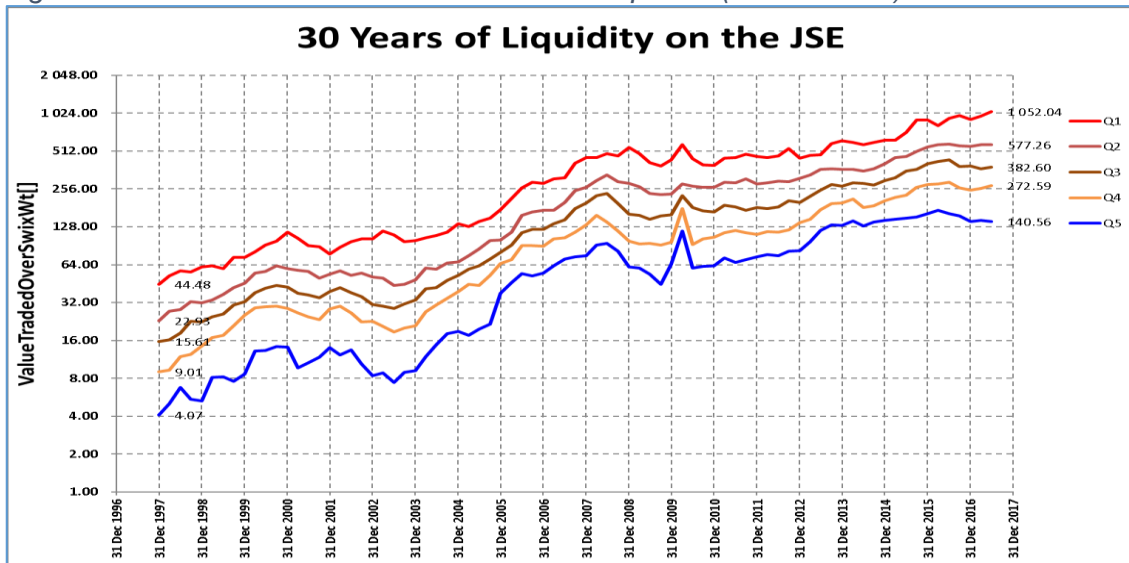
	Quintile 1 High liquidity	Quintile 2	Quintile 3	Quintile 4	Quintile 5 Low liquidity	J203T
Mean	358.80	218.00	152.41	102.69	62.17	
Annualised return	12.5%	15.0%	18.4%	18.4%	19.8%	15.9%
Standard deviation	22.6%	18.8%	18.7%	17.5%	14.4%	19.2%
Observations	237	237	237	237	237	

Source: Own research

#### 5.2.7.2. Results

The Localized Turnover as a measure of illiquidity for the top 160 companies ranked by Market Capitalisation and grouped into quintiles are presented in Figure 32 below. The quintile with the high liquidity companies (Quintile One) had the highest mean of the Localized Turnover of 218.00 significantly higher than the mean of the most illiquid quintile (Quintile Five) having a Localized Turnover 62.17. The Turnover percentage has been improving over the period under consideration (1997 - 2017) for all quintiles.

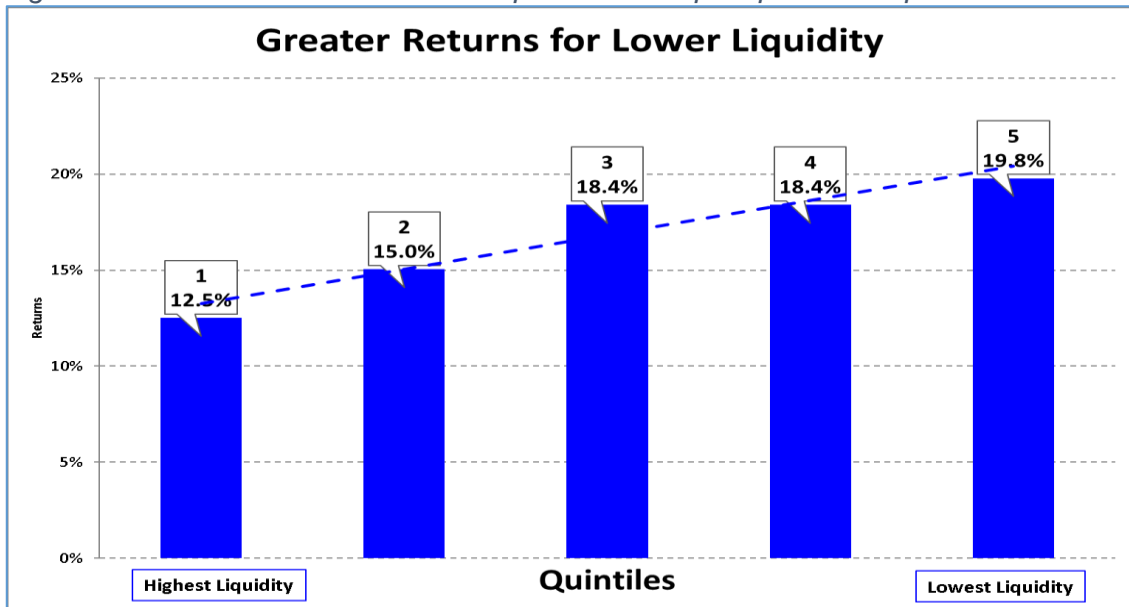
Figure 32. Localized Turnover: Actual ratio over period (1997 – 2017)



Source: own research

Figure 33 shows the performance, represented by the annualised returns, of the high liquidity quintile trend to the illiquid quintile over the period of assessment (1997 to 2017). The results show that the high liquidity quintiles (Quintile One and Quintile Two) on average performed lower than the illiquid quintiles (Quintile Four and Quintile Five).

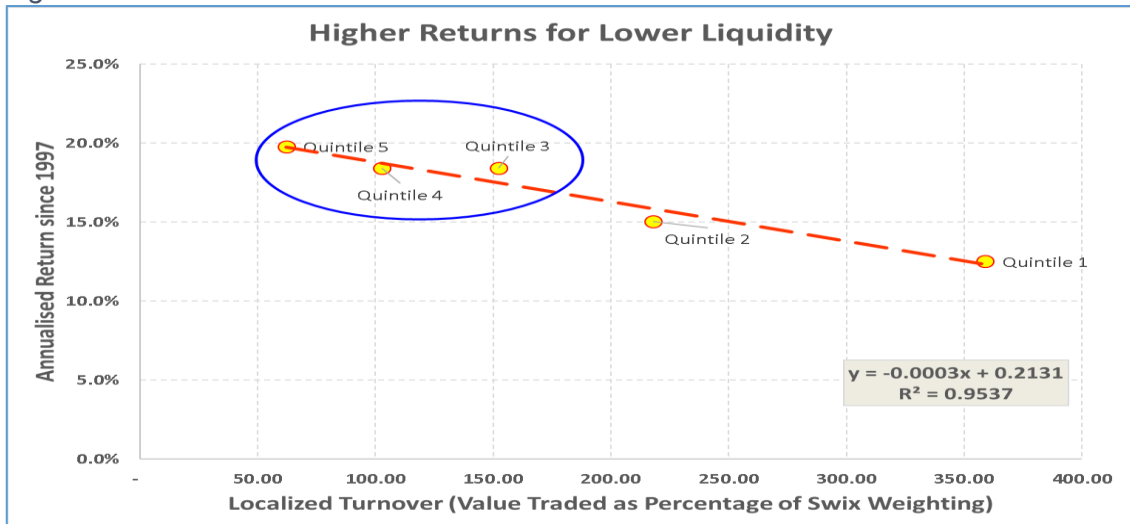
Figure 33. Localized Turnover: Least liquid to most liquid quintile comparison



Source: own research

Figure 34 indicates the association between the returns earned by the style,  $y$ , and the level of a firm liquidity as measured by the Localized Turnover ratio,  $x$ . The results indicate a strong association between the returns and the level of a firm liquidity with an  $r^2$  coefficient of 0.9537 greater than 0.5 (Wegner, 2016). The Localized Turnover measure,  $x$ , explains 95.37% of the returns earned by the style,  $y$ . The Localized Turnover measure, therefore, has a strong impact on returns. The quintiles with the lowest illiquidity score are as indicated by a circle.

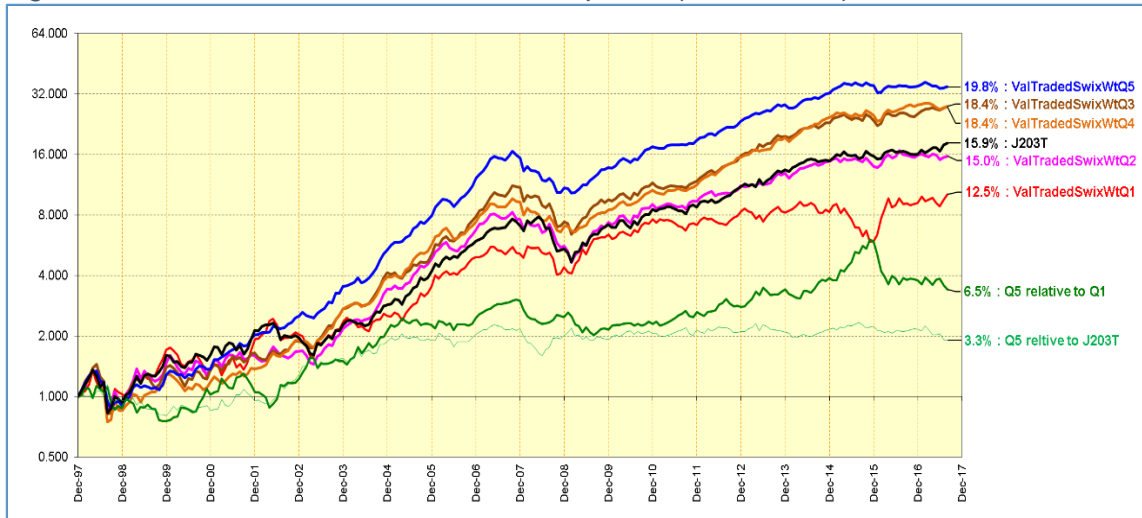
Figure 34: Annualised returns since 1997 on Localized Turnover



Source: own research

Figure 35 shows the performance of Quintile One to Quintile Five compared with the performance of the JSE All Share Index (J203T). The returns of the quintiles are ranked in descending performance indicating Quintile Five (19.8%), Quintile Four (18.4%) and Quintile Three (18.4%) performed above the JSE All Share Index (J203T)(15.8%) while Quintile Two (15.0%) and Quintile One (12.5%) underperformed the index. Relatively, the performance of the low liquid quintile (Quintile Five) against the high liquid quintile (Quintile One) was 6.5% while the performance of the illiquid quintile (Quintile 5) against the JSE All Share Index (J203T) was 3.3%.

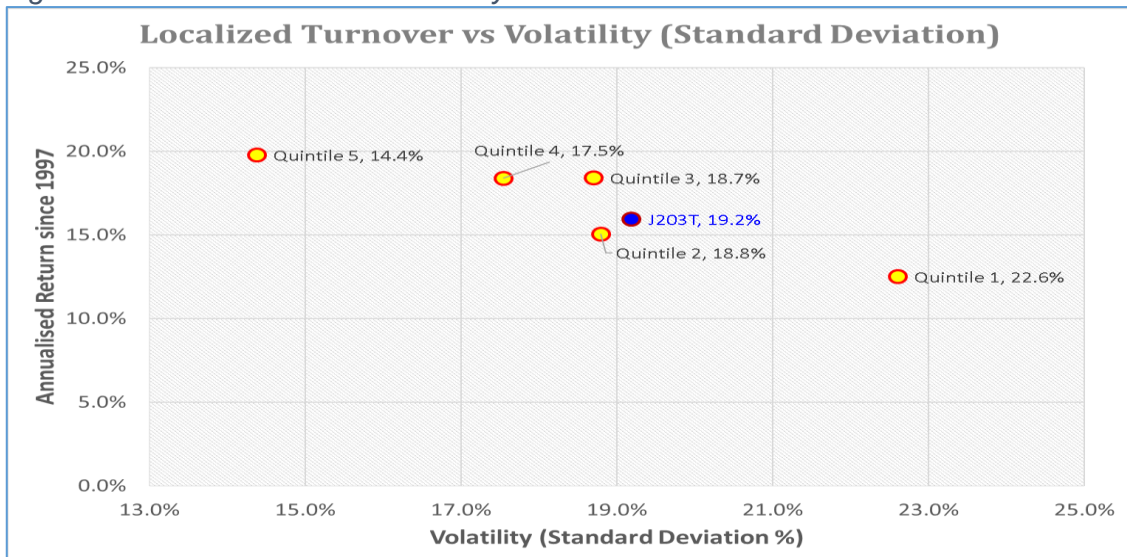
Figure 35. Localized Turnover: Returns over period (1997 - 2007)



Source: own research

Returns of the illiquid quintiles (Quintile Four and Five) are less volatile (as measured by standard deviation) compared to returns of the high liquidity quintiles (Quintile One, Two and Three). As indicated in Figure 36, Quintile Five and Quintile Four are the lowest volatile with a standard deviation of 14.4% and 17.5%, respectively followed by Quintile three with 18.7% then Quintile Two with 18.8%. The highest standard deviation is quintile one with 22.6%.

Figure 36: Annualised returns Volatility – Localized Turnover



Source: own research

### 5.2.7.3. Conclusion

The test results of the proposition that the Localized Turnover ratio is used on the JSE as a liquidity measure where a liquidity-based investment style is elected indicates a strong association between the returns and the level of a firm liquidity (as measured by the Localized Turnover ratio). With an  $r^2$  coefficient of 0.9537 greater than 0.5 (Wegner, 2016), the Localized Turnover measure,  $x$ , explains 95.37% of the returns earned by the style,  $y$ . The Localized Turnover measure, therefore, has a strong impact on returns. The illiquid quintile (Quintile Five) returns of 19.8% performed above the JSE All Share Index (J203T) returns of 15.8%. The results can, therefore, substantiate the premise of the proposition, and hence Proposition Three is accepted.

### 5.2.8. Synopsis of key Question 1: Which measure of liquidity yield the highest return?

Section 5.2.1 to section 5.2.7 presented the data on each of the seven measures. To link to research Question One: what measure of liquidity yields the highest return on the JSE compared to the JSE All Share Index (J203T)? A summary of the data presented in sections 5.2.1 to 5.2.7 is discussed in this section.

The decision on which of the measure of liquidity yield the highest return on the JSE was made looking at the measure of liquidity producing the highest excess return compared with the JSE All Share Index (J203T) and at the lowest risk measured by standard deviation. Each measure was assessed if it offered the highest liquidity premium measured as the excess return between the high liquidity quantile (Quintile One) and the most illiquid quintile (Quintile Five). From Table 11 below it is noted that only Relative Change in Volume and Localized turnover performed above the benchmark on the illiquid quintile (Quintile Five).

