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Stock Market Liquidity and Monetary Policy

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Abstract:

Purpose: *This article investigates the deterministic relationship between monetary policy and stock market liquidity in South Africa.*
Design/Methodology/Approach: *The Ordinary Least Square Method was used to capture the nexus between the Johannesburg Stock Exchange indices and selected liquidity measures over the period of 2002 to 2019. The liquidity measures chosen were multi-dimensional in nature, exhibiting characteristics such as tightness, immediacy, depth, breadth and resiliency.*
Findings: *Empirical evidence shows that liquidity depend on monetary policy adjustments as the results reveal that liquidity is dependent on changes in South African Benchmark overnight rate (SABOR). The strength and significance of the relationship depended on the indices and period of analysis. The liquidity measure used was also influential as the results showed a negative relationship between SABOR and adjusted illiquidity measure in line with theory. Also, in line with theory effective spread was found to be positively related with SABOR. The relationship conflicted the theory on the trading volume as it was positively related to SABOR. However, the analysis could not confirm that the relationship between liquidity and monetary policy is asymmetric.*
Practical Implications: *The article highlights the fact that stock market investment professionals, traders and regulators should account for the effects of changes in interest rates when modeling market frictions like liquidity.*
Originality/Value: *An investigation was done in an emerging equity market which is different from the dynamics and mechanics of the developed equity markets because the emerging stock markets are illiquid and constitute a lot of market imperfections. Furthermore, developing countries' financial markets are extremely segmented and less efficient. The results revealed important insights that stock liquidity is time variant and index dependent and contrary to many studies the relationship between stock liquidity and monetary policy is not asymmetry.*

Keywords: *Stock liquidity, adjusted illiquidity measure, effective spread, trading volume, monetary policy, interest rates.*

JEL codes: *E52, G11, G23.*

Paper type: *Research article.*

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1. Introduction

A significant number of finance and economic models are built under the presumption that liquidity plays no role. Classic financial market theories for example Sharpe (1964) and John Lintner (1965) capital asset pricing models and Black and Scholes model's (1973) model were created on the basis of frictionless markets. Investors are assumed to buy and sell any amount of securities without any restriction, also with no impact on the price. However, there is a new body of scholars that acknowledges the existence of market frictions in the form of trading costs, short sale restrictions, market impact and other market illiquidities that has impact on securities price (Amihud, 2002; Chordia, Roll and Subrahmanyam, 2001; Acharya and Pedersen, 2005). Thus, liquidity indeed has a role in dynamic stochastic general equilibrium (DSGE) models. There is plenty empirical evidence that revealed the impact of liquidity on asset pricing. Examples include the finding that restricted stock trades at a steep discount relative to highly liquid stocks.

Prior to Chordia, Roll, and Subrahmanyam's (2000; 2008) theoretical proposition on the determinants of stock market liquidity there was no empirical work that had been devoted to common determinants of liquidity nor to their empirical manifestation and the correlated movements in liquidity. Period prior to year 2000 was associated with period of high market liquidity. This is the period during which the developed world markets were associated with highly liquid stock markets as the supply of credit was unlimited. However, the 2007/2009 global financial crisis led to a drying up of markets (Thalassinos *et al.,* 2015a; 2015b). The potential impairment on assets caused by the lack of liquidity during this period heightened the importance of understanding liquidity and its macroeconomic determinants. Thus, understanding the influence of monetary policy variables as determinants of liquidity provides vital information of financial frictions that are built around capital markets, and the critical role played by monetary policy in regulating credit supply (Adrian and Shin, 2009). This article sought to investigate the influence of changes in South African Benchmark Overnight Rate (SABOR) on stock market liquidity.

The results indicate that liquidity is dependent on changes in SABOR. The strength and significance of the relationship is dependent on the indices and period of analysis. The liquidity measure used was influential on the results as a negative relationship between SABOR and adjusted illiquidity measure in line with theory was found. Also, confirming theory and other empirical studies contractionary monetary policy was found to be associated with high effective spread. Contrary to theory and other studies the SABOR was found to be positively related to volume traded.

