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Monetary Policy and Stock Market Liquidity: Empirical Evidence from the Johannesburg Stock Exchange (JSE)

By

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ABSTRACT

The recent financial crisis has given liquidity an important role in the financial market functioning. Especially in small size equity markets like the African, lack of liquidity has been reported as major issue. In order to source the causes of the lack of liquidity, this study investigated the relationship between monetary policy and stock market liquidity in South Africa using fixed and random effect estimations for stock specific effect and VAR impulse response function for portfolio analysis. We first estimate a Taylor rule for South Africa, which we augment with a financial indicator adapted from the literature and use the difference between actual and fitted values to measure monetary stance. The literature on the monetary policy rules in South Africa revealed M3 as the instrument used by the SARB before the period of inflation targeting that started in February 2000. We then used the monetary stance computed from the Taylor rule and the growth rate of M3 as measures of monetary policy. The panel regression analysis, with monetary policy measured by the growth rate of money supply, is only significant in the case of illiquidity models while monetary policy shows no effect on liquidity models in that case. In the case of monetary policy as measured by Taylor rule, the turnover model revealed a negative relationship, but weakly significant. Further, a positive and significant effect at 5% and 10% was revealed for Amihud's illiquidity measure and Roll's price impact measure. The impulse response analysis shows different results as compared to the stock specific analysis. The study found that monetary policy, as measured by money supply, has a positive effect on the liquidity variables which are turnover and trading volume; and also found that the monetary policy, as measured by the Taylor monetary stance, has a positive effect on illiquidity variables.

DECLARATION

I, Patrick H. Nyika do hereby declare that this dissertation is the result of my investigation and research and that this has not been submitted in part or full for any degree or for any other degree to any other University.

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Chapter 1: Introduction

1.1 Theoretical and Empirical Background

Fabre and Frino (2004) investigated how liquidity of specific stocks reacts to the change in industry liquidity. This is what is called commonality in liquidity, which has also been investigated by Hasbrouck and Seppi (2001) and Chordia et al. (2000). However, what factors drive market-wide liquidity in developed and developing economies? One important factor, as recently studied by Fernandez-Amador et al. (2013), is monetary policy. Monetary policy, as implemented by the central bank, has its effect on market rates which in turn is transmitted into economic activities, this was properly described by Mishkin (1995) who studied monetary policy transmission channels and these are: interest channel, asset prices channel, exchange rate channel and the balance sheet channel.

Commonality in liquidity has captured much attention from researchers in the recent decade. The term “commonality in liquidity’’ captures the fact that the liquidity of an individual firm is at least partly determined by market-wide factors (Brockman and Chung, 2002). Recent studies took the research in the area of commonality in liquidity further. Mancini et al. (2013) investigated commonality in liquidity in the foreign exchange market and found significant variation in liquidity across exchange rates and also significant commonality in liquidity across currencies, equities and bonds. Karolyi et al (2012) found that commonality in liquidity is greater in countries with high market volatility. In emerging markets, Qin (2006) argued that, they possess distinct characteristics that separate them from developed markets and further found that, because of the uniqueness of the liquidity constraints to emerging markets, commonality in liquidity is strong in emerging markets than developed markets. Qin’s (2006) results showed that, in emerging markets, asset specific return is more affected by market wide factors than asset specific factors and that commonality in liquidity in emerging markets may be the result of higher stock volatility and inventory risk.

Furthermore, the inventory paradigm of the market microstructure suggests that stock liquidity increases if the costs of financing and holding assets is low, for instance, the lower the price paid to finance holding of stocks (inventory turnover) and the lower the perceived risk of holding the stocks (inventory risk); the more liquid the stocks become. For more clarity, in holding inventories, firms need to borrow to cover the cost of holding, which is further related to the market rate. Thus, if all firms hold inventory and all borrow at the market rate to cover the cost of holding; this implies that the cost of holding inventories may be correlated across securities due to the fact all firms borrow at the market rate to manage inventories (Chordia et al., 2001). Monetary policy has a direct effect on the cost of financing and

the perceived risk of holding financial assets, thus, monetary policy also affects stock market liquidity (Fernandez-Amador et al., 2013). The study attempts to imagine the same for monetary policy as conducted by the central bank, because the central bank directly affects the prime rate. So indirectly, the cost of holding inventory may be seen as a common factor that drives liquidity while monetary policy may be seen as a direct mechanism or common factor that affects liquidity due to its direct effect on the prime rate.

Similarly, Brunnermeier and Pedersen (2008) modelled the interaction between funding liquidity and asset liquidity and suggested that traders with limited capital found it difficult to meet their margin requirements and these results in failure to provide liquidity to the market. It is on this basis that, an expansionary (contractionary) monetary policy reduces (increases) restrictions for margin borrowing and therefore, enables (encumbers) the funding liquidity of market participants (Fernandez-Amador et al., 2013).

Not really related to commonality in liquidity, but some scholars have also researched and particularly focused on the relationship between liquidity and stock returns. Amongst those are, Amihud and Mendelson (1986b), Datar et al. (1998) and Butler et al. (2005) and so on. They used turnover ratio as a proxy for stock market liquidity and found that it plays an important role in the determination of equity returns. Some authors found liquidity to be an important determinant of transaction costs. However, liquidity and illiquidity variables are also affected by other explanatory variables. As mentioned by Gao and Kling (2006), the work of inventory paradigm can be used to determine factors that affect liquidity variables, which is the core of our study. Inventory paradigm states that liquidity is related to the risk of inventory holding, while information based trading stresses that the release of news about the macroeconomic conditions affects market liquidity. In that direction and in terms of liquidity and illiquidity factors, a number of scholars use bid-ask spread as an il/liquidity measure; for example Aitken and Frino (1996). They found that the level of trading activity, volatility of stock prices and price level significantly determine illiquidity on the Australian Stock Exchange. Even though monetary policy and the cost of holding inventories provide a theoretical basis for the study, focus is mainly on the relationship between monetary policy and stock market liquidity in South Africa, this is because they are both related to the market rates. We chose South Africa because it is one of the leading emerging economies, as compared to the previous studies which focused on developed economies.

Not many scholars have focused on the relationship between monetary policy and stock market liquidity. Goyenko and Ukhov (2009) and Florackis et al. (2014) are two other studies that have documented on this relationship. Furthermore, the work of Fernandez-Amador et al. (2013) is conducted in developed economies and no relationship has been established in emerging and developing economies. The only exception in emerging economies is the work of Qin (2007), however he documented more on the commonality in liquidity rather than the relationship between monetary

policy and asset liquidity. Therefore, the purpose of this study is to document on the relationship between monetary policy and stock market liquidity in emerging economies, with a particular focus on the Johannesburg Stock Exchange (JSE) in South Africa.

1.2 Gap and Motivation of the Study

The study intends to provide empirical evidence on the commonality in liquidity in South Africa and this was regarded as the study knowledge gap. A study of such nature was previously conducted in developed economies by Fernandez-Amador et al. (2013), but theoretically founded by Chordia et al. (2001). This study can be seen as vital because liquidity is a major problem in African stock markets. In order to resolve the liquidity challenge, the study first needs to investigate factors that drive liquidity. A stock market is a form of financial system such as the banking system, the debt or bond market and the private equity market. These markets altogether promote economic growth and allow firms to raise funds through selling of equity ownership on the stock exchange or borrow funds or working capital through the debt market to finance projects. Stock markets have now become a major source for firms to raise capital and further offer a platform through which individuals may buy ownership of firms without having to interact with them.

The capital markets in Africa are of small size and face many other problems, with illiquidity as the major one. Garcia and Liu (1999) reported liquidity as one of the major factors affecting stock market development. It can be noted that stock markets now constitute an important part of the world financial system, their instability is of a priority to policy makers and it seems relevant to study how monetary policy strategies affect the liquidity of specific stocks. As compared to developed economies, the stock market in African economies is of small size and face liquidity challenges. A liquid capital market is somehow characterized as a market with colossal transactions, which are often executed without any secondary effect on asset prices (Brunnermeier et al., 2008). Portfolio investment in the Sub-Saharan African (SSA) countries is mainly focused on the most active and liquid stock markets: those are for example, South Africa, Nigeria, Kenya, Mauritius and Zimbabwe. The dominant of all of them is the Johannesburg Stock Exchange (JSE), which accounts for 38% in terms of listed companies and 83% in terms of total market capitalization in the SSA countries. There is a relationship between liquidity and economic growth as argued by Chipaumire and Ngirande (2014); who also indicate that the capital market is seen, especially in the African economies, as the driver of domestic saving and increasing quantity and quality of investment.

Despite the level of development, low liquidity is still one of the prominent elements in the study of capital market development when it comes to empirical studies of capital markets in Africa. However, stock markets in Africa have significantly contributed to the financing of the biggest corporations in Africa, but market

integration as well as well-established institutions are highly needed as policy tools to solve the low liquidity problem of the African stock markets (Yartey and Adjasi, 2007)**.** The lack of empirical investigation on the relationship between monetary policy and stock market liquidity in emerging economies is what motivated this study. The study provides empirical evidence on the relationship and compares the findings to the ones documented for developed economies.

1.3 Statement of the Problem

Amihud and Mendelson (1986) found that illiquidity and stock returns are related, their work was one of the first to have established this relationship. This is now intensively investigated and many researchers in the area have focused on developed economies while almost no attention is given to emerging and developing economies. In the context of African capital markets, only the relationship between returns and liquidity has been investigated, for example, the work of Assefa and Mollick (2014) documents on the relationship between stock market returns and liquidity, they found that stock returns and liquidity are positively related when South Africa is excluded from the selected countries.

To our knowledge, the relationship between monetary policy and stock market liquidity has not been investigated in South Africa. Therefore, it is very important to study the impact of monetary policy on the liquidity of stocks. In other words, "what is the impact of monetary policy on the stock exchange micro (stock specific) liquidity or macro (portfolio or all share index) liquidity?'' This same impact analysis is investigated by Florackis et al. (2014), but they use the bond market as the driver of macro liquidity, which in-turn, impacts the pricing and the liquidity of equity markets. Very few studies have specifically focused on the impact of monetary policy on liquidity as compared to the abundant work on the relationship between liquidity and returns in Africa.

1.4 Objectives of the Study

The literature is dominated by the relationship between returns and liquidity, but the underlying factors driving the liquidity itself are ignored in the emerging market economies like the South African economy. The main focus of this study is to explore the impact of monetary policy, as proxied by money supply, which includes broad money (M3) and the other measure by a policy rule such as Taylor rule in South Africa. Our study is focused on South Africa where M3 has been the main monetary policy instrument before the introduction of inflation targeting by the South African Reserve Bank (SARB) as a policy strategy in February 2000. M3 also includes time deposits, short-term repurchase agreements and many other large and liquid assets.

This study focuses on stocks listed on the Johannesburg Stock Exchange (JSE) and studies their reaction to monetary policy. This study is different from the work of

Fernandez-Amador et al. (2014) and Florackis et al. (2014) because it is performed in an emerging economy while theirs focuses on developed economies. For example, Florackis et al. (2014) studied that bond markets behave as the first receiver of macro liquidity shock that is later transmitted into the stock market. The study estimates a Taylor rule that is augmented with a financial indicator adapted from Naraidoo and Paya (2012) as compared to Fernandez-Amador (2014) who estimated a closed economy Taylor rule. Furthermore, the study focuses on the following il/liquidity measures and these are: trading volume, turnover ratio, Amihud (2002) illiquidity measure, turnover price impact measure by Florackis et al. (2011), Roll (1984) impact of stock, Roll (1984) relative impact of stock and finally Amihud and Mendelson (1986) transaction costs measure. The illiquidity measure is basically the ratio of bid-ask spread divided by the average of bid-ask prices.

1.5 Research question

The question that the study intends to answer in this study is: What is the impact of monetary policy as measured by the growth rate of M3 and monetary stance from Taylor rule on stock specific liquidity and portfolio liquidity? To answer this question, the study follows Fernandez-Amador et al. (2013) and formulates two models. We use panel regression analysis to investigate stock specific liquidity and VAR impulse response analysis to investigate the portfolio liquidity. The following section explores the literature on the relationship between monetary policy and stock market liquidity.

Chapter 2: Literature Review

2.1 Introduction

This section of the study reviewed the existing literature associated with the relationship between monetary policy and stock market liquidity. However, the most dominant literature in existence relates to monetary policy and stock prices and not the liquidity of stocks. The chapter reviewed the theory behind commonality in liquidity; this is done from monetary policy aspect and inventory paradigm aspect and also reviewed the empirical studies on the relationship liquidity and monetary policy. Finally, we present the role of liquidity and the relationship between monetary policy and liquidity in emerging economies.

2.2 Theoretical Foundation: Commonality in Liquidity and Inventory Paradigm

Commonality in liquidity as illustrated by Chordia et al. (2000) and Hasbrouck and Seppi (2001), is further extended by Coughenour and Saad (2004). The former provide more understanding on the theory while the later explain the economic source of commonality in liquidity. Coughenour and Saad (2004) studied that, adjustments that emanate from common factors in liquidity stands out because security traders in each firm trade from a common pool of capital and therefore share information related to profit and inventories. As they explained, commonality in liquidity emanates from common variation in demand and supply of liquidity. Coughenour and Saad (2004) further argued that, commonality in liquidity that is generated from demand side could be related to a common factor that stimulates systematic variation in the desire to transact while commonality in liquidity that is generated from the supply side may be related to systematic variation in the costs of supplying liquidity. According to Chordia et al (2000), the sources of commonality in liquidity are not limited to demand and supply factors, but program trading of simultaneous large orders might also excrete common pressure on dealers' inventories. So, inventories and information asymmetry are common factors that influence liquidity of securities.