Table 11: Summary of returns vs JSE All Share Index (J203T)

Liquidity measure	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Benchmark - J203T <b>15.8%</b>	N/A	N/A	N/A	N/A	N/A
Relative Change in Volume	11.85%	15.23%	15.49%	15.11%	<b>18.26%</b>
Bid Ask Spread	16.70%	21.10%	17.60%	15.50%	13.30%
Turnover	12.40%	<b>17.20%</b>	15.20%	17.00%	13.40%
Localized Turnover	12.50%	15.00%	18.40%	18.40%	<b>19.80%</b>
Amihud ILLIQ	14.20%	16.00%	12.80%	<b>19.20%</b>	13.90%
Adjusted Amihud AdjILLIQ	14.40%	15.50%	13.20%	<b>18.70%</b>	14.30%
Price Reversal	14.90%	<b>17.20%</b>	16.80%	16.50%	10.20%

Source: own research

Table 12 shows that the high performing measures by excess return on the best quintile compared to the JSE All Share Index (J203T) are (in descending order): Bid-Ask Spread (Quintile Two) = 4.61%, Localized Turnover (Quintile Five) = 3.49%, Amihud measure (Quintile Four) = 2.97%, Adjusted Amihud measure (Quintile Four) = 2.54%, Relative change in Volume (Quintile One) = 2.15%, Turnover (Quintile Two) = 1.24% and Price Reversal (Quintile Two) = 1.24%. Only Relative Change in Volume, Turnover and Localized Turnover had positive illiquidity premium (5.73%, 0.89% and 6.49%, respectively) however only Relative Change in Volume and Localized Turnover performed above the JSE All Share Index (J203T) by 2.15% and 3.49%, respectively.

Table 12: Excess Return for each measure

Liquidity measure	Excess return Q1 V Q5 (illiquidity premium)	Excess return Q5 vs J203T	Excess return Best Quintile vs J203T
Relative Change in Volume	<b>5.73%</b>	<b>2.15%</b>	2.15%
Bid Ask Spread	-2.91%	-2.13%	4.61%
Turnover	<b>0.89%</b>	-2.04%	1.24%
Localized Turnover	<b>6.49%</b>	<b>3.49%</b>	3.49%
Amihud ILLIQ	-0.26%	-1.61%	2.97%
Adjusted Amihud AdjILLIQ	-0.09%	-1.26%	2.54%
Price Reversal	-4.09%	-4.80%	1.24%

Source: own research

Table 13 provides a summary of the standard deviation for each measure. Generally, across all measures except for Price Reversal, the standard deviation of the illiquid quintile (Quintile Five) is lower than that of the high liquidity quintile (Quintile One).

Table 13: Summary of Standard deviation vs the JSE All Share Index (J203T)

Liquidity measure	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Benchmark - J203T <b>19.20%</b>	N/A	N/A	N/A	N/A	N/A
Relative Change in Volume	17.91%	18.14%	17.13%	17.33%	16.43%
Bid Ask Spread	18.30%	<b>20.60%</b>	<b>19.30%</b>	17.80%	17.30%
Turnover	<b>22.00%</b>	17.80%	17.60%	15.70%	15.50%
Localized Turnover	<b>22.60%</b>	18.80%	18.70%	17.50%	14.50%
Amihud ILLIQ	18.50%	<b>20.70%</b>	18.60%	16.30%	15.00%
Adjusted Amihud AdjILLIQ	18.60%	<b>20.50%</b>	19.00%	16.10%	14.70%
Price Reversal	16.10%	15.60%	16.30%	17.30%	<b>22.90%</b>

Source: own research

Table 14 summarises the association between each measure of liquidity and the returns as indicated by the  $r^2$  coefficient. Only relative Change in Volume (0.869), Bid-Ask Spread (0.601) and Localized Turnover (0.953) indicated a stronger association between returns and the liquidity measure with  $r^2$  coefficient above 0.5 (Wegner, 2016).

Table 14: Correlation between returns and the liquidity level for each measure

Liquidity measure	$r^2$ coefficient return and Liquidity
Relative Change in Volume	<b>0.869</b>
Bid-Ask Spread	<b>0.601</b>
Turnover	0.083
Localized Turnover	<b>0.953</b>
Amihud ILLIQ	0.033
Adjusted Amihud AdjILLIQ	0.018
Price Reversal	0.344

Source: own research

The observation from the above was that Relative Change in Volume (RCV) and Localized Turnover are the only measures of liquidity that performed above the market benchmark each by 2.15% and 3.49% respectively. Both measures delivered an illiquidity premium of 5.73% and 6.49% respectively at the lowest standard deviation below the market (16.43% and 14.5%, respectively). The level of association between return and liquidity level are both stronger with  $r^2$  coefficient above 0.5. However, in all three comparisons (return, standard deviation and association between measure and returns), the results of Localized Turnover are better than that of Relative Change in Volume as indicated in Table 15 below.

Table 15: Summary of the best measures of liquidity on the JSE

Area of comparisons	Relative Change in Volume (RCV)	Localized Turnover
Returns of the illiquid quintile	18.23%	19.80%
Standard deviation	16.43%	14.50%
$r^2$ coefficient	0.869 (86.9%)	0.953 (95.3%)

Source: own research

The answer to which measure of liquidity yield the highest returns on the JSE out of the seven, is Relative Change in Volume and Localized Turnover. Localized Turnover is, however, the best of the two measures.

### 5.3. Research Question 2:

**Do returns of liquidity based investment style using the successful measure(s) from research question 1 consistently outperform the market over time or is there a time factor in the performance?**

Section 5.2 concluded by indicating that only Relative Change in Volume and Localized Turnover measures had a positive illiquidity premium and their illiquid quintiles performed above the market benchmark. In this section, we look at the consistency of returns of the two measures over the period of 20 years. In each section, a time series chart is presented, and a green line indicates how well the measure did over the period.

#### 5.3.1. Proposition 8(1): Performance of Relative Change in Volume (RCV) over the period

**The low liquidity quintile of Relative Change in Volume (RCV) has consistently outperformed the benchmark and was dependent on the time (short-term / long-term).**

##### 5.3.1.1. Introduction

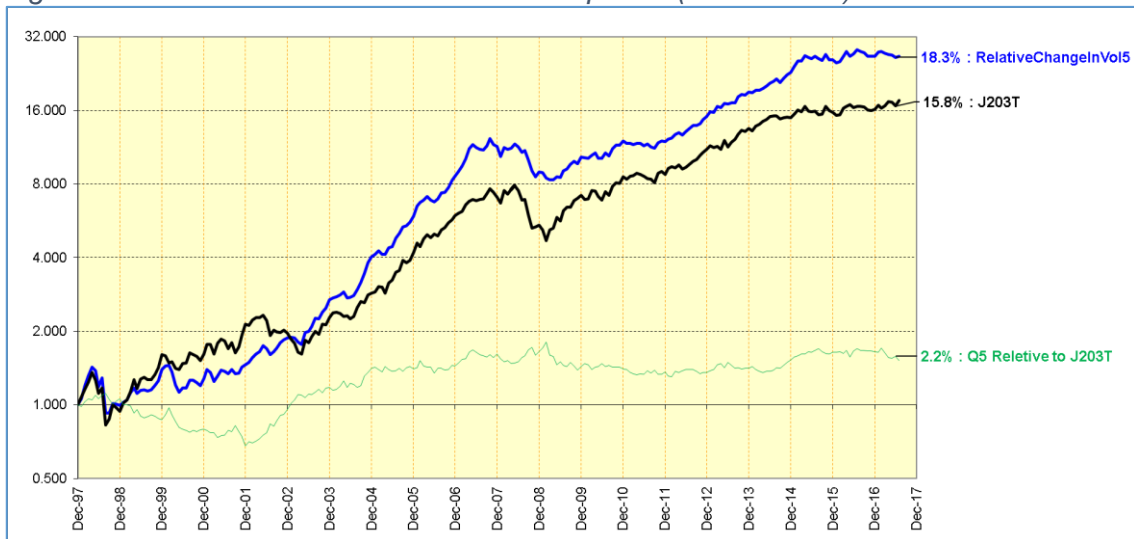
The consistency of the Relative Change in Volume (RCV) returns over the period is indicated in *Figure 37* below. It was assessed looking at the relative performance of the lowest liquidity quantile (Quintile 5) against the JSE All Share Index (J203T) over the period. The results were indicated by the green lines which show if the gap between outer quantiles is growing or not and that of the illiquid quantile with the JSE All Share

Index (J203T). If the green line flattens or drops, then the illiquidity measure is fading or even reversing (Muller & Ward, 2013).

### 5.3.1.2. Results

Figure 37 indicates that the gap between the outer quintiles was positive during the period December 1998 to December 2008, but has since been flattening. Compared to the JSE All Share Index (J203T), the style on average consistently outperformed the index throughout the period, with a relative performance of 2.2% above the index over the period.

Figure 37. Localized Turnover: Returns over period (1997 - 2017)



Source: own research

Table 16 indicates the returns of Relative Change in Volume (RCV) measure compared the JSE All share Index for a different period. Relative Change in Volume (RCV) performed above the index both in the long term (15 years and 20 years) and in the short term (10 years and 5 years).

Table 16: Relative Change in Volume returns for different time frame

Period	RCV Quintile 5 returns	Returns J203T
20 years (1997 – 2017)	18.26%	15.80%
15 years (2003 – 2017)	18.90%	15.28%
10 years (2007 – 2017)	10.04%	9.39%
5 years (2013 – 2017)	11.78%	9.30%

Source: Own research

### 5.3.1.3. Conclusion

In summary, the performance of the measure has consistently outperformed the JSE All Share Index (J203T) for the period. The results confirm that the returns delivered by liquidity based investment style using the Relative Change in Volume (RCV) measure consistently outperform the market both in a short-term and long-term.

Proposition 8(1), the consistency of Relative Change in Volume (RCV) performance, and its dependence on time, therefore, be substantiated. The test results supported Proposition 8.

### 5.3.2. Proposition 8(2): Performance of Localized Turnover over the period

**The low liquidity quintile of Localized Turnover has consistently outperformed the benchmark and dependent on time**

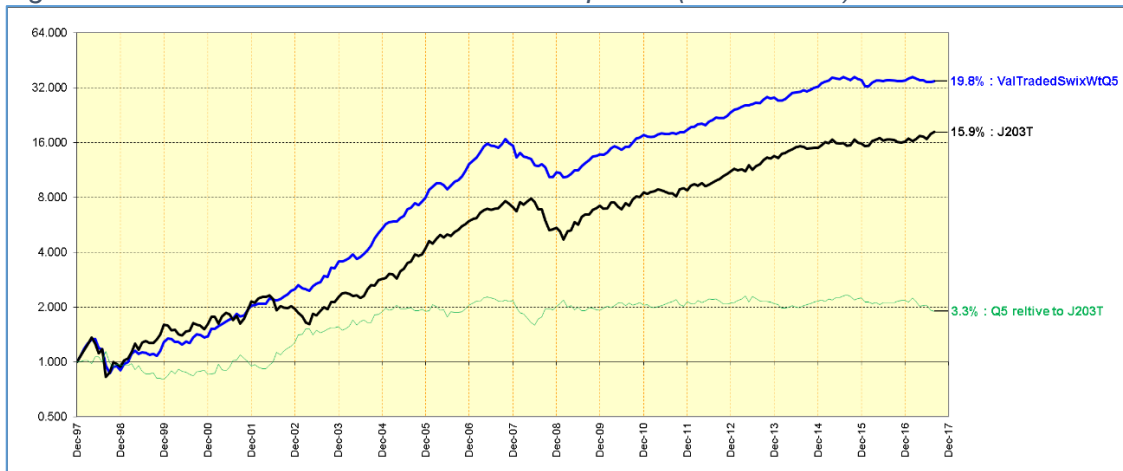
#### 5.3.2.1. Introduction

The consistency of the Turnover returns over the period is indicated in *Figure 38* below. It was assessed looking at the relative performance of the lowest liquidity quintile (Quintile 5) against the JSE All Share Index (J203T) over the period. The results were indicated by the green lines which shows the gap between outer quintiles is growing or not and that of the illiquid quintile with the JSE All Share Index (J203T). If the green line flattens or drops, then the illiquidity measure is fading or even reversing.

#### 5.3.2.2. Content

Figure 38 indicates that the gap between the outer quintiles was positive during the period December 1997 to December 2015, but has since been fading out. Compared to the JSE All Share Index (J203T), the style on average consistently outperformed the index throughout the period, with a relative performance of 3.3% above the index over the period.

Figure 38. Localized Turnover: Returns over period (1997 - 2017)



Source: own research

Table 17 indicates the return for Localized Turnover measure compared to the JSE All share Index (J203T) for a different period. Localized Turnover performed above the index only in the long term (15 years and 20 years), however in the short term (10 years and 5 years) performed under the index. Time is a factor in the performance of this measure.

Table 17: Localized Turnover returns for different time frame

Period	Localized Turnover Returns Quintile 5	Returns J203T
20 years (1997 – 2017)	19.77%	15.80%
15 years (2003 – 2017)	18.27%	15.28%
10 years (2007 – 2017)	9.16%	9.39%
5 years (2013 – 2017)	7.71%	9.30%

Source: Own research

### 5.3.2.3. Conclusion

In summary, the performance of the measure has consistently outperformed the JSE All Share Index (J203T) for the period. However, it is noted that performance of the measure against the index has been flattening on average from December 2004 to the end of the period. The results suggest the returns delivered by liquidity based investment style using the Localized Turnover measure consistently outperform the market over the period when used for 15 or 20 years, however, underperform the market in the short-term (5 and 10 years).

Proposition 8(2), the consistency of Localized Turnover performance, and its dependence on time, therefore, be substantiated. The test results supported Proposition 8.

### 5.3.3. Synopsis of Key Question 2

*Table 18: Relative change in liquidity over the period (1997 to 2017)*

Liquidity measure	Relative performance Q5 vs J203T	Relative performance Q5 vs Q1
Relative Change in Volume	5.70%	2.20%
Localized Turnover	6.50%	3.30%

Source: own research

From Table 18 it is being observed that both the returns of the Relative Change in Volume and Localized Turnover have consistently outperformed the index and such performance has been consistently improving over the period. This suggests that the returns delivered by liquidity based investment style using the Relative Change in Volume or Localized Turnover measure consistently outperformed the market over time. However, it was noted from Table 19 that Localized Turnover is only profitable when applied over a more extended period (15 and 20 years) than in a shorter period. Performance of Relative Change in Volume was consistent throughout the period.