Most of the scholars that investigated the determinants of assets liquidity contain both theoretical models and empirical findings detailing how asset liquidity is affected by both cross-sectional and longitudinal firm specific and macro-economic variables were done in developed markets (Fujimoto, 2004; Chordia *et al.,* 2005; Goyenko and Ukhov 2009). Surprisingly, even perversely, most of these scholars did

their studies on developed stock markets focusing on equities, a relatively liquid asset class. Divergent to the dynamics and mechanics of the developed markets equities, the emerging stock markets are illiquid and constitute a lot of market imperfections. Furthermore, developing countries' financial markets are extremely segmented and less efficient compared to those in developed countries. It is against this background that its more appealing to understand how monetary policy variations affects stock market liquidity overtime using data from an emerging market which is less correlated with the developed market. There are scant studies that were carried out within the context of emerging markets, the most prominent being Chu's (2015), where monetary shocks are presumed to asymmetrically affect stock market liquidity. Nevertheless, the findings of Chu (2015) do not reveal any insights on the relationship between monetary policy and individual stock liquidity (Debata and Mahakud, 2018). A re-examination of the determinants of liquidity in emerging markets is justifiable.

The main aim of this article is to examine the linkage between monetary policy and liquidity on the south African stock market. This study aims to examine the deterministic relationship between these variables using the ordinary least square (OLS) methodology. This research contributes significantly to the body of knowledge in four ways. Firstly, most articles previously focused on well developed markets and only two studies focused on China emerging market, this study examines this phenomenon on South Africa stock markets. The study on South Africa provides insights on how impulse on monetary variables affect liquidity of stock market in emerging markets.

Second, liquidity is a short-term phenomenon therefore, weekly data is used in the analysis unlike some previous studies that used monthly and quarterly data. Third, in this article Kang and Zhang's (2014) adjusted illiquidity measure was used and none of the studies used this measure. The adjusted illiquidity measure was used because it is an appropriate measure of stock market liquidity in emerging markets (Ma, Anderson and Marshall, 2016). Finally, four indices were used to test the nexus. Contrary to other studies that used individual stocks, indices constitute a more diversified portfolio and therefore unsystematic risk was considered not a problem. More over the analysis of the large cap and small cap indices was motivated by empirical results that the relationship between monetary policy and stock liquidity is lop-sided.

2. Literature Review

The stock market liquidity is defined as the ease by which a stock can be converted into cash. How easy an asset is converted into cash is more often referred to as the least cost transaction, transaction in large volume with little impact, or the speed at which the trader can get a counterpart. More specifically, stock market liquid is multi-dimensional in nature exhibiting characteristics such as tightness or low transaction costs, immediacy or speed of order execution, depth, breadth and

resiliency (Sarr and Lybek, 2002). Studies on the determinants of asset liquidity have been examined where researchers looked at liquidity components in silos, yet, liquidity is a multidimensional phenomenon whose components are intertwined (Marozva, 2017). The empirical literature on the impact of monetary policy on liquidity has gathered mixed evidence.

Goyenko and Ukhov (2009) found a direct and positive relationship between stock market liquidity and the monetary policy variations. Where the tightening of monetary policy was found to decrease stock market liquidity and vice versa for the US market. Also, Fernández-Amador, Gächter, Larch, and Peter (2013) results suggest a positive relationship between expansionary monetary policy and stock market liquidity. They found out that an expansionary monetary policy of the European Central Bank resulted in an increase of aggregate stock market liquidity in the German, French and Italian markets. Furthermore, they revealed that the effect of monetary policy is nonlinear as the small cap equitities were more impacted than the large cap equites. Chordia, Sarkar and Subrahmanyam (2005) finds that the relationship between the monetary policy and stock market liquidity exists only during periods of crisis. Also, Fujimoto (2004) finds that monetary policy variation has an influence on stock market liquidity from 1965 to 1982, but no significant relationship was established from 1983 to 2001. Goyenko and Ukhov (2009) document that monetary policy indeed affects liquidity. However, this is through a transmission mechanism where the bond illiquidity acts as a channel through which monetary policy shocks are transferred into the stock market.

Other scholars like Fujimoto (2004) and Chordia *et al.* (2005) find no linkage between stock market liquidity and the monetary policy on market liquidity. Effectively, monetary policy is assumed to have no predictive power on stock market liquidity. Debata and Mahakud (2018) argue that, the existing literature has failed to provide consistent and conclusive empirical evidence on the nexus between liquidity and monetary policy variables. This inevitably makes the comprehensive interpretation of empirical evidence difficult. Since there is no common consensus on the relationship between monetary policy and stock market liquidity, there is need for further investigations under different set ups.

