MONETARY TRANSMISSION MECHANISM AND MONETARY POLICY IN GHANA: THE ROLES OF THE FINANCIAL SYSTEM AND EXTERNAL OPENNESS.

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The candidate confirms that the work submitted is his own, and that appropriate credit has been given where reference has been made of the work(s) of others.

To my beautiful children – Aisha and Zeinab...

...and my beautiful wife – Amie Dibba-Njie

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Abstract.

This thesis assessed the hypothesis that the financial system and external openness were significant determinants of the post reform dynamics of the monetary transmission mechanism in Ghana, and the evolution in the Bank of Ghana's post reform monetary policy programming. Ghana underwent structural adjustment reform, which began in the mid-1980s. The reform was arguably the most significant structural reform programmed in its post-independence history, as it was designed to engender a shift from the pre-reform import substitution macroeconomic framework to a post reform liberalised, open economy. The reform motivated long term structural changes in key sectors of the economy, potentially including monetary transmission mechanism and monetary policy. Key aspects of the reform programme included; (1) financial structure reforms and financial sector liberalisation, (2) External openness liberalisation and (3) Monetary policy reforms. Theoretical consensus, as evidenced in the Post Keynesian and Open Economic conceptualisations, is that the nature and dynamics of the monetary transmission mechanism is determined by, amongst other factors, the institutional structure of the financial system and external openness. These theories further postulate that a Central bank's choice of, and effectiveness of its monetary policy framework(s) and policy tools, are determined by the structure and dynamics of the monetary transmission mechanism. By extension, a significant determinant of a Central bank's choice of policy frameworks and tools is the nature and dynamics of the financial system. The theoretical implications are that institutional and structural changes in a country's financial system and external openness will have long run implications for the dynamics of the monetary transmission mechanism, and well as motivate changes in a central bank's monetary policy frameworks and tools.

This thesis tests these theoretical implication using Ghana's experience with the structural adjustment reforms as an event study. Firstly, the thesis tested the hypothesis that institutional and structural changes in financial structure and external openness were significant in explaining the long run dynamics of the monetary transmission mechanism in Ghana. To test this hypothesis, we first constructed a financial structure and external openness indices using Dynamic Factor Modelling techniques. Then a benchmark model and an augmented model are constructed and estimated. The structural dynamics of the monetary transmission mechanism is assessed using three tests; (a) significance of long run and short run causality running from

monetary policy to the admissible variable, (b) significance structural change by conducting a structural break test (using likelihood ratio test) on the augmented model and, (c) assessment of impulse responses of shocks in the financial structure and external openness indices. Secondly, in light of the institutionalised market based reforms of the financial system, the thesis also tested the hypothesis that this was significant in evolution to indirect monetary targeting and inflation targeting tools. Vector Autoregressive (VAR) models of the Bank of Ghana's inflation targeting and monetary targeting frameworks are estimated. Effectiveness of both policy tools are assessed by analysing causality (short run and long run) running from both policy tools (monetary policy rate and open market operations). In addition, responses to policy induced shocks in the Bank of Ghana's Monetary Policy Rate, and Open Market Operations are also assessed using Impulse Response Function (IRF) analysis.

The overall empirical findings indicate that the structural adjustment reform, and the underlying financial system and external openness changes, were significant in the post reform dynamics of monetary transmission mechanism and monetary policy in Ghana. Both the banking sector and the post reform external openness had significant effects on GDP growth and inflation, indicating their important roles as systematic links between monetary policy and the post reform macroeconomy. The findings also suggest that development post reform financial structure motivated the observed post reform regime transitions in the Bank of Ghana's monetary policy frameworks from the direct regime to indirect institutionalised monetary targeting and inflation targeting regimes.

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List of Abbreviations.

ADF	Augmented Dicky-Fuller	MP	Monetary Policy
BBE	Bernanke, Boivin and Elliasz.	NCM	New Consensus Macroeconomics
BD	Balance of Payment	NK	New Keynesian
BOP	Bank of Ghana	N-PART	Non-Performing Asset Recovery Trust
BOG	Central Bank	OER	Official Exchange Rates
CB	Central African Economic and Monetary	OMM	Organised Money Market
CEMAC	Community.	OMOs	Open Market Operations
CDF	Common Dynamic Factors	OLS	Ordinary Least Squares
DW	Discount Windows	PC	Phillips Curve
DFM	Dynamic Factor Modelling	PK	Post Keynesian
EFP	External Finance Premium	PFA	Principal Factor Analysis
FDI	Foreign Direct Investment	PPP	Purchasing Power Parity
FSAR	Financial Sector Adjustment Reforms	QTM	Quantity Theory of Money
FSL	Financial Sector Liberalisation	SARs	Structural Adjustment Reforms
FSRP	Financial Structure Reforms Programme	SAPs	Structural Adjustment Programmes
FAVAR	Factor Augmented Vector Autoregression	TARP	Toxic Asset Recovery Programme
FOREX	Foreign Exchange	TBA	Total Bank Assets
GSE	Ghana Stock Exchange	TBD	Total Bank Deposits
GDP	Gross Domestic Product	UIP	Uncovered Interest Parity
IMF	International Monetary Fund	UMM	Unorganised Money Market
IRF	Impulse Response Function	VAR	Vector Autoregressive
LR	Likelihood Ratio Test	VECM	Vector Error Correction Model.
LL	Liquid Liabilities		
LICs	Low Income Countries		
LLMICs	Low-and Lower Middle Income Countries		
LMICs	Low Middle Income Countries		
ML	Macroeconomic Liberalisation		
MLE	Maximum Likelihood Estimation		
MSA	Measure of Sample Adequacy		
MIU	Money in Utility Function		
MB	Monetary Base		
MCI	Monetary Conditions Index		
MTM	Monetary Transmission Mechanism		

CHAPTER 1. INTRODUCTION.

Central bank's all around the world play a central in monetary policy programming, as traditionally the quasi-government institution tasked with ensuring macroeconomic stability. Central banks' choice of monetary policy framework (s) and the effectiveness of the associate monetary policy tools for engendering macroeconomic stability, are fundamentally dependent on the structure and dynamics of the monetary transmission mechanism. A central bank's understanding of the monetary transmission mechanism, and how it may evolve overtime there fundamental for the continued effectiveness of its macroeconomic stability efforts. The monetary transmission mechanism has been described as explaining 'which macroeconomic variables respond to monetary policy shocks, when, why, how, how much and how predictably' (Mahadeva and Sinclair, 2002). Bofinger (2001) described it as the 'long, indirect and complex relationship between monetary policy actions and final target variables' (which traditionally are inflation and output). The fundamental conceptualisation of the mechanism of monetary transmission, is that a monetary policy induced shocks by the Central bank (or policy authority) is transmitted to influence the dynamics of inflation and output. The transmission mechanism is postulated to be a dynamic, transitory structural process. The nature of this dynamism, and the complexity of the transmission process is dependent of the institutional and structural features such as the role of money supply (Freidman, 1987), the financial system and financial structure (Minsky, 1957) and the extent of external openness (Bofinger, 20010). Minsky (1957) for example opined that the efficacy of monetary policy largely depends on the financial system and what uses are made of in. Dornbusch (1980) also opined that the extent of the external openness of an economy influences the significance of the external dimension monetary transmission mechanism. The author further opined that this in turn influence monetary policy programming. The role of such factors as degree flexibility of the exchange rate regime, degree of capital account convertibility and degree of trade liberalisations, are fundamental determinants of the role of exchange rates in the inward transmission of external shocks. Monetary policy on the other hand,

describes the use of policy instruments at the disposal of Central banks, by which they attempt to engender macroeconomic stability. This traditionally focuses on stabilising inflation and GDP growth. The conceptual discourse is that policy induced monetary shocks, are transmitted to inflation and GDP growth. The nature and effectiveness of this transmission process is called the monetary transmission mechanism.

The theoretical conceptualisations of the institutional / structural processes which underscore the monetary transmission mechanism, and monetary policy and tools, are traditionally demarcated into three main frameworks. These are; the Exogenous Money Theory (Monetarist Paradigm), the Endogenous Money Theory (Wicksellian Paradigm) and the Open Macroeconomic Theory of exchange rate transmission (Kaldor, 1988, Moore, 1988 Palley, 2008, 2013, Boivin, Kiley and Giannoni, 2010). The monetarist paradigm is underscored by the postulated significance of money supply is directly influencing inflation and output growth through its effects on the transaction spending of economic agents. The paradigm postulates that money supply (fiat money) is under the control of the Central bank, and hence monetary policy should be based on controlling the money supply. The monetarist paradigm postulates that inflation is always and everywhere a monetary phenomenon, and this relationship is linear relationship. Money supply is also postulated to have a direct effect on nominal output. Thus, according to the monetary paradigm, controlling the money supply, in the mould of Freidman's Rule of a target growth rate, should be the basis for effectively in controlling inflation and output growth at a desired level. Thus per the monetarist paradigm, the dynamics of money supply is the most important institutional element of the MTM. The Wicksellian paradigm on the other hand, rejected the monetarist argument that money supply is exogenously determined by the Central bank. Instead, the framework argues that money supply is rather a passive element in the monetary transmission mechanism. Money supply is postulated to be determined by the financial system. Financial system player's money supply decisions, are postulated to respond to demand for money (loans), which is in turn determined by interest rates. Thus, the Wicksellian