Karolyi, Lee and Dijk (2012) also studied the cross-country variation of commonality in liquidity. They particularly investigated the supply side factors and the demand side factors while previous findings point at the funding constraint of financial intermediaries as a supply side factor (for example Hasbrouck and Seppi, 2001) while correlated trading activities, level of institutional ownership and investors' sentiment were found to be demand side factors (Koch, Ruenzi and Startks, 2016). The theory behind commonality in liquidity is often developed with attached empirical evidence. The liquidity of financial markets is the ability to quickly sell an asset without having to reduce its price very much or even at all. However, Amihud et al. (2005) put it in a very simple term and define it as '' the ease of trading''. The

relationship between monetary policy and the level of stock market return or specific asset return has become one of the most researched areas in macroeconomics and financial market research. It is almost a fact that asset prices react to movement in interest rates as well as other measures of monetary policy, but this depends on the expectations of economic agents.

The theory behind commonality in liquidity as illustrated by Fabre and Frino (2004) suggests that liquidity of specific stocks reacts to the change in industry liquidity. So the question asked here is what common factors drive market-wide liquidity? One important factor as recently studied by Fernandez-Amador et al. (2013) is monetary policy. Monetary policy is seen as a factor that can be used as a common source of variation in the liquidity of securities. They set monetary policy to be a primary determinant and provide empirical evidence to support their view in a number of European financial markets; those are Germany, France and Italy. They found that an expansionary monetary policy has a positive effect on the liquidity of assets while a contractionary monetary policy has the opposite effect.

Further, inventory risk can be looked at from two perspectives: a) inventory risk from economic source and b) inventory risk from changing stocks or from market microstructure perspective. First, from the production perspective, inventories are known to play a significant role in the performance of firms. They are utilised to smooth production, sales and can also be used to smooth the cost of production (Blanchard, 1983). Furthermore, inventories are also seen as working capital for firms. It has been shown that firms, to finance new projects, borrow from banks or sell stock of finished goods inventories to smooth liquidity and avoid over borrowing. So, inventory provides liquidity in the production process and is therefore a link to the performance of the firm. However when the study considers moving from the production system and consider the cost of inventory holding, the study may establish a relationship between liquidity of stock and inventory management. Zero inventory paradigms have been developed in order to assess firms' performance. But what is Inventory paradigm? This was well explained in Hall (1983), where Japanese firms' performance was studied in relation to the level of inventory they were holding. It was also found that the most performing firms amongst the Japanese manufacturing firms were holding a low level of inventories. For more clarity, in holding inventories, firms need to borrow to cover the cost of holding, which is further related to the market rate. Thus, if all firms hold inventory and all borrow at the market rate to cover the cost of holding ; this implies that the cost of holding inventories may be correlated across securities due to the fact all firms borrow at the market rate to manage inventories (Chordia et al. 2001). This may be regarded as the inventory risk from economic sources.

Second, inventory risk from changing stocks or from market microstructure as explained by Qin (2007) state that inventory turnover and inventory risk affect stock market liquidity. To support the inventory paradigm, Brunnermeier and Pedersen (2009) establish a relationship between the liquidity of assets and traders' ability to

obtain funding for liquidity. Because traders' funding depends on market's liquidity, the destabilizing forces behind margin requirements create liquidity spirals. This arises because of information asymmetry between financial intermediaries and traders as described in Chordia et al. (2000). The nonlinearity between traders' capital and market liquidity arises because of the interdependence between traders' liquidity and market liquidity. Inventory risk is one of the risks that markets liquidity providers face (these are traders). Traders' profit comes from the interaction between sellers of security and buyers of securities and they do so by incurring inventory risk (Stoll, 1978), but inventory risk is also affected by the security risk if the price of the security is too volatile.

The study can imagine the same for monetary policy as conducted by the central bank, because the central bank directly affects the prime rate. So indirectly, economic cost of holding inventory and inventory risk that emanates from changing security may be seen as a common factor that drive liquidity while monetary policy may be seen as a direct mechanism or common factor that affects liquidity due to its direct effect on the prime rate. Obermaier and Donhauser (2011) studied the relationship between zero inventory paradigms and how firms perform. In other words, they analysed the effect of inventory holding on firms' performance. They found that firms that do not perform well are those with small amount of inventory and reject the paradigm of zero inventories.

In summary, the commonality in liquidity is understood as factors that securities have, as the same source of variation. Examples of these common factors are monetary policy, the economic cost of holding inventories and the inventory risk that emanates from changing securities. Furthermore, the supply side factor that may stimulate correlated variation in security liquidity is found to be a constraint of financial intermediaries while demand side factors are correlated trading activities, level of institutions ownership and investors' sentiment. The following section reviews empirical evidence on the commonality in liquidity.

2.3 Empirical Relationship between Liquidity and Monetary Policy

Cao and Wei (2010) conducted a study on the options market liquidity and further documented on commonality in liquidity of options market liquidity. They found that small firms exhibit more commonality in option liquidity. They also found that information asymmetry plays a much more significant role than inventories in explaining commonality in options liquidity. Pukthuanthong-Le and Visaltanachoti (2009) also investigated commonality in liquidity in Thailand. They found that, industry level commonality is stronger than market wide commonality. The results of Pukthuanthong-Le and Visaltanachoti (2009) had previously been provided by Dennis and Chung (2002). They found that commonality in liquidity is present at both

industry level and also market-wide level. **I**n other to support the theory of commonality in liquidity, Chu (2015) investigated the impact of central bank policy on stock market liquidity in China. He used a dynamic copula approach and found the same results as Fernandez-Amador et al. (2013); he concludes that contractionary monetary policy induces less liquidity in assets while expansionary monetary policy is in favour of liquidity. As explained by Chu (2015), the use of dynamic copula approach allows the capturing of asymmetric information and tail dependency.

This study does not specifically focus on commonality in liquidity; however, because monetary policy is identified as a common determinant of liquidity on stock exchanges, commonality in liquidity serves as the theoretical basis for the relationship between monetary policy and liquidity of stocks. The relationship between micro liquidity and macro liquidity has been studied by Florackis et al. (2014). They developed a framework that establishes a relationship between micro and macro liquidity and the stock market. They constructed a micro liquidity measure on a portfolio and extracted the macro liquidity from the meeting days of the monetary policy committee of the Bank of England. They found that, during the recent financial crisis, (2008 financial crisis), the relationship between macro liquidity and micro liquidity has a negative sign, where expansionary monetary policy during the crisis was seen as deteriorating economic prospects.

Treasury bond liquidity and the global equity returns are introduced by Goyenko and Sarkissian (2014). They collected data on 46 markets over 34 years and studied the impact of illiquidity of the US treasuries on the global asset values. They found that the liquidity in the bond market is able to predict equity returns on both developed and emerging economies and further studied that bond market illiquidity can be considered as a proxy for aggregate worldwide risk. In the analysis, they show that the main factor driving macro illiquidity is monetary policy, as a contractionary monetary policy increases the Fed rate and therefore increases bond illiquidity and further illustrate the role of bond illiquidity in equity pricing.

Chordia et al. (2004) documented that stock market liquidity and monetary policy is linked during crises while Lee et al. (2016) investigated the effect of monetary policy announcement on stock market liquidity in Australia. They investigated 146 policy announcements that are made through the media before noon and use a data set from 2001 to 2012. They used quoted spread, effective spread and price impact that are extracted from intraday transaction data and control for trading volume and volatility which may also affect liquidity. They found that all the measures of liquidity increase before the announcement of an expansionary monetary policy. Goyenko and Ukhov (2009) study the relationship between the liquidity of the bond market and stock market. They found that, both the stock market and bond market are related through illiquidity as well as volatility. They used the vector autoregressive analysis with a bi-directional causality analysis. They found that when the stock market is liquid due to a positive shock, the bond market is illiquid, but a positive shock to illiquidity is transmitted via the bond market, the stock market is illiquid as well. They

characterize the difference in the bond and stock market illiquidity as caused by the dynamic response to these markets. They argued that there is no lag in the response of bond market to monetary policy while stock market responds with lag. Furthermore, the bond market, in their study, plays the role of monetary policy transmission into the stock market.

Amihud (2002) studied the relationship between illiquidity and stock returns in the US. He found that expected market illiquidity affects ex-ante stock returns and he concludes that expected excess return can be used as partial representation of illiquidity premium. He measured the stock market illiquidity by using daily ratio of absolute stock return to the volume of the later in dollars and takes the average over a number of periods. This measure is also seen as the price impact measure of illiquidity. Other very good measures of illiquidity mentioned by Amihud (2002) are the bid-ask spread and the probability of information based trading. He reports that illiquidity has a positive and significant impact on expected stock return in the US. Further Pastor and Stambbaugh (2003) also investigated the relationship between liquidity risks and expected stock returns. They tested the hypothesis of whether liquidity can be used as state variable for asset pricing. They found that fluctuations in aggregate liquidity influence expected stock returns.

Furthermore, Datar et al. (1998) reconsidered Amihud and Mendelson's (1986) work on the relationship between liquidity and stock returns and used a different measure of liquidity. They used the turnover ratio: the number of shares traded as a proportion of shares outstanding, to measure liquidity. They found that liquidity plays an important role in the cross-section difference in returns. They also found the result to be persistent after controlling for major determinants of stock returns such as the size of the firm, book to market ratio and the market risk measure. There are advantages of using the turnover ratio as a measure of liquidity compared to other measures. The turnover ratio is better than the bid-ask spread because scholars have reported the later as a poor proxy for illiquidity measure; it does not reflect the actual transaction costs faced by investors. They found that stock returns are decreasing functions of the turnover ratio.

Brennan and Subrahmanyam (1995) studied the empirical relationship between monthly stock returns and measures of liquidity. They estimated measures of liquidity using intraday transaction data and used Fama and French's (1993) factor to adjust for risk. The use of intraday transaction data allowed them to look at both the trade size dependency and the fixed cost of transacting. They found that the explanatory power of bid-ask spreads as measures of illiquidity resides in the effect of the reciprocal of the price level. Mooradian (2010) also investigated the relationship between illiquidity and stock returns. He employed quarterly time series data between 1980 and 2003, but he uses the aggregate commission rate as a measure of illiquidity as it captures trading costs and reflects market illiquidity. As explained by Mooradian, the commission cost matters to portfolio managers, traders as well as empirical researchers who are interested in market efficiency. He found

that the aggregate commission rate is significant over time and positively related to the excess returns of the market portfolio. He further used the vector auto-regressive analysis in order to check the dynamic relationship between stock returns and the aggregate commission rates. He found that, only unexpected changes in the aggregate commission rates affect unexpected stock returns.

Spiegel and Wang (2005) examined the cross-sectional variation in stock returns and idiosyncratic risk using monthly data. They found that returns are an increasing function of idiosyncratic risk but decreasing in liquidity. Li et al. (2014) also investigated whether liquidity and liquidity risk are priced in stock returns in Japan. They used a modified version of Amihud's (2002) illiquidity measure and found evidence of cross-sectional pricing as well as time series pricing. Yau and Ze-To (2016) argued that, liquidity is a crucial factor in the enhancement of firm value and is a critical determinant of equity returns. They found that liquidity can significantly predict future returns on stocks. The effect of liquidity on firms' value has also been investigated by Cheung et al. (2015). They focused on the real estate investment trust (REIT) and found that, corporate governance plays an intermediate role in the transmission of liquidity effect on stock returns and furthermore, the liquidity of the real estate investment trust positively affects firm value.

Chiang and Zheng (2015) tested the relationship between liquidity and excess stock returns in G7 countries using panel regression analysis. They found that market liquidity risk is positively related to excess returns. Not only liquidity, but illiquidity also has an impact on stock returns. Galariotis and Giouvris (2015) also studied the liquidity of stock markets in G7 countries but in general equilibrium models. They investigated how stock market liquidity can induce changes in macroeconomic variables. They found that, liquidity at the national level has low ability in causing changes in aggregate variables. The effect of globalization on liquidity is investigated by Levine and Schmukler (2006). They found evidence of migration which negatively impact liquidity on the domestic stock market. Evidence on the relationship between liquidity and stock returns has been provided on emerging markets. Bekaert et al. (2007) also investigated firms' liquidity in emerging markets. They found that liquidity measured using the proportion of zero average daily firms' returns predict stock returns more significantly than the liquidity measured using the turnover ratio.

The following section takes us through the state of monetary policy in South Africa.