3. Methodology and Data

The present study examines Johannesburg Stock Exchange (JSE) stock indices. Indices selected include the JSE All-Share Index, JSE Top 40-Share Index, JSE large cap Index, JSE Mid cap Index and JSE small cap Index. The sample period spans from September 2002 to September 2019. Of the selected indices the daily high price, low price, opening price, closing price and trading volume was collected to determine weekly returns, volatility and liquidity proxies. The weekly SABOR rate was collected for the same period that corresponds to the indices period.

The stock market liquidity is multidimensional with dimensions as tightness (the difference between bid and ask prices), depth (the impact of buying large volumes), immediacy (the speed of a trade) and resiliency (the speed of restoration to the previous price after a deviation due to a large volume trade) (Kyle, 1985). Considering that the study is on emerging market and liquidity is multidimensional, this study employs a number of measures to account for these dynamics. The adjusted illiquidity measure by Kang and Zhang (2014) an extension of Amihud's (2002) measure (ILLIQ) was utilised. The adjusted ILLIQ measure (AdjILLIQ) has been the priority of many researchers due to its effectiveness in measuring illiquidity especially for emerging markets. The original ILLIQ measure is more appropriate for developed countries where non-zero trading volume is less of a concern or unusual, since they are more liquid markets. Unlike in the developed markets, non-zero trading volume in emerging market is the order of the day where liquidity could be low and non-trading days occur more frequently. AdjILLIQ is defined as 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. The AdjILLIQ measure is constructed as follows:

$$\text{AdjILLIQ}_{i,m} = \left[1\text{n}\left(\frac{1}{N_{i,m}} \sum_{t=1}^{N_{i,m}} \frac{|\text{R}_{i,t}|}{\text{Vol}_{i,t}} \right) \right] \times (1 + \text{ZeroVol}_{i,m})$$

Where $N_{i,m}$ is the number of non-zero trading volume days of stock i in month *m;* $|R_{i,t}|$ is the US dollar trading volume of stock *i* on day *t*; $\text{ZeroVol}_{i,m}$ is the percentage of zero-volume days within month *m*.

Since trading activity is an intuitive measure of an asset's liquidity, in this study the traded value as a representative was used. This is supported by Amihud and Mendelson (1986), who argue that the liquidity of a stock is directly proportional to trading frequency in equilibrium as investors prefer to hold securities with higher trading frequency to avoid illiquidity risk. Also, in line with Fernández-Amador *et al.* (2013), the traded value is used as a proxy for trading activity.

To capture the transaction cost aspect of liquidity, the bid ask spread as proposed by Adler (2014), and Plerou, Gopikrishnan and Stanley (2005) was employed. The lower the liquidity of the stock the wider the bid-ask spread. Therefore, the bid-ask spread is used as a proxy in this study.

The SABOR is used as monetary policy liquidity proxy. This proxy is used because the Central bank determines the quantity of liquidity via its open market operations and ultimately the interbank market reallocates it. Thus, a higher SABOR represents contractionary monetary policy and vice versa.

The effect of market conditions on stock market liquidity is accounted for by

including stock returns and stock volatility (measured by standard deviation) as part of market-related control variables in our model (Brunnermeier and Pedersen, 2009; Hameed, Kang and Viswanathan, 2010).

3.1 Model Specification

Methodologically, most existing studies focus on time-series analysis, especially vector autoregressive (VAR) models (Fernández-Amador *et al.*, 2013; Chiu, 2015) or linear regression (Naes, Skjeltorp and Ødegaard, 2011; Nyborg and Östberg, 2014). This research will follow the linear regression method.

Selected JSE indices, selected market liquidity measures and variables that capture the effects of market conditions were incorporated into a linear regression framework. For the empirical estimation of the relationship between the selected JSE Indices and the independent variables of market liquidity, stock returns and stock volatility are expressed mathematically in equations 1-4.

$$\mathrm{JSE-ASI\_LIQ}_{j,t} = \lambda_{1t}\mathrm{SABOR}_t + \lambda_{2t}\mathrm{RET}_t + \lambda_{3t}\mathrm{VOL}_t + \lambda_{4t}\mathrm{Dummy}_t + \varepsilon_t \quad (1)$$

$$\mathrm{JSE-T40\_LIQ}_{j,t} = \emptyset_{1t}\mathrm{SABOR}_t + \emptyset_{2t}\mathrm{RET}_t + \emptyset_{3t}\mathrm{VOL}_t + \emptyset_{4t}\mathrm{Dummy}_t + \varepsilon_t \quad (2)$$

$$\mathrm{JSE-LCAP\_LIQ}_{j,t} = \beta_{1t}\mathrm{SABOR}_t + \beta_{2t}\mathrm{RET}_t + \beta_{3t}\mathrm{VOL}_t + \beta_{4t}\mathrm{Dummy}_t + \varepsilon_t \quad (3)$$

$$\mathrm{JSE-SCAP\_LIQ}_{j,t} = \alpha_{1t}\mathrm{SABOR}_t + \alpha_{2t}\mathrm{RET}_t + \alpha_{3t}\mathrm{VOL}_t + \alpha_{4t}\mathrm{Dummy}_t + \varepsilon_t \quad (4)$$