paradigm postulates that money supply by the financial system, is passively responsive to interest rates, inflation, output growth etc. It is therefore argued that monetary policy should be based on controlling interest rates (cost of money), as a tool for influencing the decisions of economic agents. Consequently, modern designs of monetary policy have been based on the New Consensus Macroeconomic (NCM) principle of using short term interest rates to achieve price stability (Arestis, 2007). This recognises the significance of interest rates as transmission mechanism of policy induced shocks in short term interest rates. The Wicksellian paradigm explicitly provides that the nature of the structural mechanism of the transmission of policy induced changes in interest rates is fundamentally influenced by the structure of the financial system (financial structure). For example, the broad Post Keynesian (Post Keynesian Accomodationists and Post Keynesian Structuralists) conceptualisation of the Wicksellian paradigm presented the financial structure as a complex multi-market structure, comprising of the money markets, banking sector and securities markets). The broad framework therefore postulates a multi-market interest rates transmission channel, involving money market rates, bank balance sheet and bank lending channels, financial asset (bonds) channel. The individual financial system sub-sectors, determine the significance of the systematic / structural role of the financial system in the monetary transmission mechanism. To signify the systematic role of the financial system, Minsky (1957) opined that the effectiveness of monetary policy is dependent on the financial system and what uses it is put to. The Open Macroeconomic theory postulates that external openness, which is underscored by a flexible exchange rate regime, capital account convertibility and trade liberalisation, adds a significant dimension to the monetary transmission mechanism. These frameworks provide a systemic construct of the nature of the how policy induced shocks are transmitted to inflation and output, both in the short and long run. Together, these three frameworks have identified the systemic components of the monetary transmission mechanism, as the dynamic relationships between monetary policy (money supply and short-term interest rates), the financial system (money markets, banking system, securities market), the external openness of an

economy, and inflation and output. The financial structure and external openness are thus intermediate systematic components, which determine the nature of the transmission mechanism links, and the effects of monetary policy, on inflation and output growth.

Key implications of the theoretical frameworks of the monetary transmission mechanism and monetary policy, is that the dynamics of a country's money supply, financial system and external openness are important explanatory factors for the dynamics of the monetary transmission mechanism, and the evolution of a Central bank's monetary policy frameworks and tools. Thus, the continued effectiveness of Central bank's monetary policy, as a tool of macroeconomic stability, will depend on its continued understanding of the changes in the monetary transmission mechanism. This continued understanding can be guided by observing structural changes in money supply, the financial system and external openness. These implications / viewpoints have underscored empirical regularities on changes in the monetary transmission mechanism and monetary policy, in for example U.S and European Union.

1.2 Motivation for the Thesis.

The motivation of this thesis to assess, in light of the structural adjustment reforms and the associated institutional and structural changes, the roles and significance of the financial system and external openness in the monetary transmission mechanism and monetary policy effectiveness in Ghana. This is important because the reforms motivated a number of important institutional and structural changes which, in theory, fundamentally change the long run dynamics of the monetary transmission mechanism and motivated the observed post reform evolution in the Bank of Ghana monetary policy frameworks and tools. These institutional and structural changes included, amongst other, changes in financial structure, changes in banking sector size, structure and activity levels, changes in external openness. For example, the financial structure in Ghana, changed from a pre-reform state-owned banking sector, to a post reform, privately-owned diversified financial system. The post reform

financial system comprised of a commercial banking sector, credit granting non-bank financial institutions money market, rural community banks and a stock market (Ghana Stock Exchange).

Within the banking sub-sector, there were indications of structural changes in sector structure, size and activity levels. For example, on the structure of the banking sector, 4-bank concentration ratio for the period 1980-1986 were; Total Banking Sector Assets (84.3%); Total Bank Deposits (89.9 %) and Total Loan Advances (79.5%). Following the reforms, the average for the 4- bank concentration ratio for the period 1990-1996 were; Total Banking Sector Assets (73.7%); Total Banking Sector Deposits (76.4%) and Total Banking Sector Loan Advances (59.3 %). Additionally, there were evidence of changes in banking sector activity levels by observation of the pre-reform financial disintermediation, and post reform recovery in financial intermediation. For example, using Bank Deposits / GDP as measure of financial depth, the pre-reform banking sector contracted from 16.5% in 1976 to 4.2% by 1984. Following the reforms however, the average financial intermediation rose from 5.2% in 1986 to 28% by 2015. There were also indicators of changes in credit market conditions. For example, average nominal bank lending rates for the period 1966 to 1985 10.3%. This was the period of interest rate controls by the Bank of Ghana. Following liberalisation (removal of restrictions), nominal bank loan rates averaged 29% for the period 1986-2005, indicating a long term shift in the structure of nominal bank lending rates. In addition, there was a long term change in both the volume and sectoral distribution of bank credit supply to the private sector. For example, under the credit directive regime, bank credit supply to the agricultural and mining sectors averaged 25.01% and 4.7% respectively, for the period 1980-1986. Following credit market decontrol, these values averaged 11.5% and 1.89% respectively, for the period 1990-1996. On the other hand, bank credit supply to manufacturing and construction sectors increased from an average of 23.21% and 11.56% respectively, for the period 1980-1986, to 28.27% and 14.2% respectively, for the period 1990-1996. Both the changes in interest rates and credit supply dynamics indicate long term changes in credit market conditions. Further Indicators of structural changes were provided by post reform

changes in the long run dynamics of the GSH /$US exchange rate. The pre-reform exchange rate regime was a fixed rate regime (pegged to the GBP). The exchange rate liberalisation was underscored by a regime shift from fixed to a flexible rate regime. Following the exchange rate liberalisation in 1986, the GHS / $US rate depreciated by approximately 80% by 2005, supporting a view of long run change in post reform exchange rate dynamics in Ghana.

Alongside these institutional and structural changes, there was a post reform transition in the Bank of Ghana's monetary policy frameworks, tools and objectives. The BOG's pre-reform monetary policy involved direct policy regime, underscored by direct controls on interest rates and credit supply, complimented by high reserve requirements. With post reform institutional changes in the financial system, the policy regime changed to indirect (market based) monetary management, using monetary instruments such as Open Market Operations (OMOs), discount windows and reserve requirements. Broad monetary policy objective was macroeconomic stability (of inflation and GDP growth). Official monetary policy framework became inflation targeting in 2002, with the use of the BOG policy rate as the monetary policy tool and price stability as the explicit objective of monetary policy. Against this backdrop these changes, there were indicators fundamental change in the long run dynamics of inflation and GDP growth. For example, using measures of changes in standard deviation, the volatility of output growth rate fell from a pre-reform average of 5.9% for the period 1966-1985 to a post reform average of 0.69% for the period 1986-2005. Average inflation fell from 32.3% during the period 1966 to 1985, to 23.3% during the period 1986 to 2005. Over the same periods inflation volatility fell from 31.4 % to 9.97%.

These structural changes, in theory, will not only change the nature and dynamics of the monetary transmission mechanism, but also monetary policy programming and the effect of monetary policy on the post reform economy. The motivation is therefore, to empirically assess the role financial system and external openness in Ghana's post reform monetary transmission mechanism and the significance in the Bank of Ghana's post reform monetary policy frameworks and tools.

1.3. Aims of the Thesis.

The aim of this thesis is to develop an econometric model, to empirically as the roles of the financial system and external openness in the monetary transmission mechanism and monetary policy. Specifically, the aim is to assess the hypothesis that the financial system and external openness are significant determinants of long run dynamics of monetary transmission mechanism, and the post reform transition to indirect monetary targeting and inflation targeting frameworks in Ghana. The broad hypothesis is divided into two sub-hypotheses;

- **#Hypothesis One#**: Aims to test the hypothesis that financial structure and external openness are significant are significant systemic determinants of the long run dynamics of the monetary transmission mechanism in Ghana. Using time series data from 1960 -2015, and a Factor Augmented Vector Regressive (FAVAR) model, the aim is to estimate a benchmark model and an Augmented Model. Financial structure and external openness indices will be developed using Dynamic Factor Modelling, and incorporated into the augmented model as systematic components. It is expected that changes in the changes in financial structure and external openness are significant in explaining the post reform changes in inflation and GDP growth dynamics in Ghana.
- **Hypothesis Two**: Aims to test the hypothesis that banking sector was significant in the effectiveness of the post reform indirect monetary targeting and inflation targeting frameworks. The post reform markets based institutionalisation of the financial systems should, in theory, support market based institutionalised indirect monetary policy frameworks. This effectively tests the institutional rationale for the post reform transitions to indirect monetary targeting and inflation targeting. To test this hypothesis, time series data for the period 1980 – 2015 used, and VAR models of the Bank of Ghana's monetary targeting framework and the inflation targeting model are estimated. The estimation assesses the effects of policy induced shocks in the Bank of Ghana Monetary Policy Rate (MPR), and Open Market Operation on key macroeconomic

variables, including inflation GDP, credit supply from banks, bank deposit rates and bank loan rates. It is expected that the banking sector is significant in the post reform monetary targeting and inflation targeting frameworks, thus supporting the institutional rationale for the post reform transitions in the Bank of Ghana's policy frameworks and tools.

The data are sourced mainly from the Bank of Ghana, Global Financial Development Data (GFDD), International Financial Statistics and World Development Indicators published by the World Bank.