2.4 Monetary Policy in Developing Economies: The Case of South Africa

The primary objective of any central bank in the world is stability of the economy and most importantly price stability. In Africa, there are different exchange rates regimes as well as in developed economies. While South Africa has adopted a flexible exchange rate regime, countries such as Cote D'ivoire, Burkina-Faso, Niger, Benin, Togo, Senegal, Mali and Guinea-Bissau have committed themselves to a managed

fixed exchange rate regime and form a currency union like the European Union. The prime objective behind the exchange rate regime that a country adopts is price stability. The other aspect that central banks worry about is how its policy decision gets transmitted into the real economic activities. The work of Mishkin (1995) provided a short summary of how the action taken by the central bank impacts the economy. Amongst the most accepted transmission channels are asset prices. Any action taken by the central bank on its prime rate affects the market rates, such as short term rates which in turn affect asset prices (Mishkin ,1995).

The liquidity effect of monetary transmission mechanism has been investigated by Christiano and Eichenbaum (1992). The liquidity effect of monetary transmission is such that, a positive shock to monetary growth leads to lower interest rates and an increase in economic activities, this is in contrast to the view of inflationary pressure of positive monetary shock. Not to deviate too much, the objective of this study is to investigate the impact of monetary policy on stock market liquidity. In other words, do shocks to monetary policy measures impact the liquidity of stocks or the buying and selling ability of assets? Before moving to possible answers to that question, the study first reviews the measures of monetary policy in emerging economies with a particular focus on South Africa.

Smal and Jager (2001) provided a review on how the monetary policy transmission works in South Africa. To start with, the modern monetary policy rule which is called inflation targeting was implemented in South Africa for the first time in February (2000). In the South African Reserve Bank Act, No.90 of 1989, the primary objective of the Bank is to protect the value of the currency for long term economic growth. The foundation of monetary policy as formulated by De Kock (1985), outlined the objectives, which are: maintaining a stable financial environment and stable price inflation. To that effect, broad money targeting prevailed before inflation targeting implementation in 2000, but globalization and the interaction of the South African capital market with foreign capital markets forced the SARB monetary policy committee to include more broad targeting instruments. The SARB started considering credit extension, the yield curve level, foreign reserves, rand exchange rate, and fluctuations in the inflation rate as well as the liquidity in the banking sector, (Sals, 1997). What has been the evolution of inflation targeting in emerging economies, including South Africa?

The work of Mishkin (2004) explored the issues that make inflation targeting work in emerging economies with important examples being Brazil and Chile. He acknowledges that inflation targeting is really complicated in emerging economies. The work of Mishkin (2004) went back to the argument of Calvo (2001). Their point is that, too much discretion is a bad thing in the implementation of inflation targeting in emerging economies because of institutional problems that characterise these economies. As redefined by Mishkin (2004), inflation targeting consists of strategies to be taken by the central bank. The first is the public announcement of the target that the reserve bank will commit itself to in the medium and long run. Second, this

commitment becomes a primary goal for the central bank; third, a well-defined strategy in which other macroeconomic variables and not only monetary aggregate and exchange rate are included; fourth, the strategy needs to be transparent using frequent communication with the public and finally; provide accountability for the attainment of the bank's primary objective. Mishkin (2004) added that, a strong fiscal policy, financial and monetary institutions are crucial in successful inflation targeting.

In Africa, it is well documented that, South Africa is one of the most emerged nation with strong institutions. However, from the beginning of 2013 to to-date, the rand/dollar exchange rate has experienced considerable fluctuations. The rand has depreciated considerably reaching R17 to a US dollar in 2016, as compared to a moderate value of R8 to R10 a US dollar in the years before 2013. In such a volatile currency environment, how does the central bank react if their primary goal is to maintain a stable currency value to facilitate financial and price stability? Even before that, some scholars have estimated monetary policy rule in South Africa. The status of policy rule such as the Taylor rule has been documented in South Africa. The work of Woglon (2003) estimated a Taylor rule for the South African economy with specifications for both an open and a closed economy. He found that, the implementation of inflation targeting since 2000 has not led to calm macroeconomic conditions in South Africa. He studied that the central bank reacts flexibly to external shocks to the exchange rate.

In summary, monetary policy implementation in South Africa has been money supply targeting and inflation targeting. The period of aggregate money supply targeting before February 2000, was disturbed by the liberalization of the country's capital market while the period of inflation targeting that started in February 2000 has experienced external shocks to the exchange rate. This study concentrates on the inflation targeting period and the methodology section provides a model for estimating a Taylor rule for South Africa and further defines the models used in investigating the impact of monetary policy on stock market liquidity.

2.5 The Importance of Liquidity in African Stock Markets

The Johannesburg Stock Exchange (JSE) assessed the African capital market liquidity in 2014. They argued that liquidity is low in most of the African stock markets as compared to other international stock markets. Factors that contribute to lack of liquidity in these markets are for example; restricted short selling, absence of retail investors, lack of documentation and standardization, long term holding of pension funds and high transaction costs. The importance of liquidity is further documented by their study and they found liquidity to be the lifeblood that is indispensable to living stock markets. In the absence of liquidity, book values are affected and investors are constrained and may not meet their portfolio requirements.

However, solutions are suggested to improve the liquidity of those African stock markets. The diversity of products is highly recommended while transaction costs must be cut down, and at the same time, private equity investments are encouraged (Chipaumire and Ngirande, 2014). The recommendation of hard currency listing of securities may help in managing risk. Chipaumire and Ngirande (2014) investigated the relationship between stock market liquidity and economic growth in South Africa. They found that regulation, accounting, tax and supervisory systems affect liquidity in South Africa. Choi and Cook (2006) also investigated the relationship between liquidity and macro-economic variables in the Japanese stock markets; they found that the deterioration in the balance sheet of the banking sector that led to credit constraints reduced the ability of investors to take advantage of high returns. Other channels through which liquidity may affect the economy are also documented in their study and they studied that an increase in equity risk is positively associated with transaction costs which in turn may reduce market liquidity.

African stocks markets are small and illiquid, with weak regulatory institutions (Odera, 2012). As argued by Fernandez-Amador et al. (2013), low stock market liquidity is associated with reduced traders' funding liquidity and high margin requirements. Monetary policy may affect market liquidity, as contractionary monetary policy has a negative impact on margin borrowing while expansionary monetary policy increases market liquidly and facilitates margin borrowing.

Chapter 3: Methodology

3.1 Introduction

The relationship between monetary policy and the level of stock market liquidity or specific asset liquidity is not documented for African stock markets; even the most developed capital market in Africa has no deep investigation of this relationship. However the relationship between asset prices and monetary policy has been investigated extensively. As mentioned in the literature review, the most researched areas globally are on the developed parts of the globe and the recent researches in the area of monetary policy and stock market liquidity employed time series methodology such as vector autoregressive (VAR) at aggregate level as well as linear Ordinary Least Squares regression analysis. Studies that used VAR modelling for example are Fernandez-Amador et al., (2013); Chu (2014) and those that employed linear regression are for example Florackis et al. (2014).

This study followed Fernandez-Amador et al. (2013) and Goyenko and Ukhov (2009) in its methodological approach and estimates two models. The first model allowed us to conduct the investigation at a micro level while the second model allowed us to investigate the effect at macro level or the impact of monetary policy on portfolio liquidity. The micro analysis consists of the impact of monetary policy on individual stocks in a dynamic panel regression model. The second model studies the impact at macro level using a VAR impulse response analysis. Before the presentation of the models; we first needed to investigate the monetary policy rule. The study specified and estimated a Taylor rule monetary policy for South Africa and then formulated the monetary policy stance as the difference between actual and fitted values (Cooper et. al, 2016).

3.2 South Africa Reserve Bank and the Period of Inflation Targeting

As argued by Coulibaly (2012), stabilizing output in emerging economies requires the understanding of factors that drive the economies. The literature review as presented in the previous section indicated that, the use of money supply target prevailed before the adoption of inflation targeting that started in 2000 in South Africa. Before the inflation targeting regime, the reserve bank of South Africa focused its monetary policy on targeting M3 starting in the mid-80s until late 90s. Nell (2000) analyses South Africa's money supply for the period 1966-1997. He found that, market oriented policy advocated by the monetarists led the SARB to set a target for the growth rate of M3. He further argued that the target has been stable for the period he studied.

Even though money supply targeting and inflation targeting have dominated central banks' policies, unconventional reserve banks' policies have also been used during

crises and the 2008 financial crisis is an example, (Yehoue et al., 2009). They argued that the use of unconventional foreign exchange and short term liquidity as easing measures for monetary policy have prevailed during the 2008 crisis. However, in emerging economies, they pointed out that, unconventional policy strategy is not that relevant because emerging economies do not initiate shocks but are vulnerable to shocks. Ahrend et al. (2008) investigated the relationship between excess returns on markets and financial crises. They found that, periods with relatively low interest rates, which is below Taylor rule target, lead to increases in asset prices. Asset prices may also increase when interest rates are in line with Taylor rule predictions. Further, they found monetary policy to be expansionary during the period 2002-2005.

Is inflation targeting a good policy strategy in emerging economies? Amato and Gerlach (2002) studied that inflation targeting is a good policy for emerging markets. Aron and Muellbauer (2007) also found that the era of inflation targeting in South Africa has significantly improved as compared to the money supply (M3) targeting regime. They also studied that there is little misinformation between the monetary authorities and the private sector. Even though political instability has been the main driver of the recent fluctuation in rand/dollar exchange rate, the exchange rate might be a crucial variable in the South African monetary policy rule. Zettelmeyer (2004) investigated how monetary policy affects the exchange rate in Australia, Canada, and New Zealand using three months market interest rates to identify shocks. They found that contractionary monetary policy leads to appreciation of the exchange rate. In order to depict the effect of monetary policy on stock market liquidity, this study estimates first a Taylor rule for South Africa and further uses the fitted value to construct monetary stance. Because one of the primary objectives of the SARB is stability of the financial markets, the study followed Taylor (2001) and used the following specification for monetary policy rule in South Africa:

$$R_t = \gamma_i(L)R_{t-i} + (1-\gamma_i)\left[\alpha_0 + \beta_\pi E_t\pi_{t+p} + \beta_y E_t\hat{y}_{t+p} + \beta_{fi}E_t\hat{fi}_{t+p}\right] + \epsilon_t \qquad (1)$$

In equation (1), ϵ_t is the monetary policy shock R_t is the nominal interest rate which the study proxy using 3 months treasury bill rate, π_t is the inflation rate computed using consumer price index, $\hat{y}_t$ is output gap which the study proxy using industrial production while $\hat{fi}_t$ is an index for financial indicator gap. Variables such as: y_0, π_0 and fi_0 , are steady state level of output, inflation and financial indicator respectively. The above specification of Taylor rule for monetary policy was adapted from Naraidoo and Paya (2012). They estimated a linear and non-linear Taylor rule for South Africa. Instead of using a simple open economy Taylor rule which adds exchange rate as the open economy variable, they computed a financial indicator using exchange rates, stock prices and housing prices. To compute the financial

indicators, they allocated weights to each variable, where 0.6 was attributed to exchange rate, 0.3 to stock index and 0.1 to housing prices. However, the period 2012 to 2017 which is also after their study has seen a considerable fluctuation in the exchange rate in South Africa. This study therefore removed the weight they allocated to housing prices (only 10%) and added it to the weight of exchange rate. So, housing prices are excluded from the computation of the financial indicator and the study deemed exchange rates and Stock index to be the most important financial indicators. The Taylor rule estimated in this study is shown in equation (2) below.

$$R_t = \beta_0 + \gamma_1 R_{t-1} + \gamma_2 R_{t-2} + \gamma_\pi \pi_t + \gamma_y \hat{y}_t + \gamma_{fi} \widehat{fi}_t + \epsilon_t \quad (2)$$

Where β_0 is equal to $\beta_0 = (1-\gamma_i)\alpha_0 = (1-\gamma_i)(R - \beta_\pi \pi_0)$

$$m_t = \frac{M3_t - M3_{t-12}}{M3_{t-12}} * 100 \quad (3)$$

The second measure of monetary policy utilized in this study is the growth rate of M3. The growth rate is an annualized computation. The equation (3) above illustrates the computation of the growth rate of M3.The second measure of monetary policy in South Africa in (3) above is specified following Fernandez-Amador et al. (2013). The variable $\boldsymbol{m_t}$ stands for the annualized growth of money supply which is computed using monthly data. The measures of liquidity which are presented in the following section.

3.3 Measures of Liquidity and Illiquidity

Following Fernandez-Amador et al. (2013) and Goyenko and Ukhov (2009), the following variables are chosen as liquidity measures: trading volume, turnover ratio, Amihud (2002) illiquidity measure, turnover, price impact measure by Florackis et al. (2010), Roll (1984) impact of stock, Roll (1984) relative impact of stock and finally Amihud and Mendelson (1986) transaction costs measure, which is illustrated in equation (4) below. The study follows Chordia et al. (2004) and Datar et al. (1998) in choosing the liquidity variables. The main goal this study is to examine the relationship between monetary policy and stock market liquidity, we therefore employed the same liquidity and illiquidity variables as Fernandez-Amador et al. (2013). These variables are used in the panel model and the impulse response function analysis as well.

However, the only liquidity variables in the seven are turnover ratio and trade volume; all the remaining five are considered as illiquidity variables. Brennam and Subrahmanyam (1995) also use those two as liquidity measures. The following equation illustrates how the illiquidity variables are computed.

- ✓ Amihud (2002) illiquidity measure:

$$AI_{iym} = \frac{|R_{iyd}|}{TV_{iyd}} \quad (4)$$

In equation (4), the left hand side AI_{iym} is the Amihud (2002) illiquidity measure, the numerator on the right hand side is the return of stock i in year y and on the day d, the denominator also converts the same information, but TV stands for trade volume.