*Table 19: Summarized performance results for different time frame*

Period	RCV Quintile 5 returns	Localized Turnover Returns Quintile 5	Returns J203T
20 years	18.26%	19.77%	15.80%
15 years	18.90%	18.27%	15.28%
10 years	10.04%	9.16%	9.39%
5 years	11.78%	7.71%	9.30%

Source: Own research

## 5.4. Chapter summary

The data presented in the above section in answering research question one on which measure of liquidity produced the highest return compared to the market benchmark represented by the JSE All Share Index (J203T), indicates that the Relative Change in Volume and Localized Turnover have positive illiquidity premiums, and both produced returns higher than the market benchmark for Quintile Five. It is, however, noted that in all three level of comparisons (return, standard deviation and association between

measure and returns), the results of Localized Turnover are better than that of Relative Change in Volume (*RCV*).

The data for research Question Two, also supported the two measures Relative Change in Volume and Localized Turnover as consistently outperformed the index and such performance has been consistently improving over the period. Localized Turnover is only profitable if used over a more extended period (15 and 20 years). Therefore, the data presented confirm that the returns delivered by liquidity based investment style using the Relative Change in Volume measures consistently outperformed the market over time whether used in a shorter or longer period.

## Chapter 6: Discussion of Results

### 6.1. Introduction

The empirical results presented in the preceding Chapter Five provides insights into to the primary research question of the study: whether liquidity based investment style, using the appropriate liquidity measure, produces profitable returns on the JSE that consistently outperforms the market benchmark, as represented by the JSE All Share Index (J203T). The foundation of the analysis is based on Ibbotson et al. (2013) literature that liquidity meets the criteria by Sharpe (1992) to be used as an investment style. Each set of data is presented using each measure as a critical component of an investment style with the ultimate purpose of producing profitable returns that outperforms the market benchmark.

The illiquidity theory followed in each assessment is that returns of the most illiquid asset or portfolio (Quintile 5), should be higher than the return of the high liquid asset or portfolio (Quintile 1) (Amihud et al., 2012; Amihud & Mendelson, 1986; Hassan & Javed, 2011). The assessment also follows the theory that illiquid assets or portfolio earn a higher return as compensation for taking illiquidity risk, there is an illiquidity premium (Amihud, 2002; Amihud & Mendelson, 1986).

The results of this study confirm the work of Moreira De Sousa (2015) that investment style effectiveness depends on the geographical market measured and the liquidity measure chosen. Moreira De Sousa (2015) findings are confirmed by the commonly used measures such Amihud (2002) Illiquidity ratio (ILLIQ), Bid-Ask Spread and Price Reversal that performed poorly in this study on the JSE compared to they did in other markets. Similar studies performed in other markets confirmed the liquidity measures such as the use of Amihud (2002) illiquidity measure in the NYSE/AMEX and NASDAQ to be the best (Brennan et al., 2013).

Through answering, each of the research questions with their proposition the specific goals of this study as stated in Section 1.4 have been met by understanding how each measure performs, which one is better than the others, and whether it has been consistent over the period.

The results stem from a graphical time series method used in analysing the data similarly to that of Muller & Ward (2013). Each section below is structured first to provide an introduction, content, and a conclusion on each test conducted.

Table 20: Research goal 1

GOALS	DESCRIPTION
<b>Goal 1</b>	<p>To examine the selected measures of liquidity and understand how each performs against the market benchmark, typically an index, in this case, the Allshare Index (J203T) as a proxy for the market performance. The selected measures for examinations are:</p> <ul style="list-style-type: none"> <li>• Amihud (2002) ratio of return to a dollar volume (<i>ILLIQ</i>),</li> <li>• Kang &amp; Zhang (2014) modified version of the Amihud return to a dollar volume (<i>AdjILLIQ</i>),</li> <li>• Amihud &amp; Mendelson (1986) Bid-Ask Spread,</li> <li>• Vayanos &amp; Wang (2013a) Price Reversal,</li> <li>• Muller &amp; Ward (2013) value traded as a percentage of market capitalisation (Turnover),</li> <li>• Vidović et al. (2014) Relative Change in Volume, and</li> <li>• Author's proposed new measure, Value Traded as a percentage of SWIX (Localized Turnover).</li> </ul>

## 6.2. Research Question 1: Which measure of liquidity yield the highest returns on the JSE?

### 6.2.1. Proposition 1: The use of Amihud illiquidity measure (*ILLIQ*)

The use of Amihud illiquidity measure (*ILLIQ*), as a measure of liquidity on the JSE, will yield a higher return on the JSE outperforming the JSE All Share Index (J203T).

#### 6.2.1.1. Introduction

The Amihud illiquidity ratio of shares listed on the JSE with a market capitalisation rank of below 160 was calculated. The results were ranked in a descending order and allocated using equal waiting to five quintiles. Quintile One with the highest Amihud illiquidity ratio representing the high liquid shares in line with Amihud (2002). Quintile

Five represents the low liquidity portfolio characterised by a high Amihud illiquidity ratio as presented in Table 4. Amihud (2002) hypothesised that asset returns should increase with illiquidity. The hypothesis suggested that the more illiquid an asset be, returns are expected to be higher.

For Amihud (2002) proposition to hold, we expected Quintile Five which contains the low liquidity shares to earn a higher return. As we move from quintile one to five, returns were expected to grow as the shares become more illiquid. The findings of this study, however, were not consistent with Amihud (2002) proposition. Sections 6.2.1.2 to 6.2.1.3 present the findings from results of the test using data from the JSE for a period of 20 years, which started from 1997 to 2017.

The existential, relational proposition one, The use of Amihud illiquidity measure (*ILLIQ*), as a measure of liquidity on the JSE that will yield the highest returns, outperform the JSE All Share Index (J203T), is found to be false.

#### 6.2.1.2. Discussion

In testing the proposition that the use of Amihud illiquidity measure (*ILLIQ*), as a measure of liquidity on the JSE, will yield a higher return on the JSE outperforming the JSE All Share Index (J203T), a graphical time series method was used similarly to that of Muller & Ward (2013). Annualized returns of the All Share index (J203T) for the period beginning in December 1997 to June 2017 was 15.8% with a standard deviation of 19.2%. Both the annualised returns and standard deviation were the benchmarks that needed to be outperformed by the returns using the Amihud illiquidity measure (*ILLIQ*). The standard deviation is a proxy for measuring of risk; therefore, a lower standard deviation than the benchmark is acceptable.

The Amihud & Mendelson (1986) hypothesis that there is an illiquidity premium earned by illiquid stock versus the most liquid as compensation for taking illiquidity risk is not valid on the JSE when Amihud illiquidity ratio is used as a measure of liquidity. From the results, illiquidity premium is found to be negative (-0.26%) between the illiquid quintile and the most liquid quintile as measured using Amihud (2002) *ILLIQ* measure. The return of the second illiquid quintile (Quintile Four) was the highest of all quintiles at 19.20% outperforming the index by 2.97%.

The high performance at Quintile Four is contrary to Amihud (2002) proposition suggesting Quintile Five should be the highest performing quintile because it is the most illiquid quintile. However, from the top line in Figure 2, we observed that Quintile Five Amihud ratio deviated from the trend from December 2010 to December 2017. The results suggested that there could be other factors affecting the performance of Quintile Five.

For Amihud (2002) proposition to hold on the JSE, we expected to see a linear relationship between returns and level of liquidity. This means, that return was supposed to increase from Quintile One up to Quintile Five, which is not the case. The most illiquid quintile (Quintile Five) calculated using Amihud (2002) illiquidity measure (*ILLIQ*) relatively underperformed the market benchmark by -1.6%.

#### 6.2.1.3. Conclusion

The findings of this study using Amihud (2002) measure of illiquidity (*ILLIQ*) is that illiquidity premium is negative to equity returns on the JSE. Similarly to the findings of Hassan & Javed (2011), Aitken & Comerton-Forde (2003), Bekaert, Harvey, & Lundblad (2007) and Vidović, Poklepović, & Aljinović (2014) the commonly used Amihud (2002) (*ILLIQ*) measure does not drive a valid conclusion regarding the performance of illiquidity based investment style.

The proposition that the use of Amihud illiquidity measure (*ILLIQ*), as a measure of liquidity on the JSE, will yield the highest returns and outperform the JSE All Share Index (J203T), is found to be false. Therefore, Amihud illiquidity measure (*ILLIQ*) does not yield the highest return on the JSE and is not supported as a measure of illiquidity to be used on the JSE as part of a liquidity-based investment strategy.

Research goal one is confirmed as met about examining the Amihud illiquidity measure (*ILLIQ*) and understanding how it performed against the market benchmark, the Allshare Index (J203T).

## 6.2.2. Proposition 2: The use of Adjusted Amihud illiquidity measure (*AdjILLIQ*)

**The use of Adjusted Amihud illiquidity measure (*AdjILLIQ*) as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).**

### 6.2.2.1. Introduction

The Adjusted Amihud illiquidity ratio (*AdjILLIQ*) of shares listed on the JSE with a market capitalisation rank of below 160 was calculated. The results were ranked in descending order and allocated using equal weighting to five quintiles. Quintile One with the highest Adjusted Amihud illiquidity ratio representing the high liquid shares in line with Amihud (2002) and Kang & Zhang (2014). Quintile Five represents the low liquidity portfolio characterised by a high Adjusted Amihud illiquidity ratio as presented in Table 5.

The Adjusted Amihud illiquidity ratios are based on the original Amihud (2002) proposition that assets return increase in illiquidity. Zero trading days were there only as an adjustment factor applied from the original Amihud (2002) measure in line with the work of Kang & Zhang (2014). The expectation was that the Adjusted Amihud illiquidity ratio would produce better results compared to the original ratio (Kang & Zhang, 2014). The findings of this study, however, were not in agreement with Kang & Zhang (2014) proposition. Sections 6.2.2.2 to 6.2.2.3 presents the findings from results of the test using data from the JSE for a period of 20 years from 1997 to 2017.

The existential, relational proposition two, The use of Adjusted Amihud illiquidity measure (*AdjILLIQ*), as a measure of liquidity on the JSE that will yield the highest returns, outperform the JSE All Share Index (J203T) is found to be false.

### 6.2.2.2. Discussion

In testing the proposition that the use of Adjusted Amihud illiquidity measure (*AdjILLIQ*), as a measure of liquidity on the JSE, will yield a higher return on the JSE outperforming the JSE All Share Index (J203T), a graphical time series method was used similarly to that of Muller & Ward (2013). Annualized returns of the All Share index (J203T) for the period beginning in December 1997 to June 2017 was 15.8% with a standard deviation of 19.2%. Both the annualised returns and standard deviation were the benchmarks that

needed to be outperformed by the returns using the Adjusted Amihud illiquidity measure (AdjILLIQ). The standard deviation is a proxy for measuring of risk; therefore, a lower standard deviation than the benchmark is acceptable.

Amihud & Mendelson (1986) hypothesis that there is an illiquidity premium earned by illiquid stock versus the most liquid as compensation for taking illiquidity risk is not valid on the JSE when Adjusted Amihud illiquidity ratio is used as a measure of liquidity. From the results, illiquidity premium is found to be negative (-0.09%) between the illiquid quintile and the most liquid quintile. The return of the second illiquid quintile (Quintile Four) was the highest of all quintiles at 18.70% outperforming the index by 2.54%.

The high performance at Quintile Four is contrary to Amihud (2002) proposition suggesting Quintile Five be the highest performing quintile because it is the most illiquid quintile. However, similarly to the Amihud (2002) illiquidity measure (ILLIQ), from the top line in Figure 7, we observed that Quintile Five amihud ratio deviated from the trend from December 2010 to December 2017. The results suggested that there could be other factors affecting the performance of Quintile Five.

The data do not confirm Kang & Zhang (2014) proposition that the Adjusted Amihud illiquidity measure (AdjILLIQ) performs well in different types of emerging markets. Returns of the second illiquid quintile (Quintile Four) for the Adjusted Amihud illiquidity is 18.70% versus 19.20% produced by Amihud illiquidity measure. Both measures also performed below the market benchmark.

For both Kang & Zhang (2014) and Amihud (2002) propositions to hold on the JSE, we expected to see a linear relationship between returns and level of liquidity. This would mean return was supposed to increase from Quintile One up to Quintile Five, which is not the case. The most illiquid quintile (Quintile Five) calculated using Kang & Zhang (2014) Adjusted Amihud Illiquidity measure (AdjILLIQ) relatively performed below the market benchmark by -1.3%.

#### 6.2.2.3. Conclusion

The findings of this study using Kang & Zhang (2014) Adjusted Amihud Illiquidity measure (AdjILLIQ) is that illiquidity premium is negative to equity returns on the JSE.

The proposition that the use of Adjusted Amihud illiquidity measure (*AdjILLIQ*), as a measure of liquidity on the JSE, will yield the highest returns, outperforming the JSE All Share Index (J203T), is found to be false. Therefore, the Adjusted Amihud illiquidity measure (*AdjILLIQ*) does not yield the highest return on the JSE and is not supported as a measure of illiquidity to be used on the JSE as part of a liquidity-based investment strategy.

Research Goal One is confirmed as met about examining the Adjusted Amihud illiquidity measure (*AdjILLIQ*) and understanding how it performed against the market benchmark, the Allshare Index (J203T).

### **6.2.3. Proposition 3: The use of Relative Change in Volume (RCV)**

**The use of Relative Change in Volume (RCV) as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).**

#### 6.2.3.1. Introduction

The Relative Change in Volume (RCV) of shares listed on the JSE with a market capitalisation rank of below 160 was calculated. The results were ranked in a descending order and allocated using equal weighting to five quintiles. Quintile One with the lowest change in volume represents the high liquid stock, and Quintile Five represents the low liquidity portfolio characterised by the highest relative change in volume (Vidović et al., 2014). Table 6 above presents the data for the measure.

The leading theory for this measure is that any stock that does not trade continuously has a potential pressure of any trade following a not trading interval (Bekaert et al., 2007). A stock that does not trade continuously will have the highest positive relative change to volume and is regarded as illiquid (Vidović et al., 2014). Therefore, Amihud & Mendelson (1986) finding on illiquidity premium is expected to apply to such stock. The results this study validate the applicability of RCV used as a liquidity measure in the JSE. Sections 6.2.3.2 to 6.2.3.3 presents the findings from results of the test using data from the JSE for a period of 20 years from 1997 to 2017.

The existential, relational proposition three, The use of Relative Change in Volume (RCV), as a measure of liquidity on the JSE, that will yield the highest returns, outperform the JSE All Share Index (J203T), is found to be true.

#### 6.2.3.2. Discussion

In testing the proposition that the use of Relative Change in Volume (RCV), as a measure of liquidity on the JSE, will yield a higher return on the JSE outperforming the JSE All Share Index (J203T), a graphical time series method was used similarly to that of Muller & Ward (2013). Annualized returns of the All Share index (J203T) for the period beginning in December 1997 to June 2017 was 15.8% with a standard deviation of 19.2%. Both the annualised returns and standard deviation were the thresholds that needed to be outperformed by the returns using the Relative Change in Volume measure. The standard deviation is a proxy for measuring of risk; therefore, a lower standard deviation than the benchmark is acceptable.