1.4. Contributions to the Literature.

The contributions of the thesis to the literature are two-fold. Firstly, the thesis contributes to both modelling and understanding the effects of structural reforms on the monetary transmission mechanism and monetary policy in Ghana. Empirical researches on the impact of the SARs in Ghana have traditionally focused on its effects on economic growth, employment, poverty reduction etc. To the best of the author's knowledge, no previous empirical work assessed its implications on the monetary transmission mechanism and the Bank of Ghana monetary policy frameworks and tools. The thesis also contributes to the empirical modelling of monetary transmission mechanism in Ghana. To the best of my knowledge a Factor Augmented Vector Autoregressive (FAVAR) model of the monetary transmission mechanism in Ghana was not developed and used. The identified FAVAR model contributes to addressing potential sparse information limitations of earlier standard VAR based empirical models on monetary transmission mechanism developed for Ghana (see for example Abradu-Otoo, Amoah and Bawumia (2003), Acheampong (2005), Ghartey (2005) and Kovanen (2010).

The thesis also contributes to the broader literature on the modelling of the monetary transmission mechanism. Within the broader empirical regularity, the modelling of financial structure or external openness as key 'systemic components' of the monetary transmission mechanism is rather limited. A key contribution of this thesis, in this regard, is the development of a mechanism for constructing

financial structure and external openness indices using Dynamic Factor Modelling (DFM) techniques. This technique not only allows 'financial system' and 'external openness' to be model as structural determinant variables, but also allows the indices capture the dynamic effects of a range of financial structure and external openness indicators in a single index. This allows for the potential effects of a larger number of important variables be, without the over-parameterisation problems inherent in standard monetary VAR frameworks.

1.5. Structure of the Thesis.

The thesis is organised into seven chapters, with Chapter One being the introduction chapter, and Chapter seven being the conclusion chapter. The rest of the chapters are as follows;

Chapter Two of the thesis provides a critical synthesis of the main alternative theoretical frameworks on the monetary transmission process and monetary policy. These frameworks both motivate and inform the institutional and empirical analyses in the thesis. The chapter is organised into six main sections. Section 2.2 of the chapter provides a synthesis of the Exogenous Money Theory (monetarist paradigm) conceptualisation of the nature of, and the institutional and structural mechanisms underlying monetary transmissions and its prescriptions for monetary policy. Key aspects synthesised include the Quantity Theory of Money (QTM) expositions of the monetarist paradigm, including the classical QTM, Cambridge Cash Balance framework, the Monetarist QTM and the Keynesian Liquidity Effect Theory. The section also provides an exposition of Tobin (1965) model of the relationship between money supply and inflation. The section also assesses the implication for exogenous money theory for monetary policy prescription, by examining the McCallum Rule (McCallum, 1987, 1988). Section 2.3 of the chapter provides an overview of the Endogenous Money Theory (Wicksellian Paradigm), which identifies the financial system as a key institutional / systematic component of the MTM, and innovations in short term interest rates as a prescription of monetary policy. This section provides an exposition two main Post Keynesian

endogenous money theories; the Post Keynesian Accomodationist and the Post Keynesian Structuralist frameworks. The section also examines the implication for Interest rates transmission channels and the bank credit channels. Section 2.4 provides an overview of the Open Macroeconomic Theory of exchange rate transmissions channels. The section provides an exposition of institutional and structural mechanism of the key theories of exchange rate transmission; the Purchasing Power Parity (PPP) and Uncovered Interest Parity (UIP) theories. Further, it also provides a review of the monetary policy implications of exchange rates transmission theories. Section 2.5 reviews the institutional and structural issues of MTM and monetary policy in developing countries. Section 2.6 provides and analysis of the institutional and structural implications of the main alternative theoretical frameworks on the monetary transmission mechanism.

Chapter Three provides an analysis of post reform institutional and structural changes relevant to the monetary transmission mechanism and monetary policy in Ghana. The analysis of the institutional and structural changes is done in the context of the structural adjustment reforms. The chapter is divided into four sections. Section 3.1 provides and analysis of long run changes in inflation and GDP growth dynamics. Section 3.2 analyses institutional and structural changes in the financial system. This includes analysis of changes in the aggregate financial structure, the micro-banking sector structure and the long run dynamics of bank lending interest rates and credit supply, following liberalisation. Section 3.3 analyses the implications of changes in external openness for key Balance of Payment variables. Section 3.4 analysis of regime shifts in the Bank of Ghana monetary policy frameworks and tools. The analysis of institutional and structural changes in the financial system examines changes in. The analysis of structural change in the openness of the economy, examining changes in the long run dynamics of the GHS/$US official exchange rate. The analysis of monetary policy regime shift analysis the transitions in Bank of Ghana's monetary policy regimes, including frameworks, objectives and tools. This analysis includes the transition from direct monetary targeting, to indirect monetary targeting, to inflation targeting and the exchange rate

targeting framework. It also examines the associated changes in the money supply dynamics and its correlations with changes in the dynamics of inflation and GDP growth. 3.7 discusses the potential implications of these institutional and structural changes for the monetary transmission mechanism in Ghana.

Chapter Four explains the research hypotheses, the econometric models, estimations methodologies used for the analyses. The chapter are organised into three main sections (4.2 and 4.3). Section 4.2 outlines the research hypothesis, and explains the estimation methodologies for testing #Hypothesis One#. The section explains the research hypothesis, the econometric modelling, outlining the structure of the Factor Augmented Vector Autoregressive (FAVAR) model and estimation techniques. This includes the estimations steps of constructing the financial structure and external openness indices. These included Measure of Sampling Adequacy using the Kaiser-Meyer-Ohlin (KMO); correlations analysis and Principal Factor Analysis. The section also explains methodologies for the specification and estimation of the specified benchmark model and the augmented FAVAR model. This explains the methodologies used for the estimation of the time series properties of the variables, including the Augmented Dicky-Fuller Units Roots Test and Johansen Cointegration Tests. Further, the section explains the model diagnostic tests, including Residual Autocorrelation Test and Residual Heteroskedasticity Test. The section also explains the Structural breaks test (Likelihood Ratio) test and Stability Test of Impulse Response Functions (IRFs) used for estimating structural change. Section 4.3 outlines the research hypothesis, and explains the estimation methodologies for testing #Hypothesis Two#. The section explains the Vector Autoregressive models for the inflation targeting and monetary targeting frameworks and the recursive monetary policy identification scheme. Further, the section explains the methodologies for estimating the time series properties of the admissible variables of each model, including the Augmented Dicky-Fuller Units Roots Test and Johansen Cointegration Tests. The section Residual Autocorrelation Test and Residual Heteroskedasticity Test.

Chapter Five presents the estimation results and analysis for assessing the significance of financial structure and external openness on the monetary transmission mechanism in Ghana. The chapter is organised into 4 main sections. Section 5.2 presents estimation results of the construction of the financial structure and external openness indices. The section presents and analysis the estimations results of KMO Measure of Sampling Adequacy, Correlations (matrix) test. The section further discusses the result of the Principal Factor Analysis which estimates the number of latent factors for the set of financial structure indicators, and external openness indicators. Section 5.3 presents the specified and estimation results of the benchmark model and the FAVAR model. This includes the presentation of the ADF Unit Roots test stationarity and Johansen Cointegration test results for the constituent FAVAR model variables. Further, the section also presents the results of the model diagnostic test, including residual autocorrelations test and residual heteroskedasticity test. Finally, the section presents the results and analysis of the long run and short run causality tests, structural breaks test (likelihood ratio test) and the impulse response function analysis.

Chapter Six presents the estimation results and analysis for estimating the effects of the Bank of Ghana post reform indirect monetary policy tools. The chapter is organised into 5 sections. The chapter restates the estimated models of the BOG's inflation targeting and monetary targeting models. It also presents estimation results and analysis, including the results of Augmented Dickey Fuller Unit Roots Test of stationarity, Johansen Cointegration Test results and the regression results of each model. The model diagnostic test results are also presented, including the residual autocorrelations test and residual heteroskedasticity test results. The chapter then presents the estimation results and analysis of the long run and short run causality (Wald Test) test results, and the impulse response analysis of policy induced shocks in the BOG monetary policy rate and policy induced open market operations.

Chapter Seven provides a summary outline of the thesis, analysis and discussions of the empirical findings and their implications for the post reform monetary policy in Ghana. These analyses and

discussions are organised into three sections. Section 7.1 of the chapter provides a summary of the thesis. Section 7.2 provides a summary of the key empirical findings and section 7.3 discusses the implications for monetary policy.

CHAPTER 2: MONETARY TRANSMISSIONS MECHANISM AND MONETARY POLICY: THEORETICAL CONCEPTUALISATIONS.

2.1: Introduction.

The broad conceptual foundations of the theoretical monetary transmission mechanism and monetary policy, are underscored by the general consensus that policy induced monetary shocks by a Central bank are transmitted to influence inflation and nominal GDP growth dynamics over a period of time. The consensus is that the transmission process is a structural transitory mechanism, which is long indirect and complex (Bofinger, 2001). The use of monetary policy is premised on the basis that the transmission process is defined and predictable. However, given the complexity differing theoretical conceptualisations have been presented on the nature the nature of the transmission mechanism, and the influences of the institutional structure of the money supply, the financial system and external openness. The theoretical framework postulate that the monetary transmission mechanism has an internal dimension, and an external dimension. The theoretical frameworks on the nature and dynamics of the internal dimensions of the monetary transmission mechanism are traditionally demarcated into two. These are the Exogenous Money Theory (monetarist paradigm) and the Endogenous Money Theory (Wicksellian paradigm) (Fontana, 2007; Palley, 2008). While both these theoretical paradigms conceptualised the monetary transmission mechanism as the transitory effects of policy induced monetary shocks on inflation and output growth, there are fundamental differences on the nature of the institutional and structural mechanisms that underscore the process.