- ✓ Florackis et al. (2010) turnover price impact measure

$$TPI_{iyd} = \frac{|R_{iyd}|}{TOR_{iyd}} \quad (5)$$

In equation (5), the left hand side TPI_{iyd} is Florackis et al. (2010) turnover price impact measure, the numerator on the right hand side is the return of stock i in year y and on the day d, the denominator also converts the same information, but TOR stands for turnover.

- ✓ Roll (1984) impact of stock or price impact developed by Goyenko et al. (2009)

$$RPI_{iym} = \frac{Roll_{iyd}}{TV_{iyd}} \quad (6)$$

In equation (6), the left hand side RPI_{iym} is Roll (1984) price impact measure developed by Goyenko et al. (2009). The numerator in (6) is the Roll (1984) spread which is calculated as, $Roll_{iyd} = 2\sqrt{-cov(\Delta P_t, \Delta P_{t-1})}$, with P_t , the price of the security. Roll's (1984) spread is positive when $cov(\Delta P_t, \Delta P_{t-1} < 0$, otherwise it takes value zero.

- ✓ Roll (1984) relative impact of stock (or transaction costs measure)

$$RPI_{iym} = \frac{Roll_{iyd}}{P_{iyd}} \quad (7)$$

Equation (7) is Roll (1984) relative impact of stock measure which is often referred to as transaction costs measure.

- ✓ Amihud and Mendelson (1986) transaction costs measure

$$Spread = \frac{P_{ask} - P_{bid}}{\frac{1}{2}(P_{ask} + P_{bid})} \quad (8)$$

In equation (8), P_{ask} is asking price while P_{bid} is bid price. Before moving to the data section, we present the expected signs of each liquidity and illiquidity measure with

respect to the monetary policy measures. The following equation (9) is an aggregator presented in Fernandez-Amador et al. (2013), this is used to compute the monthly liquidity or illiquidity measure.

$$liq_{ym} = \frac{1}{n_{ym}} \sum_{i=1}^{n_{ym}} liq_{iym} \quad (9)$$

On the left hand side of (9), liq_{ym} is the monthly aggregate liquidity. Before moving to the empirical result analysis, we first present the expected signs with respect to each monetary policy measure as illustrated in table 3.1 below.

Table 3.1: Expected signs of (il)liquidity measures

Variables	Abbreviations	m_t	$\widehat{R}_t$
Turnover ratio	TOR	+	-
Trade volume	TV	+	-
Amihud (2002) illiquidity measure	AI	-	+
Florackis et al. (2010) turnover price impact measure	TPI	-	+
Roll (1984) impact of stock	RTC	-	+
Roll (1984) relative impact of stock	RPI	-	+
Amihud and Mendelson (1986) transaction costs measure	AMTC	-	+

The basis of monetary policy states that: an increase in money supply leads to a decrease in interest rate. In other words, higher growth rate of M3 leads to low interest rate, which we expect to have a negative impact on the illiquidity variables but positive impact on the liquidity variables. On the other hand, the monetary stance computed using Taylor rule indicates that a contractionary monetary policy or increase in the interest rate above its targeted level affects market rates and then is transmitted into asset prices (Mishkin, 1995). Asset prices however constitute a transmission mechanism for monetary policy. This low liquidity is transmitted into asset prices thereby reducing the ability or the speed of transactions (in other words, higher transaction costs) because higher interest rate leads to low equity prices. So, a higher monetary stance is expected to have a negative impact on liquidity measures such as turnover and trading volume, but a positive effect on illiquidity measures. The following subsection presents the models, both the panel model and the vector autoregressive model.

3.4 The Model

The first part of the model focuses on the impact of monetary policy on individual stocks on the JSE. We use the exact same specification as in Fernandez-Amador et

al. (2013) but modified the control variables. We first estimate a panel fixed effect model to investigate the impact of monetary policy on stock specific liquidity and VAR impulse response for the equally weighted portfolio. Twelve stocks are selected from the Johannesburg Stock Exchange. This is a random sample of stocks, but we avoid financial stocks, as they also play a significant role in the creation of money and affect the direction of monetary policy. For the macro level analysis, we use the selected stocks and construct an equally weighted portfolio. The regression model for stock specific effect is specified in equation (10) below.

$$l_{it} = \alpha + \beta_1 l_{it-1} + \beta_2 mp_{t-1} + \beta_3 Jse_{it-1} + \beta_4 zarusd_{t-1} + \beta_5 Inf_{t-1} + \beta_6 \sigma_{it-1} + \vartheta_{it} \quad (10)$$

Equation (10) states the relationship between il/liquidity variables on the LHS as a function of lag liquidity or illiquidity, lag monetary policy measure, lag JSE all share index as a control variable, lag zarusd exchange rate as a control variable, lag inflation rate as a control variable and lag volatility of the stock as a control variable. South Africa is an emerging market, and because developing and emerging economies care more about the movement in exchange rate as they export more raw materials, we therefore include exchange rate as one of the control variables because it captures the particularity of emerging economies.

In equation (10), l_{it} is the dependent variable, which can be liquidity or an illiquidity variable, l_{it-1} is lag dependent variable. The control variables are Inf_{t-1} lag inflation, mp_{t-1} lag monetary policy variable, σ_{it-1} lag volatility, $zarusd_{t-1}$ lag exchange rate and Jse_{it-1} lag of the Johannesburg all share index. The control variables are specified in terms of firms' specific variables and the aggregate macroeconomic variables. The only firm specific control variable that we include in the model is the standard deviation of daily returns. As compared to Fernandez-Amador et al. (2013) who include lag monthly returns as control variable, we only include monthly standard deviation of daily returns because there might be a correlation between the return variable and the standard deviation. The latter is known to be calculated using the former. The monetary policy measures we use in this study are growth rate of money supply M3 and the monetary stance computed from the estimated Taylor rule.

As illustrated by Fernandez-Amador et al. (2013) and in order to account for time-invariant stock specific determinants, they estimated within fixed effect estimator. Our approach is a bit different from theirs as we test for random and fixed effect before running the regressions.

We now follow Goyenko and Ukhov (2009) and Chordia et al. (2001) and define the macro-level model as follows:

$$y_t = \alpha + By_{t-1} + \varepsilon_t \quad (11)$$

In Equation (11), the left hand side is a vector of endogenous variables; those are inflation rate π_t , monetary policy measure MP_t and the liquidity or illiquidity measures. We expand equation (11) and write it in the form of matrix as presented in equation (12) below.

$$\begin{pmatrix} \pi_t \\ MP_t \\ li_t \end{pmatrix} = \begin{pmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{pmatrix} + B \begin{pmatrix} \pi_{t-1} \\ MP_{t-1} \\ li_{t-1} \end{pmatrix} + \begin{pmatrix} \varepsilon_t^{\pi} \\ \varepsilon_t^{MP} \\ \varepsilon_t^{li} \end{pmatrix} \quad (12)$$

Equation (8) is the VAR model that we use for impulse response analysis. The first term on the right hand side of (8) is a vector of constants and the last term is a vector of residuals. Because we have seven measures of liquidity, seven times two groups of impulse response functions are provided.

3.5 Data

The data employed in this study is obtained from Bloomberg and the South African Reserve Bank (SARB) website. Variables such as industrial production and consumer price index are obtained from SARB while stock prices, bid-ask prices and ZAR/USD exchange rate are obtained from Bloomberg. The data set range is from February 2000 to May 2017. First of all, our Taylor rule model includes a financial indicator variable; this variable is computed following Naraidoo and Paya (2012). These scholars weighted the nominal exchange rate by 0.6 and the stock market by 0.3 while housing prices by 0.1. However, we disregard the impact of housing prices in the computation of the financial indicators. We only consider the stock market and the exchange rate (that is ZAR/USD exchange rate) in the computation of the financial indicator. We maintain the 0.6 as in Naraidoo and Paya (2012) for the ZAR/USD exchange rate and use 0.4 for the stock market.

For the panel regression model, twelve stocks are selected while an equally weighted portfolio (so equally weighted liquidity and illiquidity measures) is constructed for the VAR impulse response analysis using the selected stocks. Individuals stocks' liquidity measures are used to compute the equally weighted aggregate liquidity and the equally weighted stock specific control variable which is the standard deviation. The movement in prices of the selected stocks is illustrated in figure 3.2 below. Table 3.2 below presents the descriptive statistics of panel liquidity and illiquidity variables while table 3.3 presents the descriptive statistics of equally weighted portfolio liquidity and illiquidity. Table 3.4 presents the descriptive statistics of the control variables. In the descriptive statistic table 3.2, TV is trade volume, TOR is turnover ratio, TPI is turnover price impact, AMTC is Amihud and Mendelson

transaction costs, RPI is Roll Price impact measure, RTC is Roll (1984) transaction costs and AI is Amihud (2002) illiquidity measure.

Table 3.2 Descriptive statistics of panel liquidity and illiquidity variables

	TV	TOR	TPI	AMTC	RPI	RTC	AI
Mean	3.43	3.25	0.12	0.01	0.07	0.02	0.05
Median	2.34	1.71	0.00	0.00	0.03	0.00	0.00
Max	39.50	40.70	187.59	0.43	0.62	0.68	68.34
Mini	1.75	2.76	0.00	-0.07	0.00	0.00	0.00
Std.	3.87	4.33	3.93	0.03	0.11	0.06	1.41
Skew	2.77	2.38	44.74	7.70	2.70	5.86	46.48
Kurt	14.38	10.24	2094.36	74.11	10.74	47.38	2248.52
JB	16564.98	7764.61	4.54	547898.80	9234.46	218033.70	5.23
Obs	2484	2484	2484	2484	2484	2484	2484

Source: Own computation

Trade volumes are in 10 billions while turnover is in 100 billions. For the period under consideration, the mean of the liquidity and illiquidity variables are 3.43 for the trade volume, 3.25 for turnover, 0.12 for turnover price impact, 0.01 for Amihud and Mendelson (1986) transaction costs, 0.07 for Roll price impact, 0.02 for Roll(1984) transaction costs and 0.05 for Amihud illiquidity. Apart from Amihud and Mendelson (1986) transaction costs measure that show a negative minimum, all other illiquidity variables display zero as the minimum value for the period.

Table 3.3 Descriptive statistics of aggregate liquidity and illiquidity variables

	AMTC	AI	RPI	RTC	TPI
Mean	0.00	0.00	0.05	0.03	6.37
Median	0.00	0.00	0.03	0.02	1.94
Max	0.02	0.01	0.23	0.07	0.00
Min	3.88	0.00	0.01	0.01	0.00
Std D	0.00	0.00	0.05	0.01	1.63
Skew	1.72	2.41	1.76	1.45	7.80
Kurt	6.36	14.01	5.76	6.20	80.07
JB	198.92	1246.54	173.20	161.00	53334.83
Obs	207	207	207	207	207

Source: Own computation

For the aggregate liquidity and illiquidity variables, the Amihud and Mendelson (1986) transaction costs measure fluctuated between 0.00 and 0.02 while the Amihud (2002) illiquidity fluctuated between 0.00 and 0.01. The Roll (1984) price impact illiquidity fluctuated between 0.01 and 0.23 while Roll (1984) transaction costs fluctuated between 0.01 and 0.06. The turnover price impact fluctuated between 0.00 and 0.002. The mean volatility is 31.95 while the volatility measure fluctuated between 13.39 and 99.62. The average inflation for the chosen period is 5.62% but inflation went to a maximum of 12.19% with the lowest inflation rate during 2000 and May 2017 is 0%. The mean of the South African rand to the Untied State dollar exchange is 8.90 for the period. Exchange rate fluctuated between 5.66 and 15.89 for the period. The all share price index fluctuated between R751 and R5444 for the period with an average of R2852.

Table 3.4 Descriptive statistics of control variables for equally weighted portfolio

	VOLATILITY	INFLATION	JSE	ZARUSD
Mean	31.96	0.06	28.52	8.90
Median	30.50	0.06	27.95	7.98
Max	99.63	0.12	54.44	15.89
Min	13.40	0.00	7.51	5.67
Std.	12.65	0.02	15.07	2.49
Skew	1.88	0.42	0.25	1.04
Kurt	9.38	3.75	1.82	3.16
JB	447.14	10.34	13.48	35.52
Obs	196	196	196	196

Source: Own computation

We have plotted the equally weighted portfolio liquidity and illiquidity variables on figure 3.1 below. The Amihud (2002) illiquidity measure shows volatile behaviour between 2000 and 2006 but calm during the financial crisis while the period 2014-2017 also shows greater volatility. Amihud and Mendelson (1986) transaction costs measure show greater volatility throughout the period.