The Amihud & Mendelson (1986) view that there is an illiquidity premium earned by illiquid stock versus the most liquid as compensation for taking illiquidity risk is validated as real on the JSE when Relative Change in Volume (RCV) is used as a measure of liquidity. From the results, there was an illiquidity premium of 5.73% between the illiquid quintile and the most liquid quintile. The return of the lowest liquidity (illiquid) quintile (Quintile 5) was the highest of all quintiles at 18.26% outperforming the index by 2.15% consistent with Amihud (2002) hypothesis that asset returns increase with illiquidity.

Vidović et al. (2014) proposition that the Relative Change in Volume (RCV) is suitable for emerging markets while it captures a small number of good stocks to be traded and the central problem of non-trading frequency is confirmed by the data on the JSE. There is a high correlation between the relative change in volume with returns as confirmed by an  $R^2$  of 0.8694. 86.94% of the returns earned from the JSE when the Relative Change can explain a liquidity-based investment style using relative change in volume as a measure of liquidity in Volume Ratio.

The returns of Relative Change in Volume Quintile Five outperforming the JSE All Share Index (J203T) also had a lower standard deviation of 16.4% compared to JSE All Share Index (J203T) standard deviation of 19.2%. This can be interpreted as RCV produces

the highest return compared to the market at a lower risk compared to that of the JSE All Share Index (J203T).

#### 6.2.3.3. Conclusion

The findings of this study using Vidović et al. (2014) Relative Change in Volume (RCV) as a measure of liquidity is that there is an illiquidity premium for holding illiquid stock in a liquidity-based investment strategy. RCV is confirmed as a valid measure of liquidity. The proposition that the use of Relative Change in Volume (RCV), as a measure of liquidity on the JSE, will yield the highest returns, and thus outperforming the JSE All Share Index (J203T), is found to be true.

Research Goal One is confirmed as met about examining the Relative Change in Volume (RCV) measure of liquidity and understanding how it performed against the market benchmark, the Allshare Index (J203T).

#### 6.2.4. Proposition 4: The use of Bid-Ask Spread

**The use of Bid-Ask Spread as a measure of liquidity on the JSE will yield a higher return on the JSE compared to the JSE All Share Index (J203T).**

##### 6.2.4.1. Introduction

The Bid-Ask Spread of shares listed on the JSE with a market capitalisation rank of below 160 was calculated. The results were ranked in a descending order and allocated using equal weighting to five quintiles. Quintile One with the lowest spread represents the high liquid stock, and Quintile Five represents the low liquidity portfolio characterised by the highest Bid-Ask Spread (Amihud & Mendelson, 1986; Chung & Zhang, 2014). Table 7 above presents the data for the measure.

Amihud & Mendelson (1986) hypothesised that asset returns are an increasing and concave function of the spread. They further proposed that the average portfolio risk-adjusted returns increase with their Bid-Ask Spread, and the slope of the return-spread relationship decreases with the spread. The expectation is therefore that the quintile with the highest spread should earn the highest return. The findings of this study, however,

were not consistent with the illiquidity premium theory. Sections 6.2.4.2 to 6.2.4.3 present the findings from results of the test using data from the JSE for a period of 20 years from 1997 to 2017.

The existential, relational proposition four, The use of Bid-Ask Spread, as a measure of liquidity on the JSE, that will yield the highest returns, outperform the JSE All Share Index (J203T), is found to be false.

#### 6.2.4.2. Discussion

In testing the proposition that the use of Bid-Ask Spread, as a measure of liquidity on the JSE, will yield a higher return on the JSE outperforming the JSE All Share Index (J203T) benchmark, a graphical time series method was used similarly to that of Muller & Ward (2013). Annualized returns of the All Share index (J203T) for the period beginning in December 1997 to June 2017 was 15.8% with a standard deviation of 19.2%. Both the annualised returns and standard deviation were the benchmarks that needed to be outperformed by the returns using the Bid-Ask Spread. The standard deviation is a proxy for measuring of risk; therefore, a lower standard deviation than the benchmark is acceptable.

Amihud & Mendelson (1986) hypothesised that asset returns are an increasing and concave function of the spread is not correct on the JSE. Contrary to Amihud & Mendelson hypothesis, a negative illiquidity premium of -2.91% was observed from the data. The findings mean that there is a disincentive for an investor to hold the illiquid stock as measured using the Bid-Ask Spread as a measure of liquidity. The return of the second highest liquid quintile (Quintile Two) was the highest of all quintiles at 21.10% outperforming the index by 4.61% contradicting both Amihud & Mendelson (1986) and Amihud (2002) propositions that the most liquid stock or portfolio will earn a higher return than the high liquid stock or portfolio.

The Bid-Ask Spread can also be interpreted as a form of cost that investors holding stock will have to forgo to sell the stock at the offered price. Therefore this further suggests that potentially an investor holding stock in Quintile Five still has to deduct about 2.7% from the returns of 13.3% if they wish to sell the stock immediately.

For an investment style using the Bid-Ask Spread, as a measure of liquidity on the JSE to be profitable, a positive illiquidity premium higher than the spread of 2.7% was expected in addition to the overall returns outperforming the JSE All Share Index (J203T). The notion of Bid-Ask Spread as a form of cost in this study is compensated by the fact that only shares ranking within the top 160 of the JSE have been included in this analysis. The general expectation is that the top 40 shares and the top 160 share in the JSE will always sell, unlike the 1% of the shares with market capitalisation ranking above 160 that were excluded from this study.

The returns of Bid-Ask Spread Quintile Five underperformed the JSE All Share Index (J203T) by 2.13% with a standard deviation of 17.3% compared to the JSE All Share Index (J203T) standard deviation of 19.2%. It has also been noted that 60.1% of the returns produced by this measure of liquidity is explained by the Bid-Ask Spread ( $R^2$  of 0.601 for the return spread correlation),

#### 6.2.4.3. Conclusion

The findings of this study using the Bid-Ask Spread as a measure of liquidity are that there is a negative illiquidity premium (-2.91%) for holding illiquid stock in a liquidity-based investment strategy. Therefore, the Bid-Ask Spread does not yield the highest return on the JSE and is not supported as a measure of illiquidity to be used on the JSE as part of a liquidity-based investment strategy.

Research goal one is confirmed as met about examining the Bid-Ask Spread measure of liquidity and understanding how it performed against the market benchmark, the Allshare Index (J203T).

#### 6.2.5. Proposition 5: The use of Price Reversal

**The use of Price Reversal as a measure of liquidity on the JSE will yield a higher return on the JSE compared to the JSE All Share Index (J203T).**

##### 6.2.5.1. Introduction

The Price Reversal ratio of shares listed on the JSE with a market capitalisation rank of below 160 was calculated. The results were ranked in a descending order and allocated

using equal waiting to five quintiles. In line with Pastor & Stambaugh (2003) suggestion, Quintile Five consisting of the highest negative autocovariance (the most substantial reversal), represents the illiquid quintile. Quintile One represents the high liquidity stock. Table 8 above presents the data for the measure. The results of this study do not support the use of Price Reversal as a liquidity measure in the JSE. Sections 6.2.5.2 to 6.2.5.3 presents the findings from results of the test using data from the JSE for a period of 20 years from 1997 to 2017.

The existential, relational proposition five, The use of Price Reversal, as a measure of liquidity on the JSE, that will yield the highest returns, outperform the JSE All Share Index (J203T), is found to be false.

#### 6.2.5.2. Discussion

In testing the proposition that the use of Price Reversal, as a measure of liquidity on the JSE, will yield a higher return on the JSE outperforming the JSE All Share Index (J203T), a graphical time series method was used similarly to that of Muller & Ward (2013). Annualized returns of the All Share index (J203T) for the period beginning in December 1997 to June 2017 was 15.8% with a standard deviation of 19.2%. Both the annualised returns and standard deviation were the benchmarks that needed to be outperformed by the returns using the Price Reversal measure. The standard deviation is a proxy for measuring of risk; therefore, a lower standard deviation than the benchmark is acceptable.

The Amihud & Mendelson (1986) conclusion that there is an illiquidity premium earned by illiquid stock versus the most liquid as compensation for taking illiquidity risk is not validated as real on the JSE when Price Reversal is used as a measure of liquidity. From the results, illiquidity premium is found to be negative (-4.09%) between the illiquid quintile and the most liquid quintile as measured using Price Reversal measure. The return of the second highest liquid quintile (Quintile Two) was the highest of all quintiles at 17.20% outperforming the index by 1.24%.

The returns of Price Reversal Quintile Five underperformed the JSE All Share Index (J203T) by 4.80% with a standard deviation of 22.90% significantly higher than the JSE All Share Index (J203T) standard deviation of 19.2%. Only 33.4% of the returns

produced by this measure of liquidity is explained by the price reversal ratio ( $R^2$  of 0.344 for the return spread correlation).

#### 6.2.5.3. Conclusion

The findings of this study using Price Reversal as a measure of liquidity are that there is a negative illiquidity premium (-4.09%) for holding illiquid stock in a liquidity-based investment strategy. Therefore, the Price Reversal does not yield the highest return on the JSE and is not supported as a measure of illiquidity to be used on the JSE as part of a liquidity-based investment strategy.

Research goal one is confirmed as met about examining the Price Reversal measure of liquidity and understanding how it performed against the market benchmark, the Allshare Index (J203T)

#### 6.2.6. Proposition 6: The use of Turnover

**The use of Turnover (Value Traded as a percentage of Market Cap), as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).**

##### 6.2.6.1. Introduction

The Turnover (calculated as value traded over market capitalisation) of shares listed on the JSE with a market capitalisation rank of below 160 was calculated. The results were ranked in descending order and allocated using equal weighting to five quintiles. Quintile One with the highest turnover represents the high liquid stock, and Quintile Five represents the low liquidity portfolio characterised by the lowest turnover. The Turnover ratio for this study follows that of Muller & Ward (2013). Table 9 above presents the data for the measure.

Amihud (2002) hypothesis that asset returns should increase with liquidity is followed in assessing Turnover as a measure of illiquidity. For Turnover to be endorsed as profitable, the expectation was that the most illiquid quintile (Quintile 5) would have the highest return in line with Amihud (2002) hypothesis. The results do not support Amihud (2002) hypothesis; Quintile Five is not the highest return. Sections 6.2.6.2 to 6.2.6.3

present the findings from results of the test using data from the JSE for a period of 20 years from 1997 to 2017.

The existential, relational proposition six, The use of Turnover, as a measure of liquidity on the JSE, that will yield the highest returns, outperform the JSE All Share Index (J203T), is found to be false.

#### 6.2.6.2. Discussion

In testing the proposition that the use of Turnover, as a measure of liquidity on the JSE, will yield a higher return on the JSE outperforming the JSE All Share Index (J203T), a graphical time series method was used similarly to that of Muller & Ward (2013). Annualized returns of the All Share index (J203T) for the period beginning in December 1997 to June 2017 was 15.8% with a standard deviation of 19.2%. Both the annualised returns and standard deviation were the benchmarks that needed to be outperformed by the returns using the Turnover measure. The standard deviation is a proxy for measuring of risk; therefore, a lower standard deviation than the benchmark is acceptable.

Amihud & Mendelson (1986) hypothesis that there is an illiquidity premium earned by illiquid stock versus the most liquid as compensation for taking illiquidity risk is not validated as real on the JSE when Turnover is used as a measure of liquidity. The results show an illiquidity premium of 0.89% between the illiquid quintile and the most liquid quintile as measured using the Turnover measure.

The return of the second highest liquid quintile (Quintile Two) was the highest of all quintiles at 17.20% outperforming the index by 1.24%. The illiquid quintile (Quintile Five) returns underperformed the market by 2.04%. The results are contrary to the finding of Muller & Ward (2013) who used the same data set but for a different period (1984 to 2012) found an illiquidity premium of 9.8% per annum on the JSE. Muller & Ward (2013) study indicated that the illiquidity premium was fading out, and as a result, speculated it to be a consequence of lower transaction cost and electronic trading a view also confirmed by Assefa & Mollick (2014).

The correlation between returns and the Turnover ration only shows that 8.3% of the returns are explained by the Turnover ratio ( $R^2$  of 0.083). The results suggest that the Turnover ratio is no longer relevant on the JSE as a measure of liquidity.

### 6.2.6.3. Conclusion

The findings of this study using Turnover as a measure of liquidity is that there is a marginal illiquidity premium (0.89%) for holding illiquid stock in a liquidity-based investment strategy. However, the illiquid quintile underperformed the market benchmark. The Turnover measure does not yield the highest return on the JSE and is not supported as a measure of illiquidity to be used on the JSE as part of a liquidity-based investment strategy.

Research goal one is confirmed as met about examining the Turnover measure of liquidity and understanding how it performed against the market benchmark, the Allshare Index (J203T).

### 6.2.7. Proposition 7: The use of Localized Turnover

**The use of Localized Turnover (Value Traded as a percentage of SWIX), as a measure of liquidity on the JSE, will yield a higher return on the JSE compared to the JSE All Share Index (J203T).**

#### 6.2.7.1. Introduction

The Localized Turnover (calculated as value traded over the Shareholder Weighted Indices (SWIX)) of shares listed on the JSE with a market capitalisation rank of below 160 was calculated. The results were ranked in a descending order and allocated using equal weighting to five quintiles. Quintile One with the highest ratio represents the high liquid stock, and Quintile Five represents the low liquidity portfolio characterised by the low Localised Turnover ratio. Table 10 above presents the data for the measure.

Localized Turnover is a modified version of Muller & Ward (2013) Turnover ratio. The measure corrects the effect of stock with multiple listing included in the market capitalisation of a company by only dividing turnover by shares listed in the local market. The SWIX was designed by the JSE only to represent the performance of companies listed on the JSE.

Amihud (2002) hypothesis that asset returns should increase with liquidity is followed in assessing Localized Turnover as a measure of illiquidity. The results support Amihud

(2002) hypothesis and confirm that a liquidity-based investment style using Localized liquidity as its measure of liquidity outperforms the market benchmark (J203). Sections 6.2.7.2 to 6.2.7.3 presents the findings from results of the test that relied on data from the JSE for a period of 20 years from 1997 to 2017.

The existential, relational proposition seven, The use of Localised Turnover, as a measure of liquidity on the JSE, that will yield the highest returns, outperform the JSE All Share Index (J203T) is found to be true.

#### 6.2.7.2. Discussion

In testing the proposition that the use of Localized Turnover, as a measure of liquidity on the JSE, will yield a higher return on the JSE outperforming the JSE All Share Index (J203T), a graphical time series method was used similarly to that of Muller & Ward (2013). Annualized returns of the All Share index (J203T) for the period beginning in December 1997 to June 2017 was 15.8% with a standard deviation of 19.2%. Both the annualised returns and standard deviation were the benchmarks that needed to be outperformed by the returns using the localized turnover measure. The standard deviation is a proxy for measuring risk; therefore, a lower standard deviation than the benchmark is acceptable.