The central conceptual tenet of the Exogenous Money Theory is the important institutional and structural role of money supply in the transmissions mechanism and monetary policy. Hence, the exogenous money theory is also called the monetarist paradigm. The central tenets of the theory are; the ‘active money’ and ‘exogenous money’ postulates. The active money postulate provides that changes in money supply (or its growth rate), has direct, determinant effects on inflation and nominal GDP in the short run. Inflation is postulated to be always and everywhere a money supply (or its

growth rate) phenomenon, and that the relationship between the two is proportional. Money supply is also postulated to positively influence nominal GDP growth. The monetarist however argued that money is neutral in the long run, having no effect on real variables. The exogenous money postulate provides that money supply is postulated to be exogenously determined by the Central bank, rather than the financial system. The Central bank is thus the monopolistic supplier of money, and can without restrictions, change the money supply (or its growth rate) to achieve set macroeconomic objectives. The paradigm therefore, postulates a money supply growth rule, as the basis of monetary policy. Prominent monetary policy frameworks of monetary targeting theory include Freidman's *k* percent rule and McCallum Rule. The monetarist's theoretical conceptualisation of the monetary transmission mechanism is traditionally synthesised using variant frameworks of the Quantity Theory of Money (QTM). Key QTM based monetarist theories include the classical QTM theory (Fisher, 1911), Cambridge Cash Balance QTM theory and monetarist QTM theory (Freidman, 1987).

The endogenous money theory rejected the active money and the exogenous money postulates of the monetarist paradigm. Its central tenet is the concept that not only money supply is endogenous, that that this is largely determined by the financial system. Rather than being an active determinant, money supply is passively responsive to interest rates, inflation, GDP growth and other market factors (Moore, 1988, Palley, 2008). The endogenous money theory thus postulates the existence of multiple channels of monetary transmissions, largely determined by the complexity of the financial system and its relationship with monetary policy. Conceptually, the foundation of the broad endogenous money theory is built on extensions of the Keynesian conceptualisation of the monetary transmission mechanism (Keynes, 1936). While Keynes did not reject the exogeneity postulate of the monetarist paradigm, he incorporated the concept of 'monetary capacity', related to the role of money demand. Keynes' concept of monetary capacity is related to money demand, and it relationship with interest rates and national income. Money demand (monetary capacity) is postulated to be endogenous (Palley, 2010). Subsequent developments on Keynes' contribution are

broadly demarcated into the Neo-Keynesian theories and Post Keynesian theories. The Neo-Keynesian theories introduced a money multiplier model, which provided an explicit distinction between 'exogenous money' and 'endogenous money'. Endogenous money, according to the neo-Keynesian theory, is created by the banking system through a money multiplier mechanism, making the overall money supply endogenous (Palley, 2010).

The Post Keynesian theories extended the concept of endogenous money, by completely rejecting both the monetarist paradigm's money supply exogeneity and active money postulates. The key foundation of the endogenous money theory is thus; money supply is endogenously determined by the financial system, and that money supply is passively responsive to such macroeconomic variables as interest rates, inflation and GDP. Conceptual arguments on the nature of the role of the financial sector in determining money supply, gave rise to two main Post Keynesian Theories on the nature of the monetary transmission mechanism. These are generally identified as the PK Accomodationist theory and PK Structuralist Theory. The Post Keynesian Accomodationist theory conceptualised the financial structure as mainly comprising of the banking sector. A key transmissions link between the Central bank and the commercial bank derives through the market for Central bank reserves. Central bank supplies short term reserves to commercial banks at a cost. This cost is taken as the Central bank's policy rate, through which its influences the banking sector's demand for reserves. Hence, the policy rate (cost of reserves) is exogenously determined by the Central bank, and is treated as given at the retail bank level. The link between the Central bank policy rate (cost of reserves) and bank loan supply is through its effects on retail bank rates. Thus, the PK Accomodationist framework is a single interest rate channel (bank loan rates) framework, which is postulated to be determined as a fixed mark-up on the cost of Central bank reserves. The Central bank is postulated to fully accommodate the demand for reserves and that liquidity constraints faced by banks is not a determinant factor in the interest rates (cost of reserves) they face. Bank deposits (loans) constitute money supply since this creates credit to economic agents. Bank supply of loans, is postulated to be

passively responsive to, amongst others, demand for loans, interest rates on loans, inflation and GDP growth (Fontana, 2002). Thus the PK Accomodationist theory identifies the significance of two main channels of monetary transmission mechanism; the cost of bank loans channel and the bank credit channel.

The Post Keynesian Structuralists theory on the other hand postulated a multi-faceted financial structure, comprising of the money market, banking system and securities market. As such, the PK Structuralists presented a multi-market interest rates framework of the MTM, including the bank loan rates. A key difference with between the PK Accomodationist and PK Structuralist theories is how determination of retail bank rates. The PK Structuralist postulates that the liquidity constraints of financial market participants are an important factor in the dynamic influence of the cost of reserves (See for example Tobin Q theory (Tobin, 1970). Hence, rather than a fixed mark-up over the cost of reserves, retail level interest rates are argued to be dynamic, determined by a number of market and structural factors. Thus, Central bank policy rate (cost of reserves) positively influences market interest rates (money market rates, bank lending rates, bond rates). The Post Keynesian Structuralist theory is thus a multimarket interest rates framework. The PK Structuralist theory postulates that while the cost of reserves is a positive determinant of market interest rates, a range of other structural factors play a role in determining rates dynamics. Key implications of the PK theories is the existence of different channels of monetary transmission. These include the existence of an interest rates transmission channels (Taylor, 1995; Svensson, 1999), bank credit channel (Bernanke and Gertler, 1995; Kashyap and Stein, 1995) and asset channel (Mishkin, 1995) channels of transmission.

The Post Keynesian prescriptions of monetary policy is thus the control of short-term interest rates by the Central bank, as a mechanism for influencing demand for money by economic agents (Allsopp and Vines, 2000; Carlin and Soskice, 2006, Palley, 2007). There are variant definitions of what constitutes innovations in short term interest rates. Traditionally, variant money market rates fit the definition of short term interest rates, including for example the cost of reserves, the overnight rates

etc. Thus, the endogenous money theory postulates the MTM as the causative effect of policy induced innovations in short term interest rates on inflation and output growth (Allsopp and Vines, 2000; Carlin and Soskice, 2006, Palley, 2007). Inflation targeting frameworks, as embodied in the Taylor rule (Taylor, 1995) reflects the endogenous money theory's prescription for monetary policy. Theoretical conceptualisations of an external dimension to the monetary transmission mechanism, are postulated by the Open Economy Theory (Dornbusch, 1980). This conceptual framework largely focus on the nature of the transmissions of external (monetary) shocks into the domestic economy. The open macroeconomic theory of the monetary transmission mechanism and monetary policy postulates that an exchange rate transmission mechanism becomes a significant structural component of the MTM, within an open economy, with a flexible exchange rate regime. The broad concept postulates that domestic inflation and GDP within small open economies, with flexible exchange rate regimes, capital account convertibility and free trade flows, influenced by external monetary and financial developments to exchange rate effects. The open economy theory is explained using two alternative frameworks; Purchasing Power Parity (PPP) and Uncovered Interest Parity (UIP) theories.

The detailed examination of these alternative theoretical frameworks are provided in more detail in the rest of this chapter. The chapter is divided into three main sections. Section 2.2 provides a synthesis of the Exogenous Money Theory (monetarist paradigm) conceptualisation of the monetary transmission mechanism and monetary policy. The section is divided into three main sub-section. Sub-section 2.2.1 explains the class of Quantity Theories of Money (QTM) synthesis of the monetary transmission mechanism. The section synthesis the classical QTM, Cambridge Cash Balance Approach, the monetarist QTM. Section 2.2.2 discussed the effects of money supply on nominal GDP (Palley 2013). Section 2.2.3 provides an exposition of the Tobin's (1965) model on how money supply shocks are transmitted to inflation. Section 2.2.4 examines the implications and prescriptions of the monetarist paradigm for monetary policy, discussing the McCallum Rule (McCallum, 1987, 1988). Section 2.2.5 provides some empirical measures of the measures of money supply. Section

2.3 examines the Endogenous money theory (Wicksellian Paradigm) conceptualisation of the institutional and structural mechanisms underscoring the monetary transmission mechanism and its prescription for monetary policy. Section 2.3.1 examines the early contribution of Keynes (1936) Liquidity Preference Theory, as the basis of the Neo-Keynesian and Post Keynesian theories on the monetary transmission mechanism. 2.3.2 examines the Neo-Keynesian conceptualisation of the endogenous money and the transmission mechanism, highlighting its contribution to the conceptualisation of the institutional role of the banking system in determining endogenous money supply. Section 2.3.3 examines the Post Keynesian endogenous money theories. This section is partitioned into two. Section 2.3.3.1 examines the Post Keynesian Accomodationist Theory while section 2.3.3.2 examines the Post Keynesian Structuralist conceptualisation of endogenous money and the institutional roles of the financial system. Section 2.3.4 examines the Post Keynesian channels of monetary transmission mechanism; focusing on the Interest rates transmission channel (cost of bank loans and cost of debt). The section also examines the credit channel (bank balance sheet channel and bank lending channel). Section 2.3.5 examines the implications of the endogenous money for monetary policy frameworks and tools. Section 2.4 provides a synthesis of the exchange rate transmissions channel theory, reviewing the Purchasing Power Parity (PPP) and Uncovered Interest Parity (UIP) theories. Section 2.5 examines monetary transmission mechanism in developing country reviews the institutional and structural issues of MTM and monetary policy in developing countries. Section 2.6 discusses the institutional and structural change implications of the main theoretical frameworks.