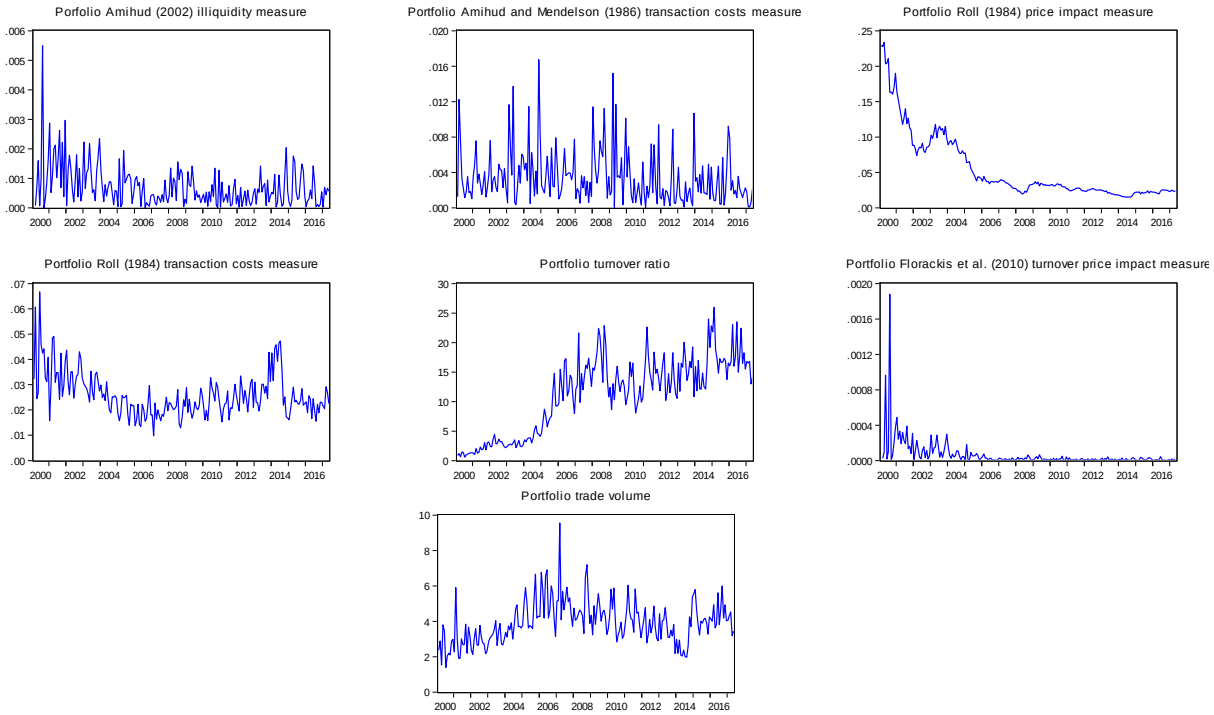


Fig 3.1 Liquidity and illiquidity measures

When we plot the Roll (1984) price impact measure, it shows a downward trending behaviour while Roll (1984) transaction costs measure show periodic trend. Between 2000 and 2006, the Roll (1984) transaction costs measure shows a downward trend while the period 2008-2014 shows an upward trend with a volatile behaviour between 2015 and 2017. When we look at the price impact measure, it shows a very volatile behaviour between 2000 and 2004 but remain smooth for the remaining period under consideration.

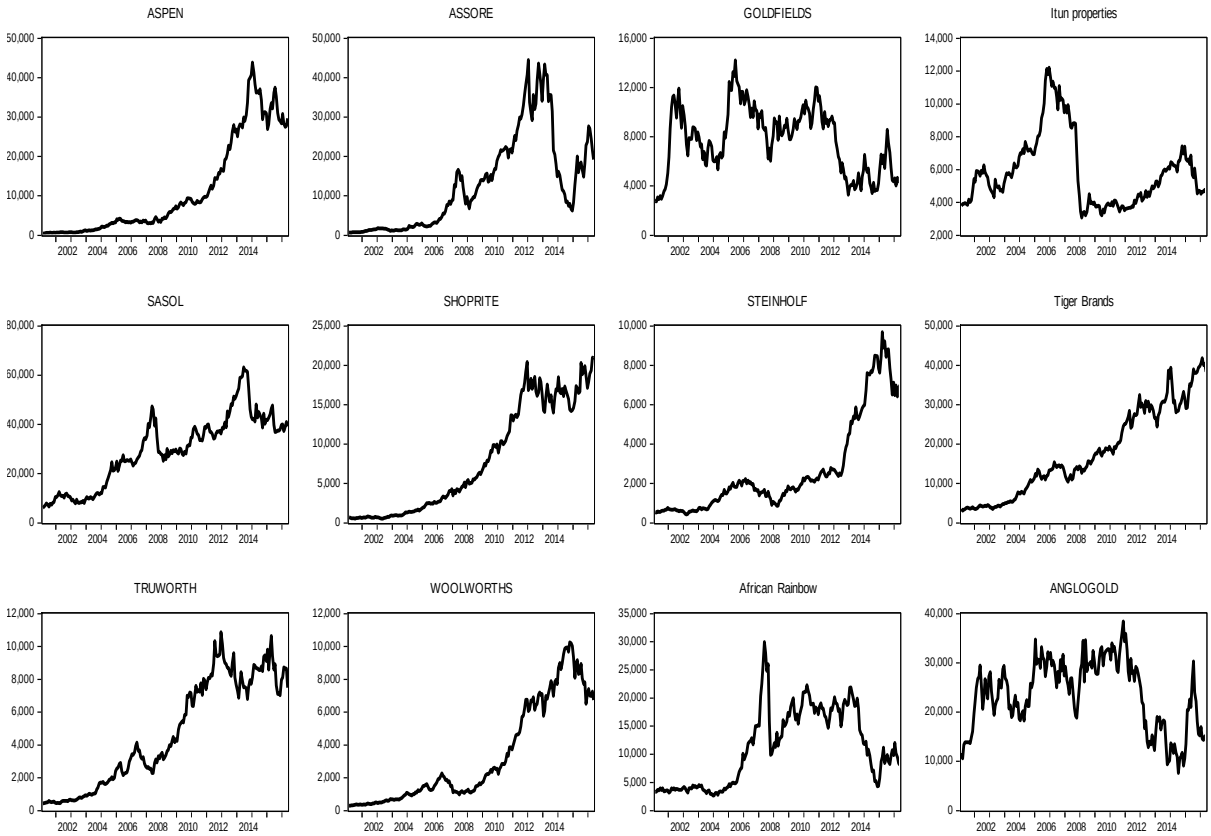


Fig.3.2 Prices of individual stocks

The above figure 3.2 illustrates the price behaviour of the twelve stocks. The most volatile stock amongst the twelve is Goldfield, African Rainbow and AngloGold. Aspen, Assore, Shoprite, Woolworth, and Truworths, Steinholf, and Tiger brand shows an upward trending before the financial crisis of 2008 and have been volatile thereafter.

Chapter 4: Empirical Results

4.1 Introduction

The first part of the results analysis presents the Taylor rule for South Africa that we estimate, and unit root tests for the panel model and the time series control variables. The second part of the results analysis presents the panel regression estimates and the VAR impulse response analysis.

4.2 Taylor Rule and Unit Root Test.

We start with the Taylor rule results of the variables that enter the regression model of Taylor rule by first providing descriptive statistics in table 4.1 below. The other variables that enter the Taylor rule model besides industrial production are inflation and the financial indicator. Second, we present a graphical illustration of the variables that enter the Taylor rule model. In computing the financial indicator we use return of the JSE all share index and the ZARUSD exchange rate. The inflation rate is computed using the South African consumer price index.

Between January 2000 and May 2017, the monthly inflation rate got to a maximum of 12.19% while its lowest level was 0% on month-to-month basis. Average inflation rate during that period was 5.62%. The Treasury bill rate also got to a maximum of 12.74 percent between 2003 and 2004. When we relate this to the financial indicator that we computed, there is a sharp drop in the same period of higher interest rates. However during the financial crisis, both Treasury bill rate and the inflation rate shoot up with an average of 7.63% for Treasury bill while the inflation rate went to nearly 12%.

Instead of using gross domestic product, we follow Sauer and Sturm (2007) and use industrial production as a proxy for output. This not only allows us to remove the non-productive sector which is the financial sector but also to estimate a Taylor rule using monthly data. On the figure 4.2, the early stage of inflation targeting in South Africa, that is the period 2000 and end 2001, inflation and the financial indicator show a negative relationship with the dynamics of the financial indicator lagging behind the inflation rate.

Table 4.1 Descriptive Statistics of Taylor Rule Model

	Financial indicator	Inflation	TBill	Industrial Production
Mean	0.05	0.06	7.63	8.90
Med	0.07	0.06	7.18	8.98
Max	0.35	0.12	12.74	10.11
Min	-0.42	0.00	4.93	7.81
Std	0.13	0.02	2.08	0.49
Skew	-1.07	0.42	0.77	-0.11
Kurt	4.67	3.75	2.61	2.23
J-B	59.85	10.34	20.55	5.01
Obs	196	196	196	196

Source: Own Computation

One may say that the financial indicator, as weighted stock prices and nominal exchange rate were driven by the price level in the economy. However, from the end of 2002, we observe a positive and dynamic relationship between inflation rate and the financial indicator.

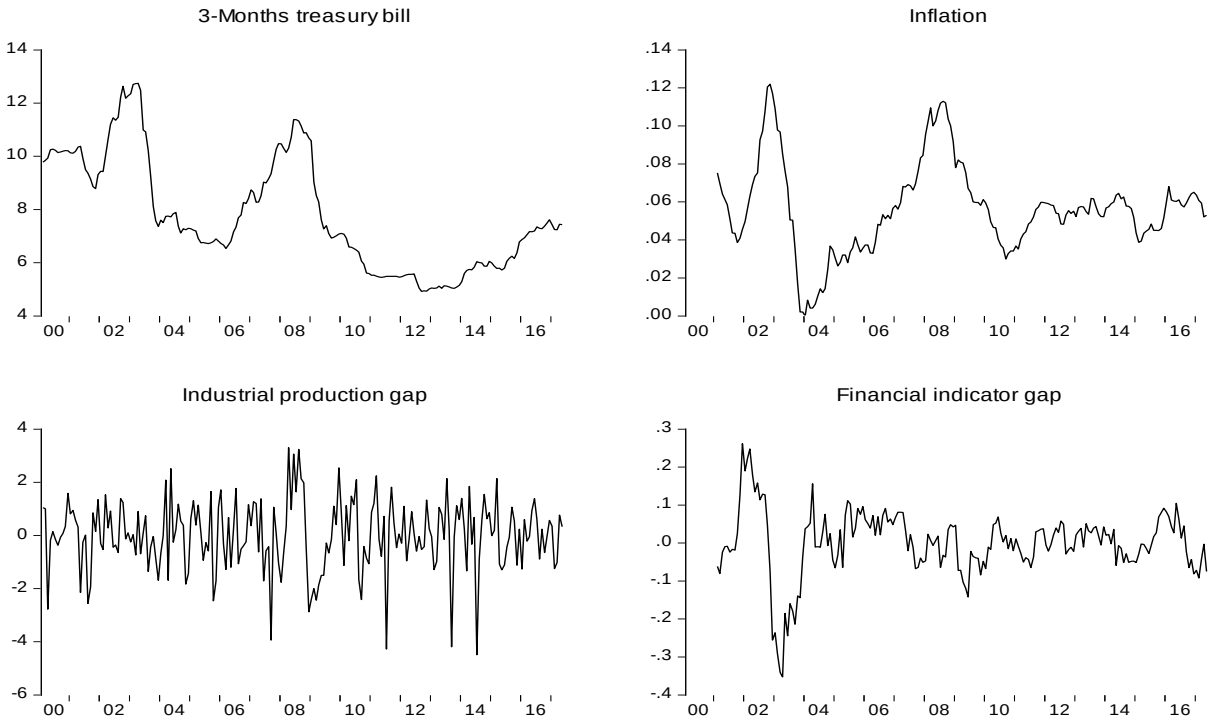


Figure 4.1 Trend of Taylor Rule variables

Between 2002 and 2004 for example, a fall in the financial indicator is followed by a decrease in the inflation rate while the sharp increase in the financial indicator between 2004 and 2008 is also followed by increasing inflation rate between 2005 and 2009.