Amihud & Mendelson (1986) finding that there is an illiquidity premium earned by illiquid stock versus the most liquid as compensation for taking illiquidity risk is validated as real on the JSE when Localized Turnover is used as a measure of liquidity. The results show an illiquidity premium of 6.49% between the illiquid quintile and the most liquid quintile as measured using the Localized Turnover measure. The return of the lowest liquidity (illiquid) quintile (Quintile Five) was the highest of all quintiles at 19.80%. It outperformed the index by 3.49% consistent with Amihud (2002) hypothesis that asset returns increase with illiquidity.

The returns of Localized Turnover Quintile Five outperforming the JSE All Share Index (J203T) also had a lower standard deviation of 14.50% compared to the JSE All Share Index (J203T) standard deviation of 19.2%. In calculating the localised Turnover ratio, Bid-Ask Spread % specific to the measure was calculated and added as a form of cost for holding an illiquid stock (see Table 21 for details). Similarly to the logic followed in Bid-Ask Spread measure, the assumption is that the spread indicates the cost an

investor will have to pay to sell a stock immediately at the bid price lower than what the asking price was (Aitken & Comerton-Forde, 2003). Bid-Ask Spread can be classified as a form of price-impact cost which has been added on top of standard direct trading cost, brokerage commissions, change fees, and taxes (Amihud & Mendelson, 2012).

*Table 21: Bid-Ask Spread as cost for Localised Turnover*

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Bid-Ask Spread included as part of cost	0.52%	0.69%	0.82%	1.15%	2.00%

The returns presented in Table 10 in section 5.2.7 are net of the Bid-Ask Spread cost. The data also shows that there is a high correlation between the Localized Turnover with returns as confirmed by a correlation  $R^2$  of 0.953. 95.3% of the returns earned from the JSE when the Localized Turnover ratio can explain a liquidity-based investment style using Localized Turnover as a measure of liquidity.

#### 6.2.7.3. Conclusion

The findings of this study using Localized Turnover as a measure of liquidity is that there is an illiquidity premium for holding illiquid stock in a liquidity-based investment strategy. Localised Turnover is confirmed as a valid measure of liquidity. The proposition that the use of **Localized Turnover**, as a measure of liquidity on the JSE, that will yield the highest returns, outperforming the JSE All Share Index (J203T), is found to be true.

Research goal one is confirmed as met about examining the Localized Turnover measure of liquidity and understanding how it performed against the market benchmark, the Allshare Index (J203T).

### 6.3. **Research Question 2: Do returns of liquidity based investment style using the best measure(s) from research question 1 consistently outperform the market over time or is there a time factor in the performance?**

The results of research question one indicated that only Relative Change in Volume measure and Localised Turnover measures of liquidity yield the highest returns on the JSE compared to the JSE All Share Index (J203T).

Table 22: Research goal 2

GOALS	DESCRIPTION
<b>Goal 2</b>	To determine which of the measures of liquidity, as a liquidity proxy in a liquidity-based investment strategy outperforms the market returns on the JSE.

The results fulfil research goal Two.

### 6.3.1. Performance of Relative Change in Volume (RCV) over the period

**The low liquidity quintile of Relative Change in Volume (RCV) has consistently outperformed the benchmark and was dependent on time**

#### 6.3.1.1. Introduction

The assessment of whether returns of liquidity based investment style using the Relative Change in Volume as a measure of liquidity consistently outperform the market over time or is there a time factor in the performance was done using Muller & Ward (2013) graphical time series method. Based on Muller & Ward (2013), if the relative performance line flattens or drops, then the illiquidity measure is fading or even reversing. The performance of quintile five against the JSE All Share Index (J203T) benchmark was observed over the research period between 1997 and 2017 to check if there were any change in patterns and monitoring the relative performance lines in *Figure 37*.

#### 6.3.1.2. Discussion

Based on the results, it was noted that the ranking between quintiles is mostly in the expected order throughout the time-series. Quintile Five has mostly been the top line for most of the time. Quintile Five also moved in the same pattern as the overall market represented by the JSE All Share Index (J203T), as expected.

Relatively the low liquidity quintile (Quintile Five) has consistently performed above the JSE All Share Index (J203T) over the period. The relative performance to the JSE All Share Index (J203T) was 2.2%. The relative performance to the JSE All Share Index (J203T) has (mostly) been flattering for the last nine years (2008 to 2017). These

observations are consistent with the observations of Muller & Ward (2013) and Assefa & Mollick (2014) that liquidity on the JSE has been sharply increasing and speculating that it could be the consequence of the improved transaction cost and electronic trading. The results of Relative Change in Volume were resilient towards time. An analysis of what the results would be in a 15, 10 and 5 year periods were considered all showed the measure performing above the market benchmark, The JSE All Share Index.

### 6.3.1.3. Conclusion

The results confirm that the Relative Change in volume measure has been consistently outperforming the market. It was observed that over time liquidity improved, however, the measure was resilient towards time as indicated by its ability to yield profitable results whether applied in a short-term or long-term investment strategy. It can, therefore, be concluded that the returns of liquidity based investment style using the Relative Change in Volume as a measure of liquidity have consistently outperformed the market over time. Despite the overall improvement of liquidity in the market, the measure continued to outperform the market even when applied in shorter investment horizon (15, 10 and 5 years).

*Table 23: Research goal 3*

GOALS	DESCRIPTION
<b>Goal 3</b>	To understand the effect of time on illiquidity (short-term versus long-term) in explaining returns and understand whether the successful measure(s) in goal 2, have consistently outperformed the market over time.

The results and findings confirm that research goal three has been met.

### 6.3.2. Performance of Localized Turnover over the period

**The low liquidity quintile of Localized Turnover has consistently outperformed the benchmark and dependent on time**

#### 6.3.2.1. Introduction

The assessment of whether returns of liquidity based investment style using the Localised Turnover as a measure of liquidity consistently outperform the market over

time or is there a time factor in the performance was done using Muller & Ward (2013) graphical time series method. Based on Muller & Ward (2013), if the relative performance line flattens or drops, then the illiquidity measure is fading or even reversing. The performance of Quintile Five was observed over the research period between 1997 and 2017 to check if there was any change in patterns and monitored the relative performance lines in *Figure 38*.

#### 6.3.2.2. Discussion

Based on the results, it was noted that the ranking between Quintile Five and the Index was mostly in the expected order throughout the time-series. Quintile Five has mostly been the top line and the JSE All Share Index the bottom line for most of the time. Quintile Five also moved in the same pattern as the overall market represented by the JSE All Share Index (J203T), as expected.

Relatively the low liquidity quintile (Quintile 5) has consistently outperformed the JSE All Share Index (J203T) over the period. The relative performance to the JSE All Share Index (J203T) was 3.3%. The relative performance to the JSE All Share Index (J203T) has (mostly) been flattering for the last 13 years (2004 to 2017). These observations are consistent with the observations of Muller & Ward (2013) and Assefa & Mollick (2014) that liquidity on the JSE has been sharply increasing and then speculating it could be the consequence of the improved transaction cost and electronic trading. The Localized Turnover measure only remains profitable in the long-term, however when used in shorter investment period (15, 10 and 5 years) the measure performed below the market benchmark, the JSE All Share Index.

#### 6.3.2.3. Conclusion

The results confirm that the Localised Turnover measure has been consistently outperforming the market. However, it was observed that over time liquidity improved. Localized Turnover is, however, sensitive in the short to mid-term arena. The conclusion is, therefore, that the returns of liquidity based investment style using the Localised Turnover as a measure of liquidity have consistently outperformed the market over time, however, there is a time factor in the performance due to the overall liquidity improvement in the market.

Table 24: Research goal 3

GOALS	DESCRIPTION
<b>Goal 3</b>	To understand the effect of time on illiquidity (short-term versus long-term) in explaining returns and understand whether the successful measure(s) in goal 2, have consistently outperformed the market over time.

The results and findings confirm that research goal three has been met.

#### 6.4. Chapter summary

Based on the empirical data, it can be concluded that both Relative change in Volume and Localized Liquidity are the most successful measures of liquidity on the JSE. The findings answer the primary research question as follows: A liquidity-based investment style, using Relative Change in Volume or Localized Turnover measures of liquidity, produces profitable returns on the JSE that consistently outperforms the market benchmark, as represented by the JSE All Share Index (J203T). Relative Change in Volume or Localized Turnover are the measures of liquidity to be used on the JSE. The research objectives and specific goals as stated in 1.4 have been met.

## Chapter 7: Conclusion

### 7.1. Introduction

The aim of the study was to conduct a comparative test of the selected liquidity measures and determine which of them when used in a liquidity-based investment style yield profitable return above the market benchmark, which is represented by the All Share Index (J203T) on the Johannesburg Stock Exchange. To understand the liquidity based investment strategy, it was deemed necessary to focus the tests on the applicability and profitability of using seven selected measures of illiquidity; namely, Amihud illiquidity measure (ILLIQ), Adjusted Amihud illiquidity measure (AdjILLIQ), Relative Change in Volume (RCV), Bid-Ask Spread, Price Reversal, Turnover and Localized Turnover. The findings support the use of liquidity as an investment style (Ibbotson et al., 2013; Muller & Ward, 2013; Theart & Niel, 2014) when liquidity is measured by Vidović et al.'s (2014) Relative Change in Volume (RCV) liquidity measure and the proposed new measure “Localized Turnover”. This concluding chapter provides a summary of key findings, implications for business management, limitations of the study and recommendations for further research.

### 7.2. Principle Findings

The main finding of the study is that that liquidity can be used as an investment style in the Johannesburg Stock Exchange (JSE) in tandem with the previous research findings that supported the use of liquidity as an investment style (Ibbotson et al., 2013; Muller & Ward, 2013; Theart & Niel, 2014). When liquidity is selected as an investment style on the JSE, the measure of liquidity to be used in measuring liquidity are Vidović et al.'s (2014) Relative Change in Volume (RCV) and the author's proposed new measure referred to as “Localized Turnover”. As shown throughout various sections of data in the study, both measures outperformed the market benchmark (J203T) return for the illiquid quintile and they, therefore, proved their profitability beyond doubt.

It is noteworthy to point out that the results of the study revealed that the commonly used measures of liquidity such as Amihud (2002) illiquidity measure (*ILLIQ*), Bid-Ask Spread, Price Reversal and Turnover developed (mainly) for the developed markets are not relevant to the South African market. When framed in this light, these findings confirm

the view espoused in the existing body of knowledge that not all commonly used measures of liquidity are applicable in their current form in the emerging markets (Kang & Zhang, 2014; Vidović et al., 2014). It is therefore important to be cautious of generalizations in applying measures that were designed for the developed markets. The same degree of caution needs to be held for the emerging markets as well. For example, Kang & Zhang's (2014) Adjusted Amihud illiquidity measure that was explicitly developed for emerging markets has also been found not to be suitable for the South African markets, mainly due to the fact that a significant portion of it was determined by the Amihud measure. Notably, measures of illiquidity are not automatically transferable, but they are context sensitive and dependent. This finding calls for more localized measures to guide relevant investment styles.

Taken together, the results of this study validate the theory of illiquidity premium (Amihud et al., 2015; Amihud & Mendelson, 1986; Hassan & Javed, 2011) that there is an illiquidity premium earned by investors holding the illiquid stock as compensation for taking illiquidity risk. It was, however, noted that the illiquidity premium only applies when the illiquid stock is defined using specific measures of liquidity such as Relative Change in Volume (RCV) and Localized Turnover in the Johannesburg Stock Exchange.

While liquidity can be used as an investment style, it is not readily identifiable in a market and, therefore, it depends on the selected proxy used to measure it. It is also notable that even though liquidity proxies measures still hold, it is not every proxy used as a measure of liquidity that is applicable in all markets. Therefore, careful selection of the appropriate liquidity measure to use is required whenever liquidity-based investment strategy is to be employed in any market, except in markets where specific liquidity measures have been validated as appropriate. The research results confirm the findings of Moreira De Sousa (2015), in particular, that returns of a liquidity-based investment style is not independent of the proxy as a measure of liquidity selected in a market.

The lack of a systematic model in the industry on how to select the suitable measure of liquidity for the specific market makes it difficult for an investor to know which measure of liquidity is applicable for that market. The current wave of research that studies the commonalities of liquidity among various markets and market-specific studies such as this one will contribute to the development of such models.

### **7.3. Implications for management**

The main implication of the results to the securities trading industry is that it extends the pool of investment strategies currently used in the market to earn higher returns that outperform the market for investment clients. The findings confirm the viability of a liquidity-based strategy when Relative Change in Volume (RCV) and Localized Turnover are used as measures of liquidity on the JSE.

An illiquidity premium in a hand of an investor could also translate to a higher cost of capital for a company. As observed by Amihud, Hameed, Kang, & Zhang (2013) a company stock liquidity will influence its cost of capital (hurdle rate for investment). The findings of this study provide management with the tools to use in measuring how illiquid their company stock is seen in the market by investors using the same measures of illiquidity as proposed for the JSE. The benefit for management to know the liquidity of their stock is that they can start employing liquidity enhancing policies as part of their financial strategy to enhance the liquidity of their stock (Amihud & Mendelson, 1991, 2012).

Contrary to the findings of Ben-Rephael, Kadan, & Wohl (2015), this study confirms that liquidity based investment style is profitable, on the JSE, when Relative Change in Volume or Localized Turnover is used as a measure of liquidity.

### **7.4. Limitations of the Research**

7.4.1. Data Sample - The data sample of the study was limited to stocks listed on the main board of the Johannesburg Stock Exchange and, therefore, inference in this study is restricted to the listed stocks. Most illiquid stock and assets are not listed; as a result, having access to the relevant data could have been challenging. Shares in a privately-owned company, for example, will qualify as illiquid assets/investment. Data of the sale of shares in privately owned companies is not readily available. That is why these companies were excluded from the design.

7.4.2. Choice of liquidity measures - The selected measures of illiquidity were not exhaustive, and the list of measures used has been reduced to only seven given the amount of time available for analysis. The selection of which measure to use

was mostly based on the most common or highest literature count, measures used in South Africa before and measures used in recent studies on other emerging markets.

- 7.4.3. Intra-day trading data (high-frequency measures) - Only low-frequency measures (daily/month) were selected for this study given the time limit allocated to complete this project. High-frequency (intra-day) liquidity proxies would require more computational time, with a large size of data over the period of analysis (20 years). High-frequency data would have allowed for market macrostructural analysis to be performed. However, the data required is not readily available, and as a result, measures of liquidity using high-frequency data was excluded from the selection. Excluding high-frequency measures from the study had no effect on the research objectives.
- 7.4.4. Delimitations - The delimitations refers to the scope and defining the boundaries of the study (Leedy & Ormrod, 2010). This study consists of the selection of liquidity proxies and stocks that excluded over 55% of listed stock, which only makes 1% of the market capitalisation on the JSE.