2.2. The Exogenous Money Theory (Monetarist Paradigm): The Conceptual Framework.

The exogenous money theory of monetary transmissions has traditionally been identified as the conventional theory, with its dominance of both theory and practice of monetary policy extending to the 1960s. Monetarists view the monetary transmission mechanism as the effects of changes in money supply or its growth rate on inflation and GDP. Central to the monetarist's institutional and structural conceptualisation of the monetary transmission mechanism and prescriptions of monetary policy, is the role effects of changes in the quantity of money supply or its growth rate in macroeconomic dynamics. Money supply, according to the monetarist paradigm, is not only exogenously determined, but also actively determines inflation and nominal GDP growth dynamics. Monetarist's exogeneity postulate is the foundation of its institutional conceptualisation. The Central bank is identified as the monopolistic supplier of fiat money, and hence is the sole institutional determinant of the quantity of money or its growth rate. The theory's conceptualisation of the transmission mechanism of money supply shocks is underscored by the 'active money' money postulate, which provides that money supply is a direct and positive determinant of inflation and nominal GDP. Money supply shocks is propagated through a money multiplier effect (Palley, 2015), driven by its effects on economic agent's transaction spending. The exogeneity postulate underscores the monetarist paradigm postulation of that inflation is always and everywhere a money supply phenomenon. It also provides the basis of the argument that money supply is a positive determinant of nominal output in the short run. Thus, the monetary transmission mechanism is conceptualised as the causative effect of policy induced change in money supply (or its growth rate), on inflation and output dynamics. In addition to the 'active money' postulate, the institutional role of money supply in the monetary transmission mechanism, and which underscore the theory's prescription of monetary policy, is the exogeneity of money supply postulate. This provides that money supply or its growth rate is exogenously and monopolistically determined by the

central bank, as the monetary policy authority. The assumption is that the central bank can, without institutional restrictions, change the money supply or its growth to achieve its policy objectives. Within the context of exogeneity postulate, the monetarist paradigm configures the money supply as fiat money, for which the Central bank is the monopolistic supplier. The supply of fiat money is postulated to constitute the monetary base. Howell's (2010) as synthesised the supply of fiat money as:

$$M_s = C_p + D_p \tag{1.1}$$

Where M_s is the broad money stock, C_p is the non-bank private sector holding of notes and coins, and D_p is the non-bank private sector' holdings of bank deposits. Howells (2010) further determined the monetary base as;

$$B = C_b + D_b + C_p \tag{2.2}$$

Where B is the monetary base, and C_b is the bank's holdings of notes and coins, and D_b is bank's deposit with the central bank. The monetarist paradigm contends that the Central bank, without institutional, operational or structural restrictions, can change the quantity of money supply or its growth rate to achieve set objectives. The central bank is postulated to have primary control over notes and coins (C_p, equation 1). The Central bank controls over the non-bank private sector holdings of bank deposits, through the institution of statutory reserve requirements, to be held with the central bank. The value of the reserve requirement at any given point is determined as:

$$R = \sigma D \tag{2.3}$$

Where R is the statutory reserves of commercial held with the central bank, σ is the reserve requirement ratio and the D is the value of customer deposits. The central bank determines the reserve requirement ratio (σ), in line with its monetary policy objectives, and through this and hence the volume of reserves (R). The Central bank can thus influenceD_p, by varying (σ), thus giving it direct leverage on the quantity of D_p or it growth rate.

2.2.1. The Quantity Theories of Money (QTM): On the Effects of Money Supply.

Central to the monetarist conceptualisation of the monetary transmission mechanism is the effect of the money supply ($M_s = C_p + D_p$) on the macroeconomy. Money supply is postulated to have an active effect on inflation and nominal GDP growth. Money supply is therefore treated as a first order issue (Palley, 1993). The monetarist thus, postulate the monetary transmission mechanism as the effects of Central bank induced money supply shock, on inflation and GDP. The monetarists' theoretical conceptualisation of the monetary transmission mechanism is traditionally synthesised using variant frameworks of Quantity Theory of Money (QTM). These QTM framework include the classical QTM frameworks (including the classical QTM model, the Cambridge Cash Balance Approach model and new classical monetarist QTM). Thus, Meyer (2001) described monetarist theory and monetarism as a reincarnation of the classical QTM dichotomy. The theoretical construct of the QTM is underscored by the classical assumptions of full employment and flexible prices and wages. Within the traditional literature, the theoretical exposition of the QTM frameworks generally starts with invocation of Fisher' equation of exchange, which is functionally represented as:

$$MV = PY \tag{2.4}$$

Where M represents the quantity of nominal money supply, V is the velocity of circulation of money, P is the price level and Y is real GDP. The equation of exchange is an identity, and in this form, may have no theoretical or empirical relevance. To motivate a theoretical relevance, the equation is traditionally transformed into a causal mechanism by the impositions structural restrictions of the following form:

$$M\bar{V} = P\bar{Y} \tag{2.5}$$

Where $\bar{V}$ and $\bar{P}$ are restricted to assume constancy. The assumption of constancy of the velocity circulation of money (V), derives from arguments that institutional features of the payments systems,

which determine it, are relatively constant. With classical full employment assumptions, nominal GDP (Y) is assumed to be at full employment equilibrium in the absence of capacity increases, and is therefore assumed to be constant in the short run.

$$P = f(M) \tag{2.6}$$

From equation 2.6, the core postulate of the QTM is that price level (P) is a function of the nominal quantity of money supply (M). Changes in the nominal price levels therefore derive from changes the nominal money supply (M). The theoretical explanation of the Fisher exposition is that under the structural assumption of full employment equilibrium and flexible prices, increases in money supply causes increases in transaction spending, with a direct effect on prices of goods and services. The monetarists' proportionality postulate provides that price levels will rise by the same proportion as the increase in money supply. Empirical regularities on the positive, proportional causal relationship between money supply and price level have generally supported the Classical QTM exposition. A notable empirical contribution is the work of McCandless and Webber (1995) who examined correlations between money supply and inflation for 110 developing and developed countries.

The key contribution of the Cambridge Cash Balance approach is the incorporation of transactions demand for money, as a structural link between money supply and nominal output. This is motivated by the interpretation of the velocity of circulation of money, as equivalent to demand for cash balances for transactions spending. However, the demand for money is assumed to be constant at equilibrium. Theoretically, this is incorporated as restriction on the velocity of circulation in the equation of exchange. Thus,

$$M = kPY \tag{2.7}$$

Where M represents the quantity of nominal money, PY represents the nominal output. k represents the fraction of nominal output that is held in cash. The conceptualisation of the mechanism of the

transmission of monetary policy impulses, is underscored on the theoretical postulation that an equilibrium exists between money supply and money demand at full employment. Thus;

$$M^S = M^D \tag{2.8}$$

Where M^S is money supply and M^D is demand for money. The exposition is that at full employment equilibrium, economic agents hold the desired levels of cash balances, given the money supply. This underlines the equilibrium condition. The flexibility assumption underscores the provision that economic agents' can costlessly adjusted their cash holdings to equate to money supply through increased spending. Changes in the money supply cause disequilibrium with respect to money demand, leading to excess cash holdings in economic agents' portfolios. This motivates increased transactions spending to rid of the excess cash leading to increases in nominal output (PY). In the long run, equilibrium is restored and money supply becomes neutral. While upholding the cardinal classical postulation of a stable money demand and long run money neutrality, a major departure of new classical monetarist theoretical synthesis is the acceptance of the Keynesian dichotomy of short run non-neutrality of money. As a deviation from the classical QTM dichotomy, the new monetarist paradigm postulates that changes in money supply, given a stable demand for money, affects real variables (national income and economic activity) in the short run.

2.2.2 Effects of Money Supply on Nominal Output (Palley, 2013).

Palley (2013) for synthesised the monetarist conceptual postulation of the effect of money supply on nominal output as follows:

$$M = mB \tag{2.9}$$

Where M represents the money supply, m is the money multiplier, B is the monetary base.