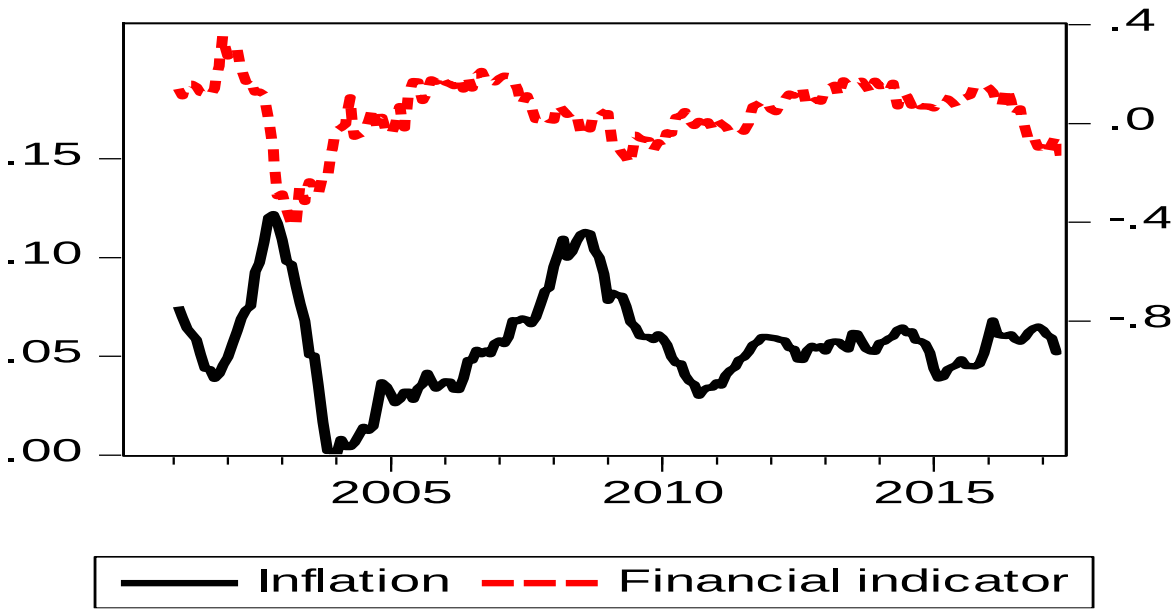


Figure 4.2 Relationship between inflation and financial indicator

The same pattern is observed between 2008 and 2012 and thereafter. Asset prices played a significant role during the period of inflation targeting in South Africa. The role of asset prices in monetary policy rule was first argued by Bernanke and Gertler (2001). The purpose of this study is not the relationship between asset prices and monetary policy, but liquidity and monetary policy. The South African Reserve Bank has indicated the stability of the financial market as one of its primary objectives; therefore we find it relevant to illustrate on the role of a financial indicator in the SARB's policy rules. The result of the Taylor rule that we augmented with a financial indicator following Naraidoo and Paya (2012) is presented in table 4.2 below.

Table 4.1 Taylor rule estimates

	Parameters	t-statistic	Prob	Prob(F-statistic)	R-square	DW
γ_1	1.31***	19.40	0.000			
γ_2	-0.33***	-5.06	0.000			
γ_π	2.47***	1.77	0.077			
γ_y	0.02*	2.62	0.000	0.000	0.98	1.98
γ_{fi}	0.89***	4.06	0.000			

"***" "**" "*", are significant at 1%, 5% and 10% percent respectively, Prob= probabilities

The result indicates that the past treasury bill rates (both, lag one and lag two) are significant at 1% level but with changing signs. Industrial production is significant at 10% level while inflation rate and the financial indicator are both significant at 1% level of significance. The model fits the data well with an Adjusted R-square of 0.98 and the Durbin-Watson statistics of 1.98, which indicates no first order serial correlation. This result confirms the findings of Naraidoo and Paya (2012).The sign of the parameter estimates are the same as in Naraidoo and Paya (2012) with the

exception of negative output gap coefficient similar to the one reported by Woglom (2003). The financial indicator therefore seems to be an important factor in SARB policy rule.

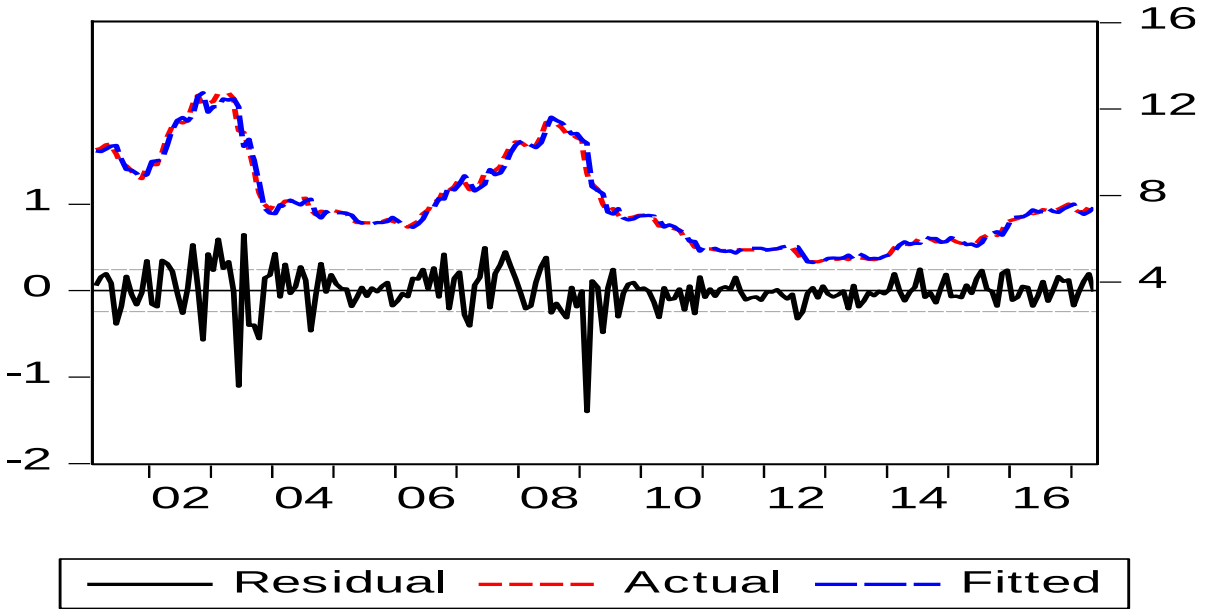


Figure 4.3 Relationship between inflation and the financial indicator

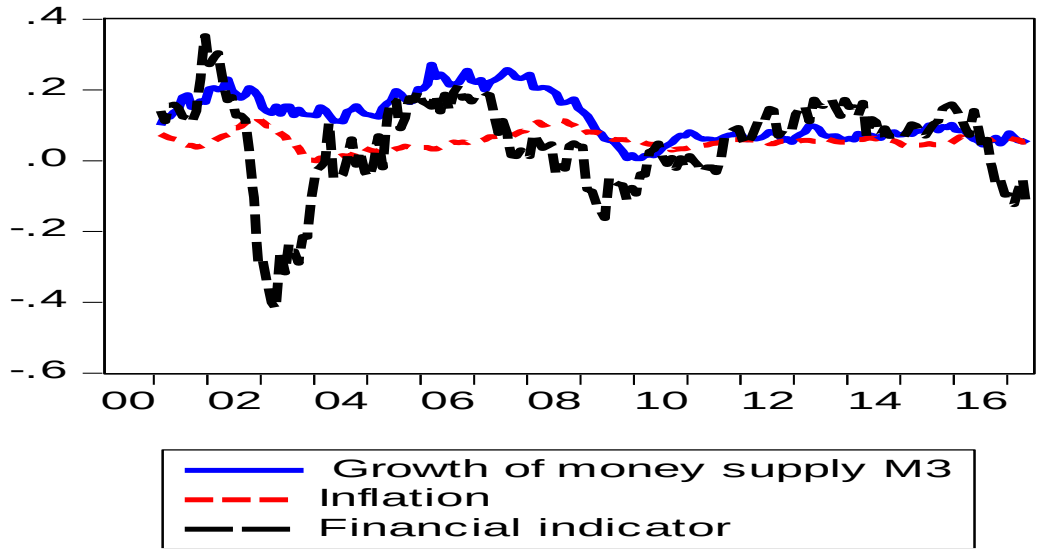


Figure 4.4 Relationship between inflation, financial indicator and money growth

Using the fitted values from the above estimate, we computed the monetary policy stance as the difference between the actual and the fitted values (Cooper et. al, 2016). A graphical illustration is presented on figure 4.3 above. The second measure of monetary policy in this study is the growth rate of M3. On figure 4.4 above, we

observe that money supply increased during 2000 and 2002, which is the early stage of inflation targeting. Further we discover that, the increase in the financial indicator during that period was after the increase in the money supply. We may argue that, the increase in money supply during that period translated into asset prices as inflationary pressure, however, inflation fell during that period because of the central bank's commitment and its new policy strategy of inflation targeting, which consists of publicly announcing a nominal anchor to be achieved in the long run.

Table 4.3 Monetary Policy Measures

	Money supply growth	**Monetary stance**
Mean	0.122	0.000
Median	0.102	-0.002
Maximum	0.272	0.649
Minimum	0.005	-1.399
Std. Dev.	0.066	0.239

Source: Own computation

Focusing on the growth rate of M3, there is a sharp increase between 2000 and 2002, which fell and reach its lowest in 2005. The period 2005 and 2007 also experienced an increase in money supply with a significant drop from end 2008 to the end of 2010. Money supply also increased during 2011 and has since been fluctuating around a constant level for the period 2012-2017. Table 4.3 above shows the descriptive statistics of both monetary policy measures which are the growth rate of M3 and the monetary stance computed from Taylor rule. The methodological approach adopted in this study consists of estimating a fixed/random effect panel regression and VAR impulse analysis for the equally weighted portfolio.

There are various tests for panel unit root analysis for all the seven dependent variables. A number of tests beside the time series Augmented Dickey-Fuller test have been developed for panel unit root analysis. Levin and Lin (1992, 1993) test, Augmented Dickey-Fuller Chi-square test and the Pesaran (2007) are widely used in the analysis of panel data stationarity. The unit root test for the panel data shows that, most of the liquidity and illiquidity variables are not stationary at level, but stationary when the first difference is considered, they are all stationary. The same applies to the time series control variables and the monetary policy measures that we have considered in this study. Because the time range of our data is a bit long, we have chosen to report Augmented Dickey-Fuller Chi-square test. The variables stand as defined in the data section.

Table 4.4 Panel Unit Root Test

Variables	Level			1st Difference		
	ADF			ADF		
	A	B	C	A	B	C
TOR	27.16	62.12***	22.25	812.94***	767.15***	920*79***
TV	60.64***	109.60***	25.57*			
AI	182.37***	251.08***	153.44***			
TPI	173.86***	196.40***	201.26***			
RTC	67.51***	66.78***	66.90***			
RPI	45.34***	18.03	97.58***			
AMTC	199.26***	26.54***	115.81***			

ADF= Augmented Dickey-Fuller Chi-square test, A=intercept, B = intercept & trend, C = no intercept no trend
''***''**''*'' are significant at 1%, 5% and 10% respectively

The panel unit root test shows that the turnover ratio is stationary only after 1st difference is taken, all the other liquidity and illiquidity variables are stationary at level.

4.5 Control Variables and Monetary Policy Variables Unit Root

Variables	Level			1st Difference		
	ADF			ADF		
	A	B	C	A	B	C
VOLATILITY	5.59***	5.79***	1.74*			
INFLATION	1.91	1.90	0.82	7.24***	7.23***	7.26***
ZARUSD	0.87	1.52	0.80	14.14***	14.13***	14.10***
JSE	0.07	2.42	2.45	15.90***	15.90***	15.30***
MP(TR)	13.78***	13.82***	13.83***			
MP(M)	1.42	2.49	0.84	14.78***	14.76***	14.81***

ADF= Augmented Dickey-Fuller Chi-square test, A=intercept, B = intercept & trend, C = no intercept no trend
''***''**''*'' are significant at 1%, 5% and 10% respectively

When we come to the control variables and monetary stance, the results show that monetary policy computed from the Taylor rule MP (TR) is stationary at level while the growth rate of money supply MP (M) is stationary after 1st difference. For the control variables, volatility is stationary at level but, inflation rate, zarusd exchange rate and the JSE all share index are all stationary after 1st difference is taken.

4.3 Panel Regression Estimates

We first perform the Hausman test on the different liquidity and illiquidity measures and the results are presented in table 4.6 below. The last column of table 4.6 and 4.7 show the appropriate models after the Hausman test is performed. Table 4.6 shows the results when money supply is considered and table 4.7 shows the results when monetary stance is considered. The results revealed that estimating random effect is best for turnover while fixed effect is good for trade volume. For the illiquidity variables, random effect is found to be good for four of the illiquidity variables while fixed effect is good for Amihud and Mendelson (1986b) transaction costs.

Table 4.6: Hausman test for random/fixed effect (with growth rate of money supply)

Models tested	Chi-Sq statistic	Prob	Appropriate Model
Turnover ratio	0.00	1.00	Random
Trade volume	65.33	0.00	Fixed
Amihud (2002) illiquidity measure	10.98	0.09	Random
Florackis et al. (2010)	7.92	0.24	Random
Roll (1984) impact of stock	2.79	0.83	Random
Roll (1984) relative impact of stock	0.00	1.00	Random
Amihud and Mendelson (1986)	38.03	0.00	Fixed

Table 4.7: Hausman test for random/fixed effect (with monetary policy stance)

Models tested	Chi-Sq statistic	Prob	Appropriate Model
Turnover ratio	0.95	0.99	Random
Trade volume	64.75	0.00	Fixed
Amihud (2002) illiquidity measure	10.31	0.11	Random
Florackis et al. (2010)	7.00	0.32	Random
Roll (1984) impact of stock	1.76	0.94	Random
Roll (1984) relative impact of stock	0.00	1.00	Random
Amihud and Mendelson (1986)	36.14	0.00	Fixed

4.3.1 Panel results discussion (Growth rate of money)

The parameters as presented in table 4.8 are in the same order as presented in equation (10), the panel model that we presented in Chapter 3. The first parameter β_1 is the coefficient of lag liquidity (the dependent variable). The second parameter is the coefficient of monetary policy measure; the third parameter captures the effect of all share index while the fourth parameter is the coefficient of the zarusd exchange rate. The fifth parameter captures the effect of inflation while the last parameter captures the effect of stock specific volatility. The values that are not in brackets represent the coefficient estimated and the values in brackets are the t-statistics of the estimated coefficients. Seven different models are presented in each table; each model corresponds to each liquidity variable. Table 4.9 has the same characteristics as table 4.8 and presents the results when monetary stance is used as a monetary policy measure while table 4.8 contains the results when the growth rate of money supply is used as a monetary policy measure. The models estimated are illustrated by the liquidity or the illiquidity variable.