## **7.5. Suggestions for future research**

Based on the findings of this study, many future research areas and suggestions stem from this study. The following areas are proposed for further research:

- 7.5.1. The proposed new measure of liquidity has only been tested on the JSE; it is proposed that applicability of the measure be tested in other markets where multiple stock listing exists.
- 7.5.2. This study only included on the share listed on the main board of JSE with a market capitalisation ranking below 160. Shares included in the JSE All Share index represented 99% of the market. The study excluded the about 55% of listed companies in the main board making up the remaining 1% of the market capitalisation, most of which might be classified as illiquid. South Africa has seen new exchanges like ZAR X, 4 Africa Exchange (4AX) and A2X to compete with the JSE, which were excluded from this study. A re-run of the study including all listed shares on the main board and other board such as FTSE\JSE ALTX and the new stock exchanges should be conducted testing more liquidity measures especially high-frequency measures that were not tested in this study.
- 7.5.3. Further research is needed on the development of a framework or model that

can be used to simplify the selection of relevant liquidity measure on the market. The development of a systematic framework to guide investor in the selection of the applicable measure of liquidity through a process of eliminating others based on factors such as market characteristic will contribute to the existing body of knowledge.

## **7.6. Conclusion**

The findings of this study confirm both Amihud (2002) hypothesis that asset returns increase with illiquidity and the Amihud & Mendelson (1986) hypothesis that there is an illiquidity premium earned by illiquid stock versus the most liquid as compensation for taking illiquidity on the JSE. Taken together, the main thrust of findings is that the optimum market return liquidity based model on the JSE is possible only when illiquidity is measured by the Relative Change in Volume (RCV) measure or the new proposed measure, the Localized Turnover. The Localized Turnover model is only applicable, if a long-term investment horizon is considered.

## Reference List

- Acharya, V., & Pedersen, L. (2005). Asset pricing with liquidity risk. *Journal of Financial Economics*, 77(2), 375–410. <https://doi.org/10.1016/j.jfineco.2004.06.007>
- Aitken, M., & Comerton-Forde, C. (2003). How should liquidity be measured? *Pacific-Basin Finance Journal*, 11(1), 45–59. [https://doi.org/10.1016/S0927-538X\(02\)00093-8](https://doi.org/10.1016/S0927-538X(02)00093-8)
- Ali, A., & Boadu, S. (2016). *Analysis of the bid-ask spread and its implication for portfolio returns*. (Master's Thesis). Nord University. Retrived from <https://brage.bibsys.no/xmlui/bitstream/handle/11250/2405282/Ali.pdf?sequence=1>
- Amihud, Y. (2002). Illiquidity and stock returns: cross-section and time-series effects. *Journal of Financial Markets*, 5(1), 31–56. [https://doi.org/10.1016/S1386-4181\(01\)00024-6](https://doi.org/10.1016/S1386-4181(01)00024-6)
- Amihud, Y., Hameed, A., Kang, W., & Zhang, H. (2012). The Illiquidity Premium: International Evidence. *SSRN Electronic Journal*, 117(2), 350–368. <https://doi.org/10.2139/ssrn.2191949>
- Amihud, Y., Hameed, A., Kang, W., & Zhang, H. (2015). Stock Liquidity and the Cost of Equity Capital in Global Markets. *Journal of Applied Corporate Finance*, 27(4), 68–74. <https://doi.org/10.1111/jacf.12147>
- Amihud, Y., & Mendelson, H. (1986). Asset pricing and the bid-ask spread. *Journal of Financial Economics*, 17(2), 223–249. [https://doi.org/10.1016/0304-405X\(86\)90065-6](https://doi.org/10.1016/0304-405X(86)90065-6)
- Amihud, Y., & Mendelson, H. (1991). Liquidity, Asset Prices and Financial Policy. *Financial Analysts Journal*, 47(6), 56–66. <https://doi.org/10.2469/faj.v47.n6.56>
- Amihud, Y., & Mendelson, H. (2012). Liquidity, the Value of the Firm, and Corporate Finance. *Journal of Applied Corporate Finance*, 24(1), 17–32. <https://doi.org/10.1111/j.1745-6622.2012.00362.x>
- Amihud, Y., & Mendelson, H. (2015). The Pricing of Illiquidity as a Characteristic and as Risk. *Multinational Finance Journal*, 19(3), 149–168.
- Asparouhova, E., Bessembinder, H., & Kalcheva, I. (2010). Liquidity biases in asset pricing tests. *Journal of Financial Economics*, 96(2), 215–237. <https://doi.org/10.1016/j.jfineco.2009.12.011>
- Assefa, T. A., & Mollick, A. V. (2014). African stock market returns and liquidity premia. *Journal of International Financial Markets, Institutions and Money*, 32, 325–342.

- <https://doi.org/10.1016/j.intfin.2014.06.009>
- Banerjee, S., Gatchev, V. a., & Spindt, P. a. (2007). Stock Market Liquidity and Firm Dividend Policy. *Journal of Financial and Quantitative Analysis*, 42(2), 369. <https://doi.org/10.1017/S0022109000003318>
- Bekaert, G., Harvey, C. R., & Lundblad, C. (2007). Liquidity and expected returns: Lessons from emerging markets. *Review of Financial Studies*, 20(6), 1783–1831. <https://doi.org/10.1093/rfs/hhm030>
- Ben-Rephael, A., Kadan, O., & Wohl, A. (2015). The diminishing liquidity premium. *Journal of Financial and Quantitative Analysis*, 50(1–2), 197–229. <https://doi.org/10.1017/S0022109015000071>
- Bharath, S. T., Jayaraman, S., & Nagar, V. (2013). Exit as Governance : An Empirical Analysis Exit as Governance : An Empirical Analysis. *The Journal of Finance*, 68(6), 2515–2547. <https://doi.org/10.1111/jofi.12073>
- Bongaert Joost Driessen Frank de Jong, D. (2012). Liquidity (Risk) Premia in Corporate Bond Markets. *The Quarterly Journal of Finance*, 2(2), 1250006.
- Borcherding, R., & Stein, M. (2016). *The Value of True Liquidity*. Retrived from <https://ssrn.com/abstract=2925772>
- Bortolotti, B., De Jong, F., Nicodano, G., & Schindele, I. (2007). Privatization and stock market liquidity. *Journal of Banking & Finance*, 31(2), 297–316.
- Brennan, M., Huh, S.-W., & Subrahmanyam, A. (2013). An Analysis of the Amihud Illiquidity Premium, 3(1), 133–176. <https://doi.org/10.2139/ssrn.1859632>
- Bryman, A., & Bell, E. (2014). *Research methodology: Business and management contexts*. Cape Town: Oxford University Press.
- Chelley-Steeley, P. L., Lambertides, N., & Steeley, J. M. (2015). The effects of non-trading on the illiquidity ratio. *Journal of Empirical Finance*, 34, 204–228. <https://doi.org/10.1016/j.jempfin.2015.05.004>
- Cheng, S., Hameed, A., Subrahmanyam, A., & Titman, S. (2017). Short-Term Reversals: The Effects of Past Returns and Institutional Exits. *Journal of Financial and Quantitative Analysis*, 52(1), 143–173. <https://doi.org/10.1017/S0022109016000958>
- Chung, K. H., & Zhang, H. (2014). A simple approximation of intraday spreads using daily data. *Journal of Financial Markets*, 17(1), 94–120. <https://doi.org/10.1016/j.finmar.2013.02.004>
- Corwin, S. A., & Schultz, P. (2012). A Simple Way to Estimate Bid-Ask Spreads from Daily High and Low Prices. *Journal of Finance*, 67(2), 719–760. <https://doi.org/10.1111/j.1540-6261.2012.01729.x>

- Cumming, D., Johan, S., & Li, D. (2011). Exchange trading rules and stock market liquidity. *Journal of Financial Economics*, 99(3), 651–671. <https://doi.org/10.1016/j.jfineco.2010.10.001>
- Easley, D., Hvidkjaer, S., & O'hara, M. (2010). Factoring Information into Returns. *Journal of Financial and Quantitative Analysis*, 45(2), 293–309.
- Fama, E. F., & French, K. R. (1992). The Cross-Section of Expected Stock Returns. *The Journal of Finance*, 47(2), 427–465. <https://doi.org/10.1111/j.1540-6261.1992.tb04398.x>
- Fama, E. F., & MacBeth, J. D. (1973). Risk, Return and Equilibrium: Empirical Tests. *The Journal of Political Economy*, 81(3), 607–636. <https://doi.org/10.1086/260061>
- Fang, V. W., Noe, T. H., & Tice, S. (2009). Stock market liquidity and firm value. *Journal of Financial Economics*, 94(1), 150–169. <https://doi.org/10.1016/j.jfineco.2008.08.007>
- Fong, K. Y. L., Holden, C. W., & Trzcinka, C. (2017). What Are the Best Liquidity Proxies for Global Research? *Review of Finance*, (2006), 1–47. <https://doi.org/10.1093/rof/rfx003>
- FTSE/JSE. (2014). FTSE/JSE Shareholder Weighted Indices. Retrieved October 03, 2017, from <http://www.jse.co.za>
- FTSE/JSE. (2017). FTSE/JSE Africa Index Series Free Float Restrictions – Update. Retrieved October 03, 2017, from <http://www.jse.co.za>
- Goyenko, R. Y., Holden, C. W., & Trzcinka, C. A. (2009). Do liquidity measures measure liquidity? *Journal of Financial Economics*, 92(2), 153–181. <https://doi.org/10.1016/j.jfineco.2008.06.002>
- Hair, J. F., Wolfinbarger, M., Money, A. H., Samouel, P., & Page, M. (2011). *Essentials of business research methods* (2nd ed.). New York: M.E. Sharpe, Inc.
- Hamdan, A. A.-J. (2017). Ownership Concentration, Earnings Management and Stock Market Liquidity: Evidence from Malaysia. *Corporate Governance: The International Journal of Business in Society*, 17(3). <https://doi.org/10.1108/>
- Hassan, A. H., & Javed, M. T. (2011). Illiquidity Premium and Stylized Equity Returns. *IUP Journal of Financial Economics*, 9(1), 41.
- Hearn, B., Piesse, J., & Strange, R. (2010). Market liquidity and stock size premia in emerging financial markets: The implications for foreign investment. *International Business Review*, 19, 489–501. <https://doi.org/10.1016/j.ibusrev.2009.02.009>
- Holden, C. W. (2009). New low-frequency spread measures. *Journal of Financial Markets*, 12(4), 778–813. <https://doi.org/10.1016/j.finmar.2009.07.003>
- Ibbotson, R. G., Chen, Z., Kim, D. Y. J., & Hu, W. Y. (2013). Liquidity as an investment

- style. *Financial Analysts Journal*, 69(3), 30–44.  
<https://doi.org/10.2139/ssrn.1817889>
- IRESS Research Domain. (2017). IRESS Research Domain. Retrieved June 25, 2017, from  
<http://research.mcgregorbfa.com.uplib.idm.oclc.org/Station/PriceData/PriceDataDetail.aspx>
- Kang, W., & Zhang, H. (2014). Measuring liquidity in emerging markets. *Pacific Basin Finance Journal*, 27(1), 49–71. <https://doi.org/10.1016/j.pacfin.2014.02.001>
- Korajczyk, R. A., & Sadka, R. (2008). Pricing the Commonality Across Alternative Measures of Liquidity. *Journal of Financial Economics*, 87(1), 45–72.
- Kyle, A. S. (1985). Continuous Auctions and Insider Trading. *Econometrica*, 53(6), 1315–1335.
- Lang, M., Lins, K. V., & Maffett, M. (2012). Transparency, Liquidity, and Valuation: International Evidence on When Transparency Matters Most. *Journal of Accounting Research*, 50(3), 729–774. <https://doi.org/10.1111/j.1475-679X.2012.00442.x>
- Lecce, S., Lepone, A., McKenzie, M. D., & Segara, R. (2012). The impact of naked short selling on the securities lending and equity market. *Journal of Financial Markets*, 15(1), 81–107. <https://doi.org/10.1016/j.finmar.2011.07.001>
- Leedy, P. D., & Ormrod, J. E. (2010). *Practical Research: Planning and Design* (9th ed.). New York, NY: Merrill.
- Lesmond, D. A. (2005). Liquidity of emerging markets. *Journal of Financial Economics*, 77(2), 411–452. <https://doi.org/10.1016/j.jfineco.2004.01.005>
- Lischewski, J., & Voronkova, S. (2012). Size, value and liquidity. Do They Really Matter on an Emerging Stock Market? *Emerging Markets Review*, 13(1), 8–25. <https://doi.org/10.1016/j.ememar.2011.09.002>
- Lou, X., & Shu, T. (2016). Price Impact or Trading Volume: Why is the Amihud (2002) Illiquidity Measure Priced?, 1–51. <https://doi.org/10.2139/ssrn.2291942>
- Ma, R., Anderson, H. D., & Marshall, B. R. (2016). International stock market liquidity: a review. *Managerial Finance*, 42(2), 118–135. <https://doi.org/10.1108/MF-04-2015-0096>
- Mahanti, S., Nashikkar, A., Subrahmanyam, M. G., Chacko, G., & Mallik, G. (2008). Latent Liquidity: A New Measure of Liquidity, with an Application to Corporate Bonds. *Journal of Financial Economics*, 88(2), 272–298.
- Marshall, B. R. (2006). Liquidity and stock returns: Evidence from a pure order-driven market using a new liquidity proxy. *International Review of Financial Analysis*, 15(1), 21–38. <https://doi.org/10.1016/j.irfa.2004.09.001>

- Moreira De Sousa, E. (2015). *Liquidity as an Investment Style -New evidence*. Faculdade De Economia Universidade Do Porto.
- Muller, C., & Ward, M. (2011). Active share on the JSE. *Investment Analysts Journal*, 40(74), 19–28. <https://doi.org/10.1080/10293523.2011.11082538>
- Muller, C., & Ward, M. (2013). Style-based effects on the Johannesburg Stock Exchange: A graphical time-series approach. *Investment Analysts Journal*, 42(77), 1–16. <https://doi.org/10.2139/ssrn.2018203>
- Nguyen, T., Duong, H. N., & Singh, H. (2016). Stock Market Liquidity and Firm Value: An Empirical Examination of the Australian Market. *International Review of Finance*, 16(4), 639–646. <https://doi.org/10.1111/irfi.12082>
- Pastor, L., & Stambaugh, R. (2003). Liquidity risk and expected stock returns. *The Journal of Political Economy*, 3(3), 642–685. <https://doi.org/10.3386/w8462>
- Reisinger, A. K. (2012). *The Effect of Liquidity on Returns on the JSE*. (Masters dissertation), Stellenbosch: Stellenbosch University. Retrived from <http://hdl.handle.net/10019.1/71836>
- Roll, R. (1984). A simple implicit measure of the effective bid-ask spread in an efficient market. *The Journal of Finance*, 39(4), 1127–1139. <https://doi.org/10.1111/j.1540-6261.1984.tb03897.x>
- Saunders, M., & Lewis, P. (2012). *Doing research in business & management: An essential guide to planning your project*. London: Pearson Education Limited.
- Sharpe, W. F. (1992). Asset Allocation: Management Style and Performance Measurement. *Reprinted from the Journal of Portfolio Management*, 7–19.
- South Africa Saving Institute. (2017). Savings / Investment Vehicles. Retrieved July 10, 2017, from <http://www.savingsinstitute.co.za/resources/savings-investment-vehicles/#one>
- Theart, L., & Niel, K. (2014). Liquidity as an investment style: Evidence from the Johannesburg Stock Exchange. *Management Dynamics: Journal of the Southern African Institute for Management Scientists*, 23(3), 30–42.
- Vayanos, D., & Wang, J. (2012). Liquidity and Asset Prices under Asymmetric Information and Imperfect Competition. *Review of Financial Studies*, 25, 1339–1365. <https://doi.org/10.1093/rfs/hhr128>
- Vayanos, D., & Wang, J. (2013). Market liquidity - Theory and empirical evidence. *Handbook of the Economics of Finance*, 18251, chapter 19. <https://doi.org/10.3386/w18251>
- Vidović, J., Poklepović, T., & Aljinović, Z. (2014). How to Measure Illiquidity on European Emerging Stock Markets? *Business Systems Research*, 5(3), 67–81.