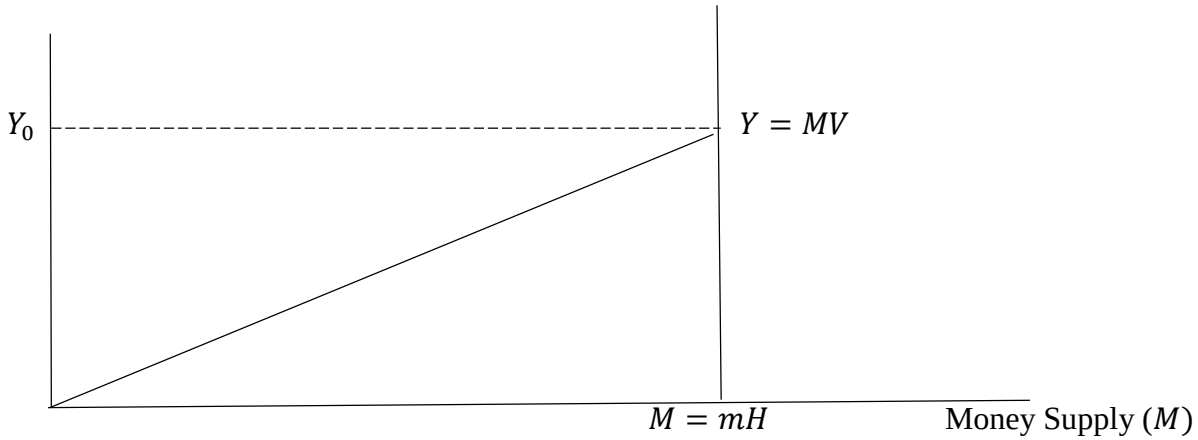
$$Y = MV \tag{2.10}$$

Y represents the nominal income and V is the velocity of circulation. Equation (2.9) provides that the money supply is determined the money multiplier and the monetary base, which are exogenously controlled by the CB. Under assumption of constant velocity of circulation of money (demand for money is stable), nominal output is determined by the money supply. Substituting (2.10) into (2.11) yields;

$$Y = mBV \tag{2.11}$$

The monetarist money supply schedule is therefore vertical, hence its association with the verticalists paradigm. The money market is postulated to constitute the money multiplier and the monetary base.

Figure 1. Money Market in the Monetarist Model.



Nominal income adjusts to create equilibrium between money demand and the exogenously determined money supply, where the money supply changes. For example, an increase in money supply, causes excess cash holdings. Agents get rid of these excess cash by spending, causing nominal income to adjust to restore equilibrium between demand for money and supply of money. Effectively, money demand and subsequently change in nominal income are driven by changes in money supply. The central bank controls the supply of reserves (H), and can thereby determine the money supply (M) and nominal income (Y), conditional on the values of the money multiplier (m) and the velocity of money (V). The fundamental theoretical postulation of the monetarist QTM is that changes in demand for money (V) and changes in exogenously determined money supply (M)

drives change in nominal GDP. Money demand is postulated to be relatively stable (changes in velocity of money (V) are relatively small). Accordingly, changes in exogenous money supply (M) is postulated to be the principal cause of changes in nominal GDP. The sources of fluctuations in money supply (M)are identified with policy induced fluctuations. Second, since money supply fluctuations are postulated to be principally responsible for variations in nominal income, this suggested that a money supply rule could serve to limit money supply variability. Finally, the assumption of exogenous money linked with stable money demand, implied that the private sector was stable and not subject to regular macroeconomic crisis. The next section provides a review the theoretical framework on the relationship between money supply, inflation and output.

2.2.3 Effects of Money Supply and Inflation: Tobin's (1965) Model.

Fundamentally, the broad monetarist paradigm postulates that inflation is always and everywhere a monetary phenomenon. The relationship between money and inflation is postulated to be proportional. The Tobin (1965) general equilibrium framework introduced money into the neo classical growth model by Solow (1956), as a theoretical exposition of the broad monetarist paradigm (classical and monetarist QTM). The Tobin effect (Tobin, 1965) was extended by Levhari and Patinkin (1968). Structurally, the Solow's (1956) neo classical growth model is a non-monetary model (Walsh, 1998). Here, I review the Tobin (1965) framework as synthesised in Walsh (1998). The standard Solow neo classical production function expresses output per capital as a function of capital per capital (Walsh, 1998).

$$y_t = f(k_{t-1}) \tag{2.12}$$

Where y_t is output and k is physical capital. The Solow neo classical production function is assumed to both be continuously differential and to satisfy the Inada conditions $f_k \geq 0, f_{kk} \leq 0, lim_{k\to 0} f_k(k) = \infty, lim_{k\to\infty} f_k(k) = 0$. The only asset in the Solow neo classical growth model is physical capital (k). Tobin (1965) incorporated money, as a second asset, forming the basis of his

general equilibrium framework. A representative household portfolio can comprise of both physical capital and money as assets. Real household wealth per capital in period t, is assumed to consist of k_t and real money balances $m_t = \frac{M_t}{P_t N_t}$, where M_t is the nominal quantity of money, P_t is the price level, and N_t is the population. Thus, Tobin's (1965) modified Solow growth model is:

$$y_t = f(k_{t-1}, m_t) \tag{2.13}$$

Tobin (1965) introduced exogenous money supply into the model by assuming government makes lump-sum transfers of money to the private sector. Denoting government transfers to households as τ, real aggregate household income is therefore, expressed as:

$$Y_D = Y_t + \tau N_t - \frac{\pi_t}{1-\pi_t}\frac{M_{t-1}}{P_{t-1}} \tag{2.14}$$

Where Y_D is the real household income, Y_t is output, τN is total government lump-sum transfer to the private sector, π is the inflation rate. The term $\frac{\pi_t}{1-\pi_t}\frac{M_{t-1}}{P_{t-1}}$ is the capital loss due to the fall in the household real money holdings attributed to inflation. The Solow model assumes a fixed savings rate (s) from household real income. Thus capital accumulation equals the portion of household real income committed to savings. This is expressed as:

$$\Delta K_t + \Delta\frac{M_t}{P_t} = s(Y_t + \tau N_t) - \frac{\pi_t}{1-\pi_t}\frac{M_{t-1}}{P_{t-1}}) \tag{2.15}$$

Where K represents the aggregate physical capital stock. In per capita quantities, $\Delta k = k_t - k_{t-1}$. With $k_t \equiv K_t/N_t$, equation (2.15) can be rearranged as:

$$\Delta k = k_t - k_{t-1} = \frac{\Delta K_t}{N_t} - \frac{n_t}{1-n_t}k_{t-1} \tag{2.16}$$

Where n_t represents the population growth rate. Dividing both sides of equation (2.15) by N_t and using the result to eliminate $\frac{\Delta K_t}{N_t}$ from equation (2.16), change in capital is constituted as:

$$\Delta k_t = \left[s\left(y_t + \tau - \frac{\pi_t}{1-\pi_t}\frac{M_{t-1}}{P_{t-1}}\right) - \left(\Delta\frac{M_t}{P_t}\right)\left(\frac{1}{N_t}\right)\right] - \frac{n_t}{1-n_t}k_{t-1} \qquad (2.17)$$

Following that $y_t = f(k_{t-1})$;

$$\Delta k_t = s\left[f(k_{t-1} + \tau - \frac{\pi_t}{1-\pi_t}\frac{M_{t-1}}{P_{t-1}}\right] - \left[\frac{\theta-\pi_t}{(1+\pi_t)(1+n_t)}\right]m_{t-1} - \frac{n_t}{1-n_t}k_{t-1} \qquad (2.18)$$

Where θ represents the growth rate of the exogenously determined money stock, so that τ is the real per capita value of the change in the nominal money stock. Thus equation (2.18) can be rewritten as:

$$\Delta k_t = sf(k_{t-1}) - 1 - s(\frac{\theta-\pi_t}{(1+\pi_t)(1+n_t)}m_{t-1} - \frac{n_t}{1-n_t}k_{t-1} \qquad (2.19)$$

Equation (2.19) provides that change in per capita stock of capital is a function of savings per worker, $sf(k_{t-1})$, transactions demand for money $1 - s(\frac{\theta-\pi_t}{(1+\pi_t)(1+n_t)}m_{t-1}$ and investment spending with respect to new entrants into the labour market $\frac{n_t}{1-n_t}k_{t-1}$. Equation (2.19) provides that change in the per capita stock of capital is a positive function of saving, a negative function of transaction demand for money and investment spending on new entrants into the labour force. Change in the transactions demand for money $(1 - s(\frac{\theta-\pi_t}{(1+\pi_t)(1+n_t)}m_{t-1})$ is thus the key intuition of Tobin's introduction of money in the Solow (1956) neo classical growth model. This provides a role of transactions demand for money in economic activity. This introduces changes in transaction demand for real money balances as a determinant of per capita stock of capital (investment in physical capital) and hence

economic activity. Recalling the classical assumption of full employment equilibrium and flexible wages and prices, and assuming that at steady state equilibrium the capita capital stock and the real transactions demand for money are constant, thus:

$$\Delta k^{ss} = \Delta m^{ss} = 0 \tag{2.20}$$

This means that at steady state equilibrium:

$$\Delta m^{ss} = \left[\frac{1+\theta}{(1+\pi)(1+n)} - 1\right] m^{ss} = 0 \tag{2.21}$$

Thus:

$$1 + \pi^{ss} = \frac{1+\theta}{1+n} \tag{2.22}$$

Equation (2.22) reflects the broad monetarist postulate that inflation is a monetary phenomenon, by providing that inflation (π) is directly determined by the growth rate of the nominal money supply (θ). Furthermore, the broad monetarist paradigm provides that this relationship is proportional in the long run.

$$\pi^{ss} = f(\theta) \tag{2.23}$$

However, while the Tobin (1965) framework recognised the existence of a well-defined demand for money, it didn't explain than why agents hold real money balances, rather than physical capital. The Money in Utility Function (MIU) models of Sidrauski (1967) provided a neo-classical theoretical framework which attempted to explains 'why' economic agents hold real money balances.