When we consider the model estimated with turnover as dependent variable, the result shows that lag turnover is negative but significant at 1% level of significance. We expected the money supply to exhibit positive effect on liquidity variables. The coefficient for monetary policy measure is positive but not significant. The JSE all share index is positive and significant at 1% while the stock specific volatility is negative and significant at 1% level of significance. The model explains 17% of the

data. When we look at trade volume, monetary policy has no significant effect on trade volume , however lag trade volume is significant at 1% and JSE all share index is weakly significant at 10% level of significance.

Table 4.8 Impact of M3 growth rate on stock market liquidity

Models	β_1	β_2	β_3	β_4	β_5	β_6	R-sq
TOR	-0.40***	0.31	0.23***	0.00	-3.13	-0.01***	0.17
	(21.34)	(0.11)	(2.59)	(0.26)	(0.41)	(2.99)	
TV	0.68***	-0.25	0.19*	-0.00	7.77	-0.003	0.79
	(93.73)	(0.61)	(2.25)	(1.76)	(0.87)	(1.40)	
AI	0.003	-0.21	-0.002	-0.00	-0.18***	-0.004	0.01
	(0.04)	(0.10)	(0.03)	(0.31)	(-0.004)	(1.51)	
TPI	0.002	-13.20**	-0.00	0.004	-6.46	-0.01**	0.004
	(0.04)	(2.28)	(0.11)	(0.97)	(0.41)	(2.42)	
RTC	0.91***	-0.01	0.00	-0.00	0.09	0.00	0.87
	(25.14)	(0.48)	(1.36)	(0.06)	(0.95)	(0.23)	
RPI	0.98***	-0.06***	0.00	0.00	0.004	-0.00	0.90
	(267.26)	(3.34)	(0.51)	(0.47)	(0.09)	(0.34)	
AMTC	0.47***	-0.04	0.00	0.00	0.00	-0.00	0.37
	(8.53)	(1.09)	(1.04)	(0.13)	(0.02)	(2.44)	

''***''**''*'' are significant at 1%, 5% and 10% respectively, R-sq, is R square

When we focus at the illiquidity variables, only the turnover price impact and Roll (1984) price impact are negative and significant at 5% and 1% respectively with respect to monetary policy measures. The stock specific volatility measure under turnover price impact measure is negative and significant at 5% level of significance. While turnover price impact only explains 0.4% of the data, the Roll (1984) price impact explains approximately 90% of the data. Amihud (2002) illiquidity measure, Roll (1984) transaction costs and Amihud and Mendelson (1986b) transaction costs measures all show negative signs with respect to monetary policy measure, but they are not significant. In summary, monetary policy measured by the growth rate of money supply has a limited effect on liquidity. This is because the monetary policy measure is negative and significant for only two models amongst the estimated seven.

4.3.2 Panel Results Discussion (Monetary Stance)

We now focus on the result when the monetary policy is measured using the stance from Taylor rule. The results are presented in table 4.9. First, when turnover ratio is used as a liquidity measure, the results show that monetary stance is negative but weakly significant at 10%. Lag turnover and stock specific volatility are all negative and significant at 1% while the zarusd exchange rate is positive and weakly significant at 10%. Inflation is negative but not significant. As it was in the case of money supply as monetary policy measure, monetary stance has no impact on the trade volume. Among the other models, monetary policy stance shows positive and

significant effect for Amihud (2002) illiquidity measure and Roll (1984) price impact measure.

Table 4.9 Impact of Monetary Stance on Stock Market Liquidity

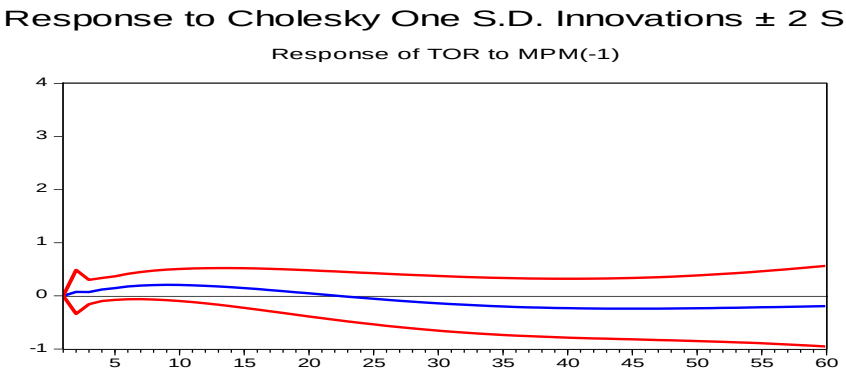
Models	β_1	β_2	β_3	β_4	β_5	β_6	R-sq
TOR	-0.40***	-0.41*	0.00	0.22*	-1.64	-0.01***	0.17
	(12.31)	(1.82)	(0.22)	(1.83)	(0.15)	(2.80)	
TV	0.68***	-0.09	-0.00	0.19	10.12	-0.001	0.79
	(21.73)	(0.46)	(1.32)	(1.86)*	(1.14)	(0.35)	
AI	0.004	0.30**	-0.00	0.002	-19.53***	-0.004	0.01
	(0.06)	(2.54)	(0.36)	(0.04)	(3.62)	(1.46)	
TPI	-0.009	-0.54	-0.00	0.02	-4.44	-0.01*	0.87
	(0.12)	(1.54)	(0.11)	(0.11)	(0.28)	(1.85)	
RTC	0.78***	0.002	0.00	-0.00	0.05	0.00	0.88
	(21.78)	(1.09)	(0.75)	(0.27)	(0.78)	(0.89)	
RPI	0.97***	0.002*	0.00	0.00	-0.001	-0.00	0.90
	(202.41)	(1.84)	(0.53)	(0.62)	(0.02)	(0.13)	
AMTC	0.47***	0.002	-0.00	0.00	-0.001	-0.00***	0.38
	(8.52)	(0.69)	(1.00)	(0.001)	(0.001)	(2.34)	

''***''**''*'' are significant at 1%, 5% and 10% respectively, R-sq, is R square

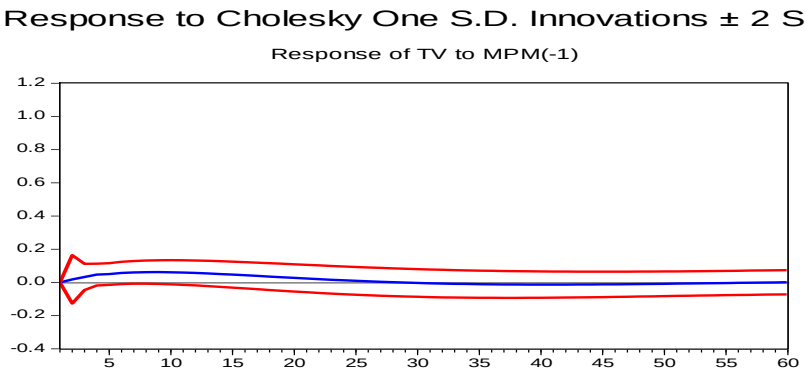
The main objective of this study is to investigate the impact of monetary policy on stock market liquidity. With the result under monetary policy measured by the growth rate of money supply, we find that money supply as a measure of monetary policy is only significant in the case of illiquidity models while monetary policy show no effect on liquidity models in that case. In the case of monetary policy measured by Taylor rule, only turnover model reveal a negative relationship but weakly significant. However, positive and significant effect at 5% and 10% are revealed for Amihud (2002) illiquidity measure and Roll (1984) price impact measure.

4.3.3 Portfolio Liquidity/Illiquidity and Money Growth

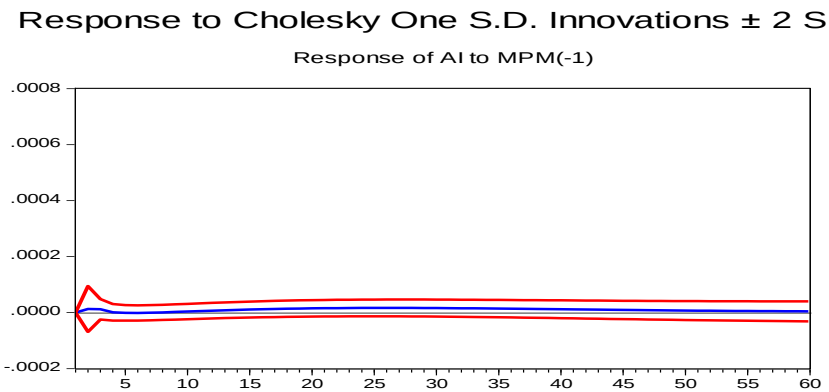
We also consider a macroeconomic vector autoregressive model and perform impulse
response analysis. In the panel regression analysis we considered 12 stocks, mostly related to real economic activity and avoid stocks of firms that operate in the financial sector. We build an equally weighted portfolio using the selected stock and perform the impulse response analysis on the liquidity variables of the portfolio. The impulse response analyses are presented on the following figures. We only report the response of the liquidity and illiquidity variables to the monetary policy measure.



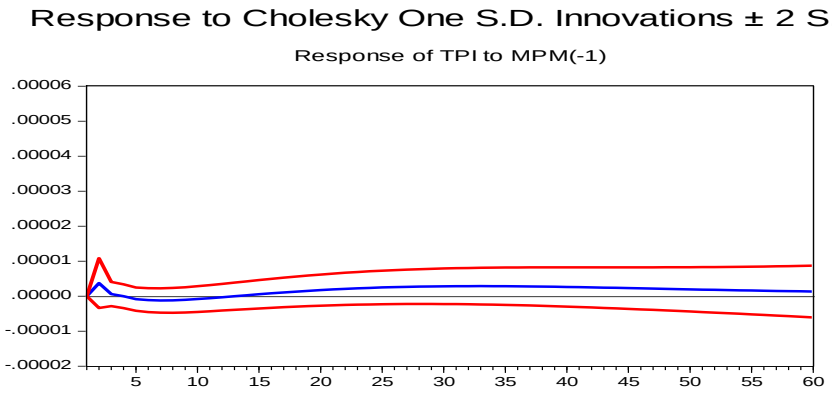
Because there are seven dependent variables, seven impulse responses as presented in the case of money supply as monetary policy measure and seven are also presented in the case monetary stance measure. The results for monetary policy measured by money supply are presented first. The first impulse response as presented above is the response of turnover to a shock in the growth rate of money supply. In the first 23 months after the shock, we see that turnover increases and then ultimately falls below zero for the remaining 37 months. The exact same behaviour is observed when we use trade volume as a liquidity variable, this is presented below.



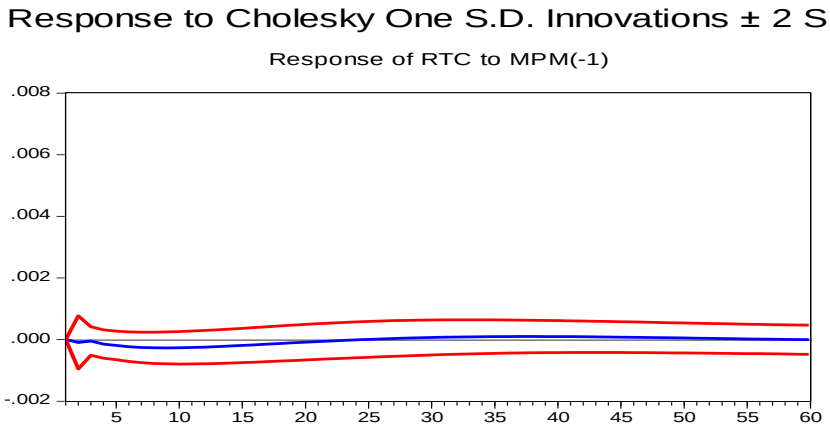
We conclude from the above analysis that, money supply has a positive effect on liquidity variables such as turnover and trading volume. The graph below shows the impact of money supply of Amihud (2002) illiquidity measure. In the first four months after the shock, we see a slight increase in illiquidity and a fall afterwards, but with no significant effect.



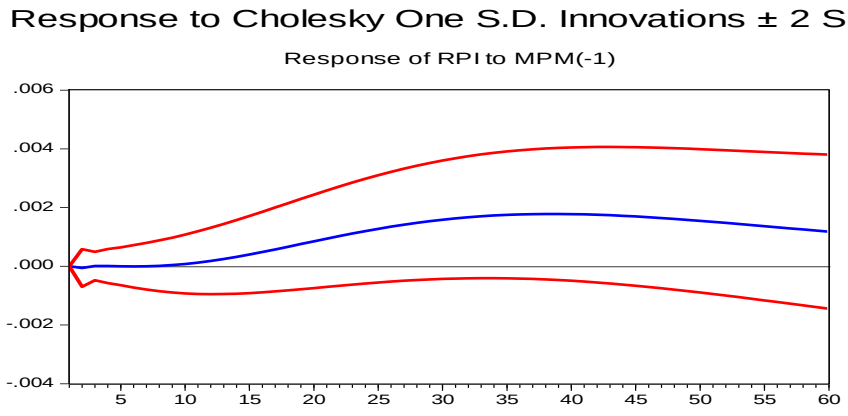
A different effect is observed when the turnover price impact is considered. We see that the price impact measure rises in the first two months, but falls sharply from the second month and remains depressed until the 15th month. This implies that monetary policy measured by the growth rate of money supply has a negative impact on turnover price impact measure.