<https://doi.org/10.2478/bsrj-2014-0020>

- Vorster, B. C. (2008). *Liquidity premium and investment horizon*. (Master's Thesis). University of Pretoria. Retrived from <http://hdl.handle.net/2263/27193>
- Wegner, T. (2016). *Applied Business Statistics: methods and Excel-Based Application* (4th ed.). Cape Town, South Africa: Juta & Company Ltd.
- Zhang, X., Yang, J., Su, H., & Zhang, S. (2014). Liquidity premium and the Corwin-Schultz bid-ask spread estimate. *China Finance Review International*, 4(2), 168–186.

## Appendix A: List of Liquidity measures

Liquidity measure	Computation	Studies using the measure	Section of this report referencing the measure
Amihud <i>ILLIQ</i>	See Equation 1	(Acharya & Pedersen, 2005; Amihud et al., 2012, 2015; Brennan et al., 2013; Cheng et al., 2017; Kang & Zhang, 2014; Lou & Shu, 2016; Ma et al., 2016)	Measures of illiquidity, subsection 2.3.1
Aminvest		(Amihud & Mendelson, 2015; Fong et al., 2017; Hassan & Javed, 2011; Kang & Zhang, 2014; Ma et al., 2016; Vidović et al., 2014)	Measures of illiquidity, subsection 2.3.1
Adjusted <i>ILLIQ</i>	Refer to Equation 4, also see Kang & Zhang (2014)	(Kang & Zhang, 2014)	Measures of illiquidity, subsection 2.3.3
Turnover	Value of shares traded / market cap	(Cumming et al., 2011; Lecce et al., 2012; Lesmond, 2005; Muller & Ward, 2013)	Measures of illiquidity, subsection 2.3.2
Amihud TRNOVER	Refer to Equation 2, also see Amihud (2002)	(Acharya & Pedersen, 2005; Brennan et al., 2013; Cheng et al., 2017)	Measures of illiquidity, subsection 2.3.2
Localized Turnover	Value of shares traded / SWIX of share	New proposed measure	Liquidity proxy construction, subsection 4.6.3.6
Closing percent quoted spread	Refer to Equation 7	(Chung & Zhang, 2014; Fong et al., 2017)	Measures of illiquidity, subsection 2.3.5

<b>Liquidity measure</b>	<b>Computation</b>	<b>Studies using the measure</b>	<b>Section of this report referencing the measure</b>
Rolls (1984) spread	Refer to Equation 8	(Ali & Boadu, 2016; Kang & Zhang, 2014; Lesmond, 2005; Roll, 1984)	Measures of illiquidity, sub section 2.3.5
Price Reversal	Refer to Equation 12	(Cheng et al., 2017; Pastor & Stambaugh, 2003; Vayanos & Wang, 2013)	Measures of illiquidity, subsection 2.3.7
Kyle's Lambda	Refer to Equation 6	(Ali & Boadu, 2016; Kang & Zhang, 2014; Kyle, 1985; Vayanos & Wang, 2012)	Measures of illiquidity, sub section 2.3.4
Relative Change in Volume	Refer to Equation 9, Equation 10 & Equation 11	(Vidović et al., 2014)	Measures of illiquidity, sub section 2.3.6
Weighted Order Value (WOV)	Refer to Equation 13	(Marshall, 2006)	Measures of illiquidity, subsection 2.3.8

## Appendix B: List of companies listed on the JSE and other markets

Code	IsIn	JbName	Multiple Listing
CZA	AU000000CZA6	Coal of Africa Ltd	Yes
FCR	AU000000FCR2	Ferrum Crescent Limited	Yes
FSE	AU000000FSE6	Firestone Energy Limited	Yes
RSG	AU000000RES1	Resource Generation Ltd	Yes
S32	AU000000S320	South32 Limited	Yes
WCC	AU000000WCC9	The Waterberg Coal Co Ltd	Yes
TAW	AU0000TAWDA9	Tawana Resources NL	Yes
IAP	AU60INL00018	Investec Australia Prop Fd	Yes
STP	BMG8465Y1093	Stenprop Limited	Yes
ZCI	BMG9887P1068	ZCI Limited	Yes
WIL	BW0000000868	Wilderness Holdings Ltd	Yes
CHP	BW00000001072	Choppies Enterprises Ltd	Yes
ATL	CA0494771029	Atlatsa Resources Corp	Yes
BUC	CA1194421014	Buffalo Coal Corp	Yes
EPS	CA2768555096	Eastern Platinum Ltd	Yes
GBG	CA3901241057	Great Basin Gold Ltd	Yes
RDI	CA77434W2022	Rockwell Diamonds Inc	Yes
CFR	CH0045159024	Compagnie Fin Richemont	Yes
REI	CH0045793657	Reinet Investments S.C.A	Yes
THA	CY0103562118	Tharisa plc	Yes
BIL	GB0000566504	BHP Billiton plc	Yes
CRP	GB0001741544	Capital & Regional Plc	Yes
BTI	GB0002875804	British American Tob plc	Yes
LNf	GB0002994001	London Fin Inv Group plc	Yes
AEA	GB0003394813	African Eagle Res plc	Yes
HMN	GB0004065016	Hammerson plc	Yes
PAN	GB0004300496	Pan African Resource plc	Yes
ITU	GB0006834344	Intu Properties plc	Yes
JBL	GB0031852162	Jubilee Platinum plc	Yes
IPS	GB00B0CJ3F01	IPSA Group plc	Yes
INP	GB00B17BBQ50	Investec plc	Yes
MNP	GB00B1CRLC47	Mondi plc	Yes
AGL	GB00B1XZS820	Anglo American plc	Yes
CCO	GB00B62G9D36	Capital&Counties Prop plc	Yes
OML	GB00B77J0862	Old Mutual plc	Yes
MEI	GB00B8HX8Z88	Mediclinic Int plc	Yes
TBG	GB00BF37LF46	Tiso Blackstar Group SE	Yes
SCD	GB00BY7R8K77	Schroder Eur REIT plc	Yes
LON	GB00BYSRJ698	Lonmin plc	Yes
SRE	GG00B1W3VF54	Sirius Real Estate Ltd	Yes
PGL	GG00B27Y8Z93	Pallinghurst Res Ltd	Yes
CRD	GG00B92NXM24	Central Rand Gold Ltd	Yes
KBO	IE00B97C0C31	Kibo Mining plc	Yes

Code	IsIn	JbName	Multiple Listing
RPL	IM00B8BV8G91	Redefine International P.L.C	Yes
NRP	IM00BDD7WV31	NEPI Rockcastle Plc	Yes
GLN	JE00B4T3BW64	Glencore plc	Yes
MMP	JE00B5N88T08	Marshall Monteagle plc	Yes
BAT	LU0011857645	Brait SE	Yes
HIL	MT0000850108	Homechoice Int plc	Yes
GLI	MU0330N00004	Go Life International Ld	Yes
ALP	MU0422N00009	Atlantic Leaf Prop Ltd	Yes
NFP	MU0453N00004	New Frontier Prop Ltd	Yes
GRP	MU0461N00007	Greenbay Properties Ltd	Yes
MDP	MU0473N00028	Mara Delta Prop Hldg Ltd	Yes
EPE	MU0522S00005	EPE Capital Partners Ltd	Yes
UPL	MU0526N00007	Universal Partners Ltd	Yes
NCS	NA0009123481	Nictus Ltd	Yes
TTO	NA000A0RF067	Trustco Group Hldgs Ltd	Yes
OAO	NGOANDO00002	Oando plc	Yes
SNH	NL0011375019	Steinhoff Int Hldgs N.V.	Yes
EPP	NL0011983374	Echo Polska Prop N.V.	Yes
GTC	PLGTC0000037	Globe Trade Centre S.A.	Yes
ERN	US2956251076	Erin Energy Corporation	Yes
NT1	US64107N2062	Net 1 UEPS Tech Inc	Yes
IHL	VGG487261064	Inter. Hotel Prop Ltd	Yes
MSP	VGG5884M1041	MAS Real Estate Inc.	Yes
ADR	ZAE000000139	Adcorp Holdings Limited	No
AFE	ZAE000000220	AECI Limited	No
AOO	ZAE000000485	African & Over Ent Ltd	No
AOVP	ZAE000000493	African & Over Ent Ltd P	No
CKS	ZAE000001434	Crookes Brothers Ltd	No
CRG	ZAE000001764	Cargo Carriers Ltd	No
HCI	ZAE000003257	Hosken Cons Inv Ltd	No
HDC	ZAE000003273	Hudaco Industries Ltd	No
JSC	ZAE000003794	Jasco Electron Hldgs Ltd	No
NED	ZAE000004875	Nedbank Group Ltd	No
NWL	ZAE000005070	Nu-World Hldgs Ltd	No
OMN	ZAE000005153	Omnia Holdings Ltd	No
PIK	ZAE000005443	Pick n Pay Stores Ltd	No
RTO	ZAE000006144	Rex Trueform Cloth Co Ld	No
SAP	ZAE000006284	Sappi Ltd	No
SBV	ZAE000006417	Sabvest Ltd	No
SFN	ZAE000006565	Sasfin Holdings Ltd	No
SOL	ZAE000006896	Sasol Limited	No
SPA	ZAE000006938	Spanjaard Limited	No
TPC	ZAE000007480	Transpaco Ltd	No
TRE	ZAE000007506	Trencor Ltd	No
RNG	ZAE000008819	Randgold & Expl Co Ltd	No
SOV	ZAE000009221	Sovereign Food Inv Ltd	No
RTN	ZAE000009700	Rex Trueform CI Co -N-	No
AON	ZAE000009718	African & Over Ent Ltd -N	No

Code	IsIn	JbName	Multiple Listing
WBO	ZAE000009932	Wilson Bayly Hlm-Ovc Ltd	No
HWN	ZAE000010583	Howden Africa Hldgs Ltd	No
NTC	ZAE000011953	Netcare Limited	No
SVN	ZAE000012043	Sabvest Ltd -N-	No
SHP	ZAE000012084	Shoprite Holdings Ltd	No
MST	ZAE000012373	Mustek Ltd	No
PSG	ZAE000013017	PSG Group Ltd	No
AMS	ZAE000013181	Anglo American Plat Ltd	No
BNT	ZAE000013694	Bonatla Property Hldgs	No
CUL	ZAE000013710	Cullinan Holdings Ltd	No
AWT	ZAE000013769	Awethu Breweries Ltd	No
TMT	ZAE000013991	Trematon Capital Inv Ltd	No
HAR	ZAE000015228	Harmony GM Co Ltd	No
BRT	ZAE000015277	Brimstone Inv Corp Ltd	No
BRN	ZAE000015285	Brimstone Inv Corp Ltd-N	No
NPN	ZAE000015889	Naspers Ltd -N-	No
VLE	ZAE000016507	Value Group Ltd	No
IDQ	ZAE000016606	Indequity Group Ltd	No
DTC	ZAE000017745	Datatec Ltd	No
GFI	ZAE000018123	Gold Fields Ltd	No
LAB	ZAE000018354	Labat Africa Ltd	No
TSX	ZAE000018552	Trans Hex Group Ltd	No
DAW	ZAE000018834	Distr and Warehousing	No
ART	ZAE000019188	Argent Industrial Ltd	No
DSY	ZAE000022331	Discovery Ltd	No
SUR	ZAE000022653	Spur Corporation Ltd	No
CMA	ZAE000023131	Command Holdings Limited	No
RMH	ZAE000024501	RMB Holdings Ltd	No
OCE	ZAE000025284	Oceana Group Ltd	No
MNY	ZAE000025409	Money Web Holdings Ltd	No
OLG	ZAE000026399	Onelogix Group Ltd	No
REM	ZAE000026480	Remgro Ltd	No
BAW	ZAE000026639	Barloworld Ltd	No
GRF	ZAE000027405	Group Five Ltd	No
TRU	ZAE000028296	Truworths Int Ltd	No
BEL	ZAE000028304	Bell Equipment Ltd	No
CSB	ZAE000028320	Cashbuild Ltd	No
DST	ZAE000028668	Distell Group Ltd	No
ARL	ZAE000029757	Astral Foods Ltd	No
IVT	ZAE000029773	Invicta Holdings Ltd	No
BSR	ZAE000029781	Basil Read Holdings Ltd	No
COM	ZAE000029823	Comair Limited	No
BCF	ZAE000030797	Bowler Metcalf Ltd	No
NHM	ZAE000030912	Northam Platinum Ltd	No
ADH	ZAE000031035	ADvTECH Ltd	No
WNH	ZAE000033916	Winhold Ltd	No
STA	ZAE000034294	Stratcorp Ltd	No
MMG	ZAE000034435	Micromega Holdings Ltd	No