2.2.4 Implications and Prescription of Endogenous Money Theory for Monetary Policy.

The central tenet of the monetarist paradigm is that money supply or its growth rate is exogenously determined by the Central bank. Additionally, the paradigm postulated that money supply is an 'active' determinant of the levels of inflation and Nominal GDP growth. Inflation is postulated to be always and everywhere a money supply phenomenon, and this relationship is a positive and proportional. To control inflation and nominal GDP, the exogenous money theory prescribes controlling the money supply or its growth rate (Carlin and Soskice, 2006; Fontana, 2007). The theory prescribes a monetary policy framework, based on a money supply growth rule. Notable monetarist paradigm based monetary targeting policy frameworks includes, amongst others, the Freidman k percent monetary growth rule (Freidman, 1960) and the McCallum rule (McCallum, 1987, 1988). As a monetary policy framework, the Freidman Rule is a fixed monetary growth rule prescribing for policy induced money supply to be increased by a constant $k\ percent$ annually. In other to meet the cyclical needs of an economy, the $k\ percent$ growth rate should be equivalent to the rate of real GDP growth (Freidman, 1960). The Freidman rule advocates for monetary growth to be acyclical rather than countercyclical, which runs counter to the Keynesian advocacy. The McCallum Rule (McCallum, 1987, 1988) is underscored the broad framework of the monetarist paradigm. Structurally, the configuration of McCallum framework is motivated to chart smooth part for nominal GDP based on controlling the monetary base:

$$\widehat{MB}_t = \alpha - \Delta v_t^a + \delta(Y_{t-1}^* - Y_{t-1}) \qquad (2.24)$$

Where $\widehat{MB}$ is the change in the monetary base (monetary policy instrument), α is a constant term incorporated to account for steady-state nominal output growth, y is the log of nominal output, Δv^a is the moving average rate of growth of monetary base velocity over the previous 4 years, y_t^* is the target value of y_t for period t. Δ represents the difference operator and δ represents a feedback

coefficient, informing how quickly deviation of output from the target value, is offset by the central bank.

The practical application of this rule, is traditionally based on direct monetary targeting (liquidity management) regime. Direct monetary targeting relies of targeting the deposits (D_b) held with the central bank as a key component of the money supply. Direct monetary targeting is functional through the Central bank institutional capacity to set a requirement for commercial bank customer deposits. This is subject to a reserve requirement ratio (σ). Thus, under direct monetary targeting monetary policy is operational by changes the commercial bank reserve requirements $R = \sigma D$ through change the reserve requirement ratio (σ). Thus, an expansionary monetary policy (a policy of increasing the money supply), involves the central bank lowering the reserve requirement ratio. This reduces the commercial bank deposit requirements with the central bank, thus increasing the quantity of loanable funds available to commercial banks to lend to the non-bank private sector. A contractionary monetary policy (reducing the money supply), has the opposite effect. The macroeconomic effect of such monetary policy actions, is postulated to have direct effects on inflation and nominal GDP.

2.2.5 Some Empirical Measures of Money Supply.

The monetarist paradigm thus perceives the monetary transmission mechanism as the transmission of Central bank induced shocks in money supply, on inflation and nominal GDP. The theory implies a number of key institutional and structural features, which are postulated to define / determine the monetary transmission mechanism and monetary policy. These measures are used to capture various definitions of C_p (measure of the quantity of notes and coins in circulation), and D_p (customer deposits with commercial banks. Hence, shock is monetary policy are broadly identified as shocks in variant measures of *notes and coins in circulation* and *customer deposits with commercial Banks*. Traditionally, these evolve around the monetary aggregates; M0 (monetary base), M1, M2 and M3.

These institutional and structural implications are of these features are variously captured in empirical regularities on monetarist paradigm.

Table 1. Empirical Measures of Money Supply.

Monetary Aggregates (Institutional Measures)	**Empirical Regularities**
M0 (Notes and Coins in Circulation)	• Leeper and Gordon (1992) • Eichenbaum and Evans (1995). • Christiano et al (1996)
M1	• Mishkin (1982) • Reichenstein (1987) • Leeper and Gordon (1992) • Sims (1992) • Eichenbaum and Evans (1995) • Christiano et al (1996)
M2	• Mishkin (1982) • Leeper and Gordon • Christiano et al (1996)
Non -Borrowed Reserves	• Cochrane (1989) • Strongin (1995) • Hamilton (1997)
Total Reserves	• Strongin (1995)
Monetary Conditions Index (MSI)	• Serletis and Chwee (1996)

Source: Adapted from Kelly, Barnett and Keating (2010)

2.3 Endogenous Money Theory (Wicksellian Paradigm): The Conceptual Frameworks.

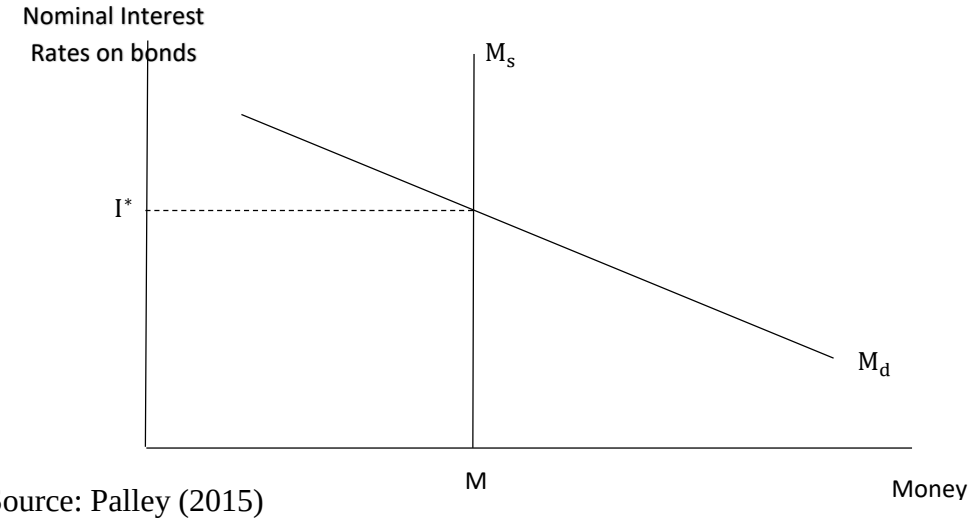
The theoretical conceptualisation of the endogenous money theory emerged from the early criticisms of the monetarist paradigm (Kaldor (1970, 1982). These criticisms are largely bi-fold, including the rejection of both 'active money' and 'money supply exogeneity' postulates, which form the pillars of the monetarist paradigm on the monetary transmission mechanism. The endogenous money thus presented a much complex and dynamic institutional and structural framework of the monetary transmission mechanism. This largely centers on the roles of demand for money (rather that supply of money) and of the financial system, as key institutional and structural determinants of the monetary transmission mechanism, and monetary policy. Variants endogenous money theories postulate the complexity of the financial system ranges from a banking system only, a system constituting a money market and securities market. As a key point of conceptual difference with the monetarist paradigm, the endogenous money theory postulates that not only is money supply is endogenously determined by the financial system, but also that it is passively responsive, rather than active, to interest rates, inflation, GDP growth etc. The endogenous money theory builds on aspects of the early Keynesian framework, which identifies the significance of the financial system, as a key institutional components of the MTM. Selgin and White (1987) for example, described the central conceptual tenet of PK endogenous money supply as based on competitive evolution of monetary arrangements, embodied by how modern financial systems are the result of profit seeking and competitive market forces, subject to central bank intervention. The broader endogenous money theory of the MTM thus has two central tenets; (1) the 'endogeneity of money supply' and (2) that money supply is passively responsive to money demand. Rather being exogenously determined by the central bank, the endogenous money theory postulates that money supply is determined by the financial system (money markets, banking sector, and securities market). The Central bank's leverage over the money supply capacity of the financial systems, derives of its supply of reserves in the market for reserves. The cost of Central bank reserves is exogenously determined (by the Central

bank) and changes in cost (of reserves) is postulated to influence a range of short and long term interest rates, including money market rates, banking lending and deposit rates and returns on bonds and other assets (Palley, 2008). The nature of the relationship between the cost of Central bank reserves and retail market rates, has is a point of difference between the PK Accomodationists and PK Structuralists. The PK Accomodationists postulate that bank lending rates for example are a fixed mark-up on the cost of central bank reserves (Moore, 1988). The PK Structuralist postulate that bank lending rate dynamics is a function of the variable mark-up, driven by the cost of central bank reserves and a host of other structural factors, including the cost of administering the loans and a default risk premium (Palley, 2008; 2013). The supply of money by the financial system is argued to be passively responsive to demand for money (e.g. bank loans), which in turn is determined by interest rates and income amongst other factors (Carlin and Soskice, 2006; Palley, 2008). A key implication of the endogenous money theories is that the monetary transmissions mechanism in underscored by a complex institutional and structural role for the financial system, gives rise to a range of transmission channels of monetary policy including the interest rates transmission channel (Taylor, 1995; Svensson, 1999), bank credit channel (Bernanke and Gertler, 1995; Kashyap and Stein, 1995) and asset channel (Mishkin, 1995) channels of transmission. This section examines the key theoretical endogenous money frameworks and their implications for the institutional and structural dynamics of the monetary transmission mechanism and monetary policy. The section examines Keynesian, Neo-Keynesian and the Post Keynesian contributions.

2.3.1 Keynes (1936) Framework: Liquidity Preference Theory.

In his *General Theory*, Keynes (1936), made fundamental contributions, which formed the foundations of the Neo-Keynesian and Post Keynesian conceptualisations of the monetary transmission mechanism and monetary policy. Tellingly, Keynes (1936) did not reject the exogeneity postulate of the monetarist paradigm. The silence of Keynes on the exogenous money, has traditionally been interpreted as an acceptance of the monetarist position on the exogeneity of money supply.