Where:

- the variable $\mathrm{JSE-ASI\_LIQ}_{j,t}$ represent liquidity measure *j* for JSE All-Share Index at time *t*;
- the variable $\mathrm{JSE-T40\_LIQ}_{j,t}$ represent liquidity measure *j* for JSE Top 40-Share Index at time *t*;
- the variable $\mathrm{JSE-LCAP\_LIQ}_{j,t}$ represent liquidity measure *j* for JSE Large Cap Index at time *t*;
- the variable $\mathrm{JSE-SCAP\_LIQ}_{j,t}$ represent liquidity measure *j* for JSE Small Cap
- Index at time *t*;
- $\gamma_t, \alpha_t, \beta_t, \text{and } \emptyset_t,$ elasticities of the explanatory variables i.e. slope of independent variables at time *t*;
- ε_t denotes the error term;
- the variable Dummy_t represents a dummy variable that take a value of 0 during stable periods and a value of 1 during the global financial crisis of 2009/2010.

4. Results and Discussion

The multiple regression models were run to investigate the deterministic relationship between the market liquidity and the independent variables of SABOR, stock return and stock volatility. The t-statistic and P-values were used to establish the significance of the relationship between these variables and the results are presented in Tables 1-4.

Table 1. *Estimation results of the regression on JSE Top 40-Share Index liquidity*

	Trading activity	***Effective spread***	***Adjusted illiq***
Volatility	7933697.0***	33.09***	-6.06e-09
	(1322631.6)	(4.782)	(5.07e-09)
Stock returns	49667.0***	0.211***	2.84e-10***
	(2950.5)	(0.00903)	(1.30e-11)
Sabor	5369636.8	30.75**	-5.08e-08**
	(3149904.8)	(9.978)	(1.64e-08)
Dummy	48949574.1*	-183.7*	-0.000000167*
	(21514470.4)	(75.13)	(8.44e-08)
_cons	144519454.2***	-561.1***	0.000000948***
	(29088237.5)	(100.7)	(0.000000148)
N	914	914	914
R^2	0.287	0.388	0.389

Note: *Standard errors in parentheses * p < 0.05, ** p < 0.01, *** p < 0.001.*
Source: *Author's caclulations.*

Table 2. *Estimation results of the regression on JSE All-Share Index liquidity*

	Trading activity	***Effective spread***	***Adjusted illiq***
Annualized Vol	7900663.1***	19.97	4.70e-10
	(2266060.6)	(17.26)	(3.48e-09)
Stock returns	99739.7***	0.226***	1.37e-10***
	(4520.2)	(0.0391)	(6.69e-12)
Sabor	10957773.5*	69.38	-3.23e-08***
	(5356305.2)	(41.89)	(9.58e-09)
Dummy	109317252.9***	-14.03	-0.000000110*
	(32694946.7)	(188.1)	(5.50e-08)
_cons	279194270.0***	-671.9***	0.000000586***
	(44443610.3)	(167.9)	(8.12e-08)
N	908	908	908
R^2	0.428	0.094	0.361

Note: *Standard errors in parentheses * p < 0.05, ** p < 0.01, *** p < 0.001*
Source: *Author's caclulations.*

Table 1 and Table 2 reveal ample evidence of deterministic relationship between monetary policy and stock returns as measured by JSE Top 40 Share Index and JSE All Share Index. SABOR is positively and significantly related to effective spread as

expected. The higher the SABOR rate the lower the money supply in the market, entailing an illiquid market. When the market is liquid we expect the cost of trading to be lower. These results confirm the theoretical linkage as explained by Brunnermeier and Pedersen (2009). In their proposition monetary policy is assumed to affect stock market liquidity by altering the borrowing constraint and fund flow into the stock market. Besides monetary policy, results shows that stock returns and stock volatility are crucial in explaining variation in liquidity. These results were consistent with Debata and Mahakud's (2018) empirical findings.