For the response of Roll (184) price impact measure to money growth rate, we see that after the shock, Roll (1984) transaction costs measure falls sharply below zero and stay below zero until the 20th month. This also implies that money supply has a negative impact on Roll (1984) transaction cost measure.



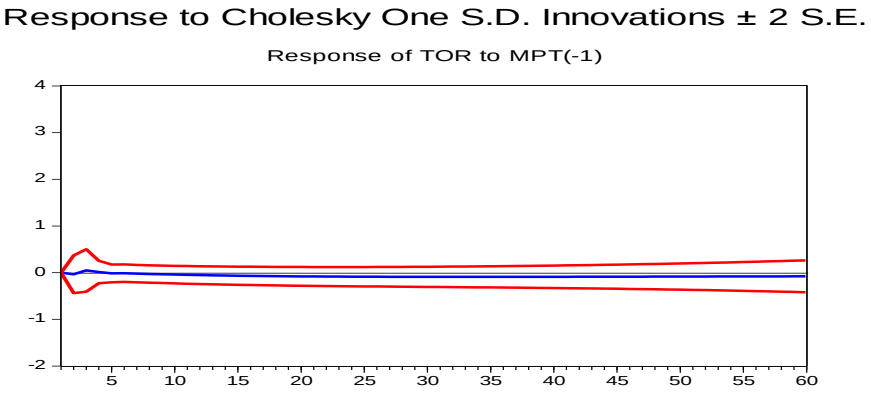
When the shock is performed on Roll (1984) price impact measure, no effect is revealed in the short run. We only see that Roll (1984) price impact only starts increasing after the 10th month but having remained constant before that.

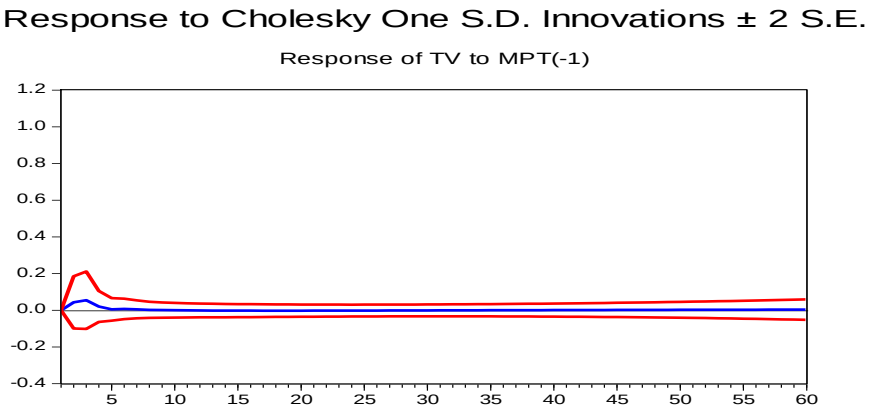


In summary, the impulse response function analysis reveals significant and negative impact of monetary policy measured by money supply on illiquidity variables and positive effect on liquidity variables. We see that both turnover and trading volume react positively to shocks to money growth while turnover price impact and Roll transaction costs measure react negatively to the same shock.

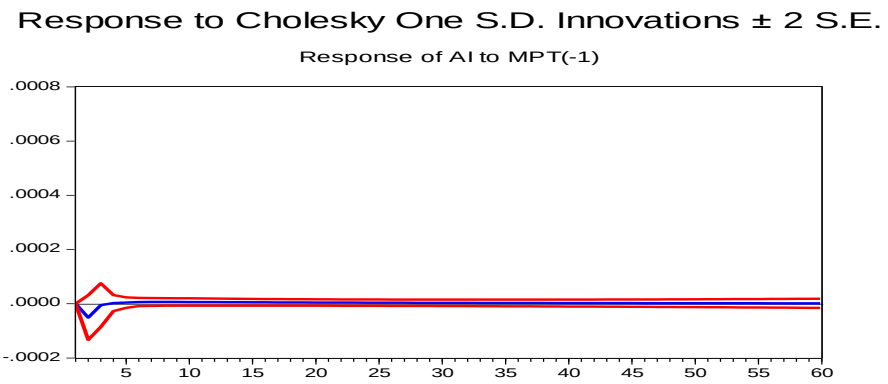
4.3.4 Portfolio Liquidity/Illiquidity and Monetary Stance

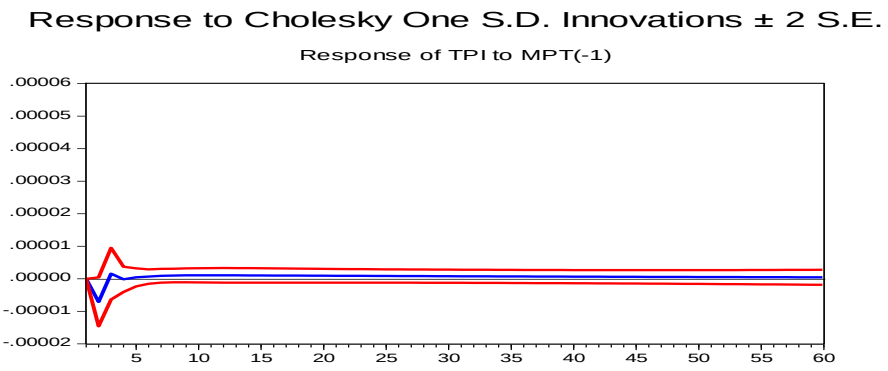
We also presented the reaction of liquidity and illiquidity variables to monetary stance computed using Taylor rule. The first graph below considers the reaction of turnover to money supply shock. There is no significant reaction of turnover in the first four months after the shock, however, turnover falls below zero five months after but the fall is not significant. When we consider trading volume, it increases sharply in the first five months and remains constant thereafter.

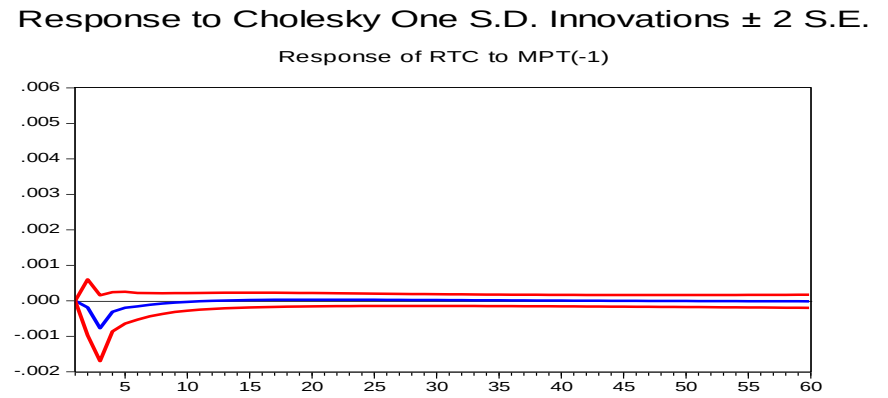




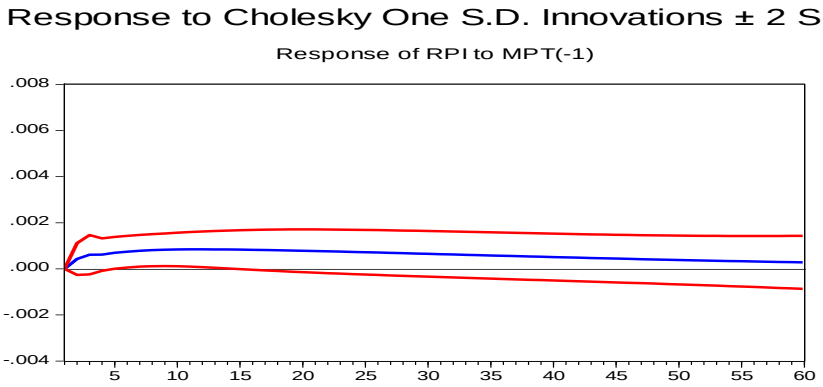
The reaction of Amihud (2002) illiquidity measure is different from those of trading volume and turnover. The impulse response of Amihud (2002) illiquidity measure to monetary stance shows that illiquidity falls sharply in the first two months and increases to a constant level afterwards.



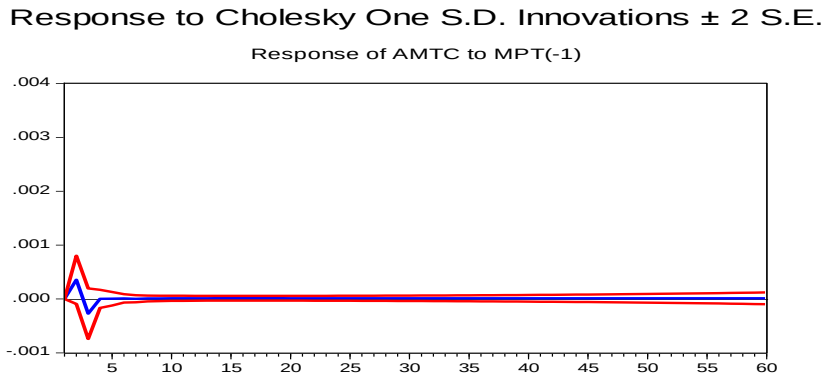




The same behaviour is observed with turnover price impact and Roll (1984) transaction costs measures. They fall sharply in the first two months but increases sharply to a constant level above zero. This implies that monetary policy measured by monetary stance has a positive effect on turnover price impact, Amihud (2002) illiquidity measure and Roll (1984) transaction costs measures but the effect is more significant with turnover price impact.



The Roll (1984) price impact measure shows a completely different behaviour. After the shock, the Roll (1984) price impact measure rises sharply above zero with no initial fall and remains above zero for the entire 60 months. This implies that monetary stance from Taylor rule has a positive and significant impact on Roll (1984) price impact measure.



When we focus on the Amihud and Mendelson (1986) transaction costs measure, we observe an increase in the transaction costs measure in the first month, which falls during the following two months and increases to a constant near-zero level after the third month. In summary, the impulse response analysis shows different results as compared to the stock specific analysis. We have found that monetary policy as measured by money supply has a positive effect on the liquidity variables which are turnover and trading volume. We also found that the monetary policy as measured by the Taylor rule monetary stance has a positive effect on a number of illiquidity variables.

Chapter 5: Conclusion

5.1 Summary of findings

Commonality in liquidity refers to the fact that stock specific liquidity reacts to changes in industry level liquidity. But what affects industry level liquidly? Fernandez-Amador et al. (2013) found monetary policy to be a common factor that affects industry liquidity and stock specific liquidity; they investigated this relationship in Germany, France and Italy. We investigated this relationship in South Africa using panel data analysis for stock specific effect and impulse response analysis for aggregate liquidity analysis.

First of all, we estimated a Taylor rule for South Africa, which we augmented with a financial indicator adapted from Naraidoo and Paya (2012) and used the annualized growth rate of M3 as our second measure of monetary policy. Seven liquidity/illiquidity measures are considered. The data used in the study is for the February 2000 to May 2017 period.

According to the literature review, the South African Reserve Bank (SARB) adopted inflation targeting starting from February 2000 while money supply targeting was the policy rule in use before 2000. First, for the panel regression analysis, our results of the impact of monetary measured by the growth rate of money supply revealed significant monetary effect on illiquidity variables.

In the panel regression analysis with monetary policy measured by the growth rate of money supply, we found that money supply as a measure of monetary policy is only significant in the case of illiquidity models while no effect on liquidity models is revealed in that case. In the case of monetary policy measured by Taylor rule, only turnover model revealed negative relation but weakly significant. However, positive and significant effect at 5% and 10% was revealed for Amihud (2002) illiquidity measure and Roll (1984) price impact measure.

The impulse response analysis showed different results as compared to the stock specific analysis. We found that monetary policy as measured by money supply has a positive effect on the liquidity variables which are turnover and trading volume. We also found that the monetary policy as measured by the Taylor rule monetary stance has a positive effect on illiquidity variables. The study partially confirmed the results of Fernandez-Amador et al (2013) and Goyenko and Ukhov (2009).

5.2 Conclusions

The objective of this study was to investigate the impact of monetary policy as measured by the money supply and the monetary computed using Taylor rule of monetary policy.At the micro level, the study concludes based on the empirical findings that the growth rate of money supply only affects illiquidity and has no effect on liquidity at stocks specific level in the South African context. However, monetary policy conducted using Taylor rule significantly affect both liquidity and illiquidity at

stock specific level. At the Macro level money supply has a positive effect on the liquidity monetary stance from Taylor rule has positive effect illiquidity variables.

5.3 Recommendations

It is recommended that future studies should distinguish between monetary policy regimes and that Taylor rule estimation in South Africa considers the inclusion of a financial indicator as in Naraidoo and Paya (2012) and also the one provided in this study.

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