Figure 2 Conceptual Framework of the Monetary Transmission Mechanism (Keynes, 1936).



Source: Palley (2015)

Keynes' (1936) key contribution to the theoretical conceptualisation of the institutional and structural dynamics of monetary transmission mechanism, is the incorporation of the significant role for the demand for money and the role of interest rates in the transmissions process. Money demand is postulated to be dynamic rather than constant, largely influenced interest rates (on bonds) and income. Keynes (1936) theoretical conceptualisation of the MTM constitutes three institutional linkages; (1) Liquidity Preference, which explains the effect of interest rates on demand for real money balances (2) Interest rate elasticity of the marginal efficiency of investments (effects of bond rates on business investments) and (3) the multiplier mechanism. The relationship between money

demand and interest rates is theoretically synthesised using a portfolio choice framework, in which economic agents are assumed to have a choice of holding their wealth either as money or bonds. Money is assumed to be non-interest bearing, while bonds are interest bearing. A theoretical explanation of why a representative economic agent' holds non-interest bearing money, is provided by the Keynesian 'Liquidity Preference Theory', which effectively explains the effect of interest rate on demand for money. To motivate the effect of bond interest rates on demand for real money balances, Keynes (1936) partitioned demand for money into three types:

$$M_d = M_t + M_p + M_{sp} \tag{2.25}$$

Where M_d is money demand, M_t is transactions money demand, M_p is the precautionary money demand and M_{sp} is speculative money demand. The transactions (M_t) and precautionary (M_p) demands for money are postulated to be functions of income, while speculative demand for money balance (M_{sp}) is a function of interest rates. Effectively, the Keynesian liquidity preference theory provides that demand for money balances constitutes active money ($M_t + M_p$) and passive money (M_{sp}) balances. The active money component is postulated to be determined by income (Y), while the passive money component (speculative of demand for money) is postulated to be determined by interest rates. Thus

$$M_{SP} = f(r) \tag{2.26}$$

Equation 2.26 provides that the passive money demand component (M_{SP}) responds to changes in interest rates (r) on bonds. To the extent that interest rates are variable, money demand is postulated to be dynamic rather than constant. This is a main point of theoretical difference with the classical and early monetarist framework. The Keynesian theoretical exposition treats money is as an asset. Businesses are assumed to borrow in the capital markets by issuing bonds. An inverse relationship is therefore, postulated to exist between bond prices (capital gains) and rates of return (interest rates).

Household holding of speculative money balances is postulated to be driven by their expectations of future interest rates movements and the impact this would have on bond prices (capital gains or capital loss). Where rates are low, household expectation of future rates rise and the subsequent potential capital loss on bonds holdings causes demand for bonds to fall, resulting to an increase in speculative money balances. The opposite is true for high interest rates. Interest rates therefore have a negative causative effect on speculative money demand. Accordingly, demand for money is function of interest rates and income.

$$M_d = f(r, Y) \tag{2.27}$$

Where M^d represents the demand for money, r is interest rates and Y is income. Fundamentally, the liquidity preference theory provides that a negative relationship exists between money demand and interest rates. The central Keynesian argument that money demand is variable rather than constant and that it is a function of interest rates (cost of capital) formed. Under the postulation that business issue bonds to raise capital for investments, the early Keynesian theory provides that bond interest rates are negatively related to business investment spending:

$$I_t = f(i_t) \qquad \frac{\partial i_t}{\partial I_t} < 0 \tag{2.28}$$

Where I_t represents aggregate investment and i_t is the cost of capital, in this case the interest rate on bonds, which the model postulates as the only enterprise financing instrument. Further, investment spending is positively related to output growth ($\frac{\partial I}{\partial Y} > 0$). Hence the Keynesian framework provides that interest rates on bonds is negatively related to output growth ($\frac{\partial i}{\partial Y} < 0$). The Keynesian portfolio choice theory has been extended to explain effect of interest rates on household investment and spending. This has been synthesised as a household portfolio optimisation framework (Fama, 1980; Cecchetti, 1995). In Fama's seminal work (Fama, 1980), the class of interest rates bearing assets

were extended beyond 'money' and 'bonds only' provision of the money view. Fama included other interest bearing assets including real estate, equity and bonds and non-interest bearing money, the interest rates on which, influence aggregate investment behaviour through what he referred to as investor portfolio optimisation problem. Investors are argued to distribute their wealth amongst real estates, bonds, equity and money. Changes in the returns on assets or other exogenous macroeconomic variables (money supply) affect the portfolio optimisation balance and hence investors adjust their portfolios to continue optimising their aggregate returns.

2.3.2 The Neo-Keynesian Endogenous Money Theory.

The key contribution of the Neo-Keynesian (NK) endogenous money theory is the provision of an explicit, institutional role for the banking system in the monetary transmission mechanism. The theory implicitly provides that the banking system is an institutional / structural determinants of the monetary transmission mechanism. This is underlined by the conceptualisation that money supply is endogenously determined by the banking system. The NK model thus introduced a money multiplier model, providing a clear demarcation between exogenous money (Central bank liabilities) and endogenous money (bank deposits created by the banking system). The exogenous money supply is identified as constituting real money supply (liabilities of the central bank) and nominal money supply. While the real money supply is exclusive determined by the Central bank, nominal money supply is endogenously determined by the banking system. Thus, rather than being perfectly inelastic, the nominal money supply is postulated to be dynamic, influenced by interest rates, money multiplier mechanism and the supply of central bank liabilities. Palley (2015) provided a synthesis of the NK framework as follows;

$$H^s = H/P \tag{2.29}$$

$$M^s = m(i,k)H^s \qquad m_i > 0,\ m_k < 0 \tag{2.30}$$

$$M^d = M(i,y,X) \quad M_i < 0, M_y > 0, M_X > 0 \tag{2.31}$$

$$M^s = M^d \tag{2.32}$$

Where H^s is the real supply of exogenous money (the liabilities of the central bank), H is the exogenous nominal central bank money supply. M^s is the supply of endogenous money, identified as $m(.)$ is the money multiplier, constituting the bank lending rates (i) and the reserve requirement ratio for bank deposits (k), and the volume of high powered money (H^s). The NK endogenous money theory, thus identified an institutional and structural role for key banking sector balance sheet variables. This includes an implicit identification of the level of bank deposits and bank credit supply, as structural determinants of endogenous money. The NK endogenous money theory further implies the existence of an interest rates transmission channel (i) and a bank credit supply channel (k)

2.3.3 Post Keynesian (PK) Endogenous Money Theory.

The Post-Keynesian (PK) Endogenous Money Theory, as a theoretical development on the NK endogenous money theory, explicitly rejected the exogeneity of money supply postulate. Money supply is thus argued to be exclusively, and endogenously determined by the financial system. The institutional and structural role of the financial system as the exclusive determinant of endogenous money supply, is therefore a prominent feature of the PK endogenous money theories' conceptualisation of the monetary transmission mechanism and monetary policy (Palley, 2008). What constitutes, and the complexity of the financial system, varies between the two main PK endogenous money theories; Post Keynesian Accomodationists, and the Post Keynesian Structuralists (Moore, 1988; Pollin, 1991). Both frameworks subscribe to the core PK view that bank lending drives the money supply, and the endogeneity of money supply postulate (the PK Accomodationists identify the banking sector, while the PK Structuralist identify the financial sector comprising the money markets, banking sector and securities (bond) markets. Moore (1988) however partitioned the alternative PK theories into PK *Horizontalists* and PK *Verticalists* (See also Palley (2008). In addition to the institutional and structural complexity of the financial system, key difference between the PK Accomodationist and the PK Structuralist frameworks is the

determination of bank lending rates, and the importance of any asset and liability management constraints of commercial banks by which deposit created by lending are supported. Fundamentally, the Accomodationists postulate that the asset and liability management of banks is not important. Central bank accommodates whatever the demand for reserves is, from banks. Accomodationists therefore argue that liquidity pressures do not matter and the supply of finance to banks is infinitely elastic at a price set by the central bank. The structuralist on the other hand, argue that bank asset and liability management is important, that it is not a necessary requirement for CBs to provide liquidity and that the process by provide liquidity is important (Palley, 2006). Effectively, structuralist postulate that liquidity pressures are important and banks face rising supply of finance (Palley, 2008). Palley (2008) further summarised these expositional differences (between the PK Accomodationists and the PK Structuralists) as: (1) the factor determinants of the complex interest rates and asset prices, (2) the behaviour of financial institutions and whether they are constrained by the availability of liquidity (reserves) from the CB and, (3) the supply price of finance to banks. Structuralists believe liquidity pressures matter and banks face a rising supply price of finance. The synthesis draws of the Palley (2008) model expositions of the PK theories.

Monetary policy (central bank policy rate) is prescribed as controlling the exogenously determined cost of reserves, which is the central bank policy rate (Fontana, 2007). Contemporary perspectives of the nature of the MTM and monetary policy such as the New Keynesian and the New Consensus Macroeconomics (NCM) frameworks are broadly underscored by the endogenous money theory, with short interest rates as the default monetary policy instrument. The policy rate then influences other money market rates, bank loan rates, securities return and hence, forming the key institutional foundation of the PK endogenous money theory of MTM and monetary policy (Howells, 2008). A key institutional implication