Code	IsIn	JbName	Multiple Listing
ELR	ZAE000035101	ELB Group Ltd	No
CPI	ZAE000035861	Capitec Bank Hldgs Ltd	No
PHM	ZAE000039269	Phumelela Game Leisure	No
PMV	ZAE000039277	Primeserv Group Ltd	No
MTN	ZAE000042164	MTN Group Ltd	No
CAT	ZAE000043345	Caxton CTP Publish Print	No
CATP	ZAE000043352	Caxton CTP Publish 6%Pf	No
ANG	ZAE000043485	Anglogold Ashanti Ltd	No
TKG	ZAE000044897	Telkom SA SOC Ltd	No
CML	ZAE000047353	Coronation Fund Mngrs Ld	No
AVI	ZAE000049433	AVI Ltd	No
FBR	ZAE000053328	Famous Brands Ltd	No
ARI	ZAE000054045	African Rainbow Min Ltd	No
AME	ZAE000055802	African Media Ent Ltd	No
RLO	ZAE000057428	Reunert Ltd	No
LEW	ZAE000058236	Lewis Group Ltd	No
SPP	ZAE000058517	The Spar Group Ltd	No
DRD	ZAE000058723	DRD Gold Ltd	No
MRF	ZAE000060000	Merafe Resources Ltd	No
MFL	ZAE000061727	Metrofile Holdings Ltd	No
WHL	ZAE000063863	Woolworths Holdings Ltd	No
FSR	ZAE000066304	Firststrand Ltd	No
APN	ZAE000066692	Aspen Pharmacare Hldgs Ltd	No
AFX	ZAE000067120	African Oxygen Limited	No
IPL	ZAE000067211	Imperial Holdings Ltd	No
ISA	ZAE000067344	ISA Holdings Limited	No
VMK	ZAE000068011	Verimark Holdings Ltd	No
WSL	ZAE000069639	Wescoal Holdings Ltd	No
CMO	ZAE000070249	Chrometco Ltd	No
SLM	ZAE000070660	Sanlam Limited	No
EOH	ZAE000071072	EOH Holdings Ltd	No
TBS	ZAE000071080	Tiger Brands Ltd	No
NPK	ZAE000071676	Nampak Ltd	No
PPR	ZAE000072310	Putprop Ltd	No
GND	ZAE000072328	Grindrod Ltd	No
MUR	ZAE000073441	Murray & Roberts Hldgs	No
MMH	ZAE000074019	Miranda Mineral Hldgs Ld	No
OAS	ZAE000074332	Oasis Crescent Prop Fund	No
WEZ	ZAE000075859	Wesizwe Platinum Ltd	No
WEA	ZAE000078002	WG Wearne Ltd	No
PGR	ZAE000078127	Peregrine Holdings Limited	No
ACT	ZAE000078416	AfroCentric Inv Corp Ltd	No
PSV	ZAE000078705	PSV Holdings Ltd	No
JSE	ZAE000079711	JSE Ltd	No
TAS	ZAE000081162	Taste Hldgs Ltd	No
INL	ZAE000081949	Investec Ltd	No
IMP	ZAE000083648	Impala Platinum Hlgs Ltd	No
BFS	ZAE000083655	Blue Financial Services	No

Code	IsIn	JbName	Multiple Listing
EXX	ZAE000084992	Exxaro Resources Ltd	No
KIO	ZAE000085346	Kumba Iron Ore Ltd	No
SVB	ZAE000086229	Silverbridge Holdings	No
AFT	ZAE000086302	Afrimat Limited	No
WKF	ZAE000087847	Workforce Holdings Ltd	No
CMH	ZAE000088050	Combined Motor Hldgs Ltd	No
ZED	ZAE000088431	Zeder Inv Ltd	No
MTA	ZAE000090692	Metair Investments Ltd	No
SOH	ZAE000092748	South Ocean Holdings Ltd	No
RBX	ZAE000093183	Raubex Group Ltd	No
TLM	ZAE000093324	Telemaster Holdings Ltd	No
SNT	ZAE000093779	Santam Limited	No
HLM	ZAE000096210	Hulamin Ltd	No
TON	ZAE000096541	Tongaat Hulett Ltd	No
ANS	ZAE000097028	Ansys Limited	No
SUI	ZAE000097580	Sun International Ltd	No
IWE	ZAE000097903	Interwaste Hldgs Ltd	No
WTL	ZAE000098133	William Tell Holdings Ltd	No
ITE	ZAE000099123	Italtile Ltd	No
BIK	ZAE000101945	Brikor Ltd	No
PKH	ZAE000101986	Protech Khuthele Hldgs	No
1TM	ZAE000102026	1time Holdings Ltd	No
HUG	ZAE000102042	Huge Group Ltd	No
ELI	ZAE000103081	Ellies Holdings Ltd	No
SNU	ZAE000107223	Sentula Mining Ltd	No
KDV	ZAE000108940	Kaydav Group Ltd	No
BLU	ZAE000109088	Blue Label Telecoms Ltd	No
CGR	ZAE000109203	Calgro M3 Hldgs Ltd	No
CSP	ZAE000109427	Chemical Specialities Ld	No
ARH	ZAE000109435	ARB Holdings Limited	No
SBK	ZAE000109815	Standard Bank Group Ltd	No
MZR	ZAE000109823	Mazor Group Ltd	No
AEG	ZAE000111829	Aveng Group Limited	No
ADI	ZAE000113163	Adaptit Holdings Limited	No
ACE	ZAE000115986	Accentuate Limited	No
TCS	ZAE000116208	Total Client Services Ld	No
ISB	ZAE000116828	Insimbi Ref & Alloy Sup	No
BVT	ZAE000117321	Bidvest Ltd	No
CLI	ZAE000117438	Clientele Ltd	No
CLH	ZAE000117792	City Lodge Hotels Ltd	No
PFG	ZAE000118279	Pioneer Foods Group Ltd	No
GPL	ZAE000119814	Grand Parade Inv Ltd	No
AIP	ZAE000123436	Adcock Ingram Hldgs Ltd	No
SSK	ZAE000123766	Stefanuti Stck Hldgs Ltd	No
BSS	ZAE000125134	BSI Steel Limited	No
MIX	ZAE000125316	Mix Telematics Ltd	No
QPG	ZAE000125647	Quantum Prop Group Ltd	No
LBH	ZAE000127148	Liberty Holdings Ltd	No

Code	IsIn	JbName	Multiple Listing
ING	ZAE000127411	Ingenuity Property Inv	No
SCL	ZAE000127460	Sacoil Holdings Ltd	No
AHL	ZAE000129177	AH-Vest Limited	No
VOD	ZAE000132577	Vodacom Group Ltd	No
DTA	ZAE000132817	Delta EMD Ltd	No
YRK	ZAE000133450	York Timber Holdings Ltd	No
CLS	ZAE000134854	Clicks Group Ltd	No
ACL	ZAE000134961	ArcelorMittal SA Limited	No
FGL	ZAE000138095	Finbond Group Ltd	No
SEP	ZAE000138459	Sephaku Holdings Ltd	No
BAU	ZAE000145686	Bauba Platinum Limited	No
LHC	ZAE000145892	Life Healthcare Grp Hldgs Ltd	No
EHS	ZAE000146171	Evrax Highveld Steel & Van	No
ASR	ZAE000146932	Assore Ltd	No
TFG	ZAE000148466	The Foschini Group Limited	No
MMI	ZAE000149902	MMI Holdings Limited	No
RBP	ZAE000149936	Royal Bafokeng Platinum Ltd	No
PLL	ZAE000151825	Platfields Limited	No
EFG	ZAE000151841	Efficient Group Ltd	No
CLR	ZAE000152377	Clover Industries Ltd	No
MSM	ZAE000152617	Massmart Holdings Ltd	No
TDH	ZAE000152658	Tradehold Ltd	No
CIL	ZAE000153888	Cons Infrastructure Grp Ltd	No
TSH	ZAE000156238	Tsogo Sun Holdings Ltd	No
COH	ZAE000156253	Curro Holdings Limited	No
NUT	ZAE000156485	Nutritional Holdings Ltd	No
MPT	ZAE000156501	Mpact Limited	No
MND	ZAE000156550	Mondi Ltd	No
HSP	ZAE000157046	Holdsport Limited	No
SNV	ZAE000159711	Santova Logistics Ltd	No
RLF	ZAE000159836	Rolfes Technology Hldgs	No
SPG	ZAE000161832	Super Group Ltd	No
VUN	ZAE000163382	Vunani Ltd	No
ANA	ZAE000163580	Adrenna Property Grp Ltd	No
MRI	ZAE000164562	Mine Restoration Inv Ltd	No
ILE	ZAE000165239	Imbalie Beauty Limited	No
BDM	ZAE000167318	Buildmax Ltd	No
TCP	ZAE000167391	Transaction Capital Ltd	No
CVH	ZAE000167714	Capevin Holdings Ltd	No
NIV	ZAE000169553	Niveus Investments Ltd	No
PPC	ZAE000170049	PPC Limited	No
AET	ZAE000170395	Alert Steel Holdings Ltd	No
MDI	ZAE000171948	Master Drilling Grp Ltd	No
KAP	ZAE000171963	KAP Industrial Hldgs Ltd	No
AND	ZAE000172870	Andulela Inv Hldgs Ltd	No
GAM	ZAE000173498	Global Asset Mngment Ltd	No
SGL	ZAE000173951	Sibanye Gold Limited	No
BGA	ZAE000174124	Barclays Africa Grp Ltd	No

Code	IsIn	JbName	Multiple Listing
ATT	ZAE000177218	Attacq Limited	No
TWR	ZAE000179040	Tower Property Fund Ltd	No
GRT	ZAE000179420	Growthpoint Prop Ltd	No
RCL	ZAE000179438	RCL Foods Limited	No
ECS	ZAE000179594	Ecsponent Limited	No
VKE	ZAE000180865	Vukile Property Fund Ltd	No
IPF	ZAE000180915	Investec Property Fund Ltd	No
CSG	ZAE000184438	CSG Holdings Ltd	No
ESR	ZAE000184669	Esor Limited	No
ASC	ZAE000185005	Ascendis Health Ltd	No
FDP	ZAE000185260	Freedom Prop Fund Ltd	No
PPE	ZAE000185526	Purple Group Ltd	No
APF	ZAE000185815	Accelerate Prop Fund Ltd	No
VIS	ZAE000187407	Visual International Hldgs Ltd	No
SAR	ZAE000188280	Safari Investments RSA Ltd	No
TOR	ZAE000188629	Torre Industries Limited	No
EQU	ZAE000188843	Equites Prop Fund Ltd	No
AVL	ZAE000189049	Advanced Health Ltd	No
RDF	ZAE000190252	Redefine Properties Ltd	No
TEX	ZAE000190542	Texton Property Fund Ltd	No
HYP	ZAE000190724	Hyprop Inv Ltd	No
AEL	ZAE000191342	Allied Electronics Corp A	No
KST	ZAE000191417	PSG Konsult Limited	No
AFH	ZAE000191516	Alexander Forbes Grp Hldgs	No
RFG	ZAE000191979	Rhodes Food Grp Hldg Ltd	No
OCT	ZAE000192258	Octodec Invest Ltd	No
FFA	ZAE000192787	Fortress Inc Fund Ltd A	No
FFB	ZAE000192795	Fortress Inc Fund Ltd B	No
ACG	ZAE000193389	Anchor Group Limited	No
QFH	ZAE000193686	Quantum Foods Hldgs Ltd	No
DLT	ZAE000194049	Delta Property Fund Ltd	No
AEE	ZAE000195731	African Equity Emp Inv Ltd	No
CGN	ZAE000197042	Cognition Holdings Ltd	No
DNB	ZAE000197398	Deneb Investments Ltd	No
MNK	ZAE000197455	Montauk Holdings Ltd	No
ACS	ZAE000198289	Acsion Limited	No
CTK	ZAE000198305	Cartrack Holdings Ltd	No
SCP	ZAE000198586	Stellar Cap Partners Ltd	No
RBA	ZAE000199642	RBA Holdings Ltd	No
NVE	ZAE000199865	NVest Financial Hldgs Ltd	No
MRP	ZAE000200457	Mr Price Group Ltd	No
ALH	ZAE000201554	Alaris Holdings Ltd	No
REB	ZAE000201687	Rebosis Property Fund Ltd	No
ORE	ZAE000201695	Orion Real Estate Ltd	No
NVS	ZAE000202149	Novus Holdings Limited	No
EMI	ZAE000203063	Emira Property Fund Ltd	No
AWA	ZAE000203105	Arrowhead Properties Ltd	No
SAC	ZAE000203238	SA Corp Real Estate Ltd	No

Code	IsIn	JbName	Multiple Listing
DIA	ZAE000203378	Dipula Income Fund A	No
DIB	ZAE000203394	Dipula Income Fund B	No
FVT	ZAE000203808	Fairvest Property Hldgs	No
CTA	ZAE000208245	CAPITAL APPRECIATION LTD	No
SYG	ZAE000208815	Sygnia Limited	No
EMH	ZAE000208898	E Media Holdings Ltd	No
TRL	ZAE000209342	Trellidor Hldgs Ltd	No
EMN	ZAE000209524	E Media Holdings Ltd -N-	No
BWN	ZAE000209532	Balwin Properties Ltd	No
RES	ZAE000209557	Resilient REIT Limited	No
GAI	ZAE000210555	Gaia Infrastruct Cap Ltd	No
RMI	ZAE000210688	Rand Merchant Inv Hldgs Ltd	No
AVR	ZAE000211637	Avior Cap Market Hldg LD	No
MED	ZAE000211876	Middle East Diamond Res Ld	No
NRL	ZAE000212783	Newpark REIT Ltd	No
GBI	ZAE000212791	Gold Brands Inv Ltd	No
BID	ZAE000216537	BID Corporation Ltd	No
AXL	ZAE000221370	African Phoenix Inv Ltd	No
ENX	ZAE000222253	enX Group Llimited	No
PEM	ZAE000222949	Pembury Lifestyle Grp Lt	No
ADW	ZAE000223194	African Dawn Capital Ltd	No
EXG	ZAE000223202	eXtract Group Limited	No
GPA	ZAE000223269	Gemgrow Properties Ltd A	No
GPB	ZAE000223277	Gemgrow Properties Ltd B	No
AVV	ZAE000227484	Alviva Holdings Ltd	No
DCP	ZAE000227831	Dis-Chem Pharmacies Ltd	No
SEA	ZAE000228995	Spear REIT Limited	No
L2D	ZAE000230553	Liberty Two Degrees	No
PFF	ZAE000238309	Premier Food Fishing Ltd	No
SHG	ZAE000240198	Sea Harvest Group Ltd	No
MAP	ZAE000242921	Master Plastics Limited	No
L4L	ZAE000243119	Long 4 Life Limited	No
KAL	ZAE000244711	Kaap Agri Limited	No
HET	ZAE000246740	Heriot REIT Limited	No
HWA	ZW0009011934	Hwange Colliery Ltd	No
CAC	ZW0009011942	Cafca Limited	No

Source: (IRESS Research Domain, 2017)

## Appendix C: Ethical clearance letter

**Gordon  
Institute  
of Business  
Science**  
University  
of Pretoria

31 May 2017

Eddy Mabuza

Dear Eddy Mabuza

*Please be advised that your application for Ethical Clearance has been approved.*

*You are therefore allowed to continue collecting your data.*

*We wish you everything of the best for the rest of the project.*

*Kind Regards*

GIBS MBA Research Ethical Clearance Committee