There is a negative relationship between monetary policy shock and the Kang and Zhang's (2014) adjusted illiquidity (Adjilliq). Surprising, there results reveals a positive relationship between SABOR and trading activities, this means that as the liquidity in the market deteriorates stock market liquidity improves. Lastly, the dummy variable was found to be significant, an indication that stock market liquidity altered during the global financial crises.

Table 3. *Estimation results of the regression on JSE Large Cap Share Index liquidity*

	Trading activity	***Effective spread***	***Adjusted illiq***
Volatility	-3484709.4***	-849.2	0.000000534**
	(936446.0)	(906.5)	(0.000000191)
Stock returns	5484.4***	0.701	1.10e-09***
	(389.1)	(0.648)	(8.48e-11)
Sabor	1161866.0	1240.6	-0.000000568*
	(1012783.2)	(1242.9)	(0.000000224)
Dummy	45727843.3***	3032.3	-0.00000518***
	(5531228.1)	(3167.1)	(0.000000818)
_cons	77518060.0***	-6728.1	0.00000734***
	(7286549.4)	(6426.3)	(0.00000183)
N	908	908	908
R^2	0.315	0.005	0.351

Note: *Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*
Source: *Author's caclulations.*

Tables 3 and 4 indicate that the adjusted illiquidity measure generally deteriorates with increase in the South African benchmark overnight rate. The results were in line with theory and other empirical studies (Brunnermeier and Pedersen, 2009; Söderberg, 2008). Also, volatility and stock returns implicitly cause all the three-stock market measures of liquidity. However, there is no significant difference on the effects of monetary policy on stock liquidity between large capitalisation stock and small capitalisation stocks. This is contrary to empirical results by Chu (2015) that reveals that the relationship between monetary policy and stock liquidity is asymmetric. Lastly, the dummy was significant for trading activity and adjusted illiquidity under the JSE small cap Index and only significant under the effective spread for large cap companies.

Table 4. *Estimation results of the regression on JSE Small Cap Share Index liquidity*

	Trading activity	***Effective spread***	***Adjusted illiq***
Volatility	1259603.9	59.08***	1.26e-08
	(1551860.3)	(7.737)	(4.23e-08)
Stock returns	20247.4***	0.112***	3.91e-10***
	(1519.0)	(0.00553)	(3.40e-11)
Sabor	6638954.9*	17.87	-0.000000224***
	(2595046.1)	(10.16)	(6.45e-08)
Dummy	8465178.1	-261.3***	6.40e-08
	(12563408.3)	(68.82)	(0.000000403)
_cons	60844626.3**	-612.9***	0.00000406***
	(18796125.9)	(82.80)	(0.000000496)
N	908	908	908
R^2	0.395	0.581	0.328

Note: *Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*
Source: *Author's caclulations.*

5. Conclusion

The main aim of this article was to examine the linkage between monetary policy and liquidity on the south African stock market. In line with other studies the OLS methodology was employed. An analysis of the JSE All-Share Index and JSE Top 40_Share Index confirmed theoretical prediction as the South African Benchmark Overnight Rate was negatively related to stock liquidity as measured by the adjusted illiquidity measure. Also, in line with theory an expansionary monetary policy was associated with a decrease in effective spread and vice versa. Contrary to expectation, SABOR was found to be positively related to liquidity as measured by the trading volume. The result meant that an improvement in the market liquidity associated with decrease in SABOR was associated with lower trading volumes and a departure from theoretical propositions.

Most scholars indicate that the relationship between stock market liquidity and monetary policy variables is asymmetric hence, in this study small cap stocks and large cap stocks were put into perspective. However, the results indicated that the relationship is not asymmetric. In line with theory the adjusted illiquidity measure was found to be negatively related to SABOR. This supports the idea that less liquid stock markets are influenced by contractionary monetary policy, and highly liquid stock markets are dependent on expansionary monetary policy. The relationship conflicted the theory on the other two measures of liquidity (effective spread and trading volume) as they were positively related to SABOR.

The results revealed that the nature of relationship is subject to liquidity measure used and also tend to depend on the sample of analysis. Therefore, scholars and practitioners are advised to segregate their analysis based on these important

matrices. An analysis of individual stocks instead of indices can also give important insights. When analysing individual stocks, firm specific factors should be controlled. Lastly, empirical results in this study indicated that stock market liquidity is also period dependent, thus, research should be carried out for two separate periods (period of crises and stable periods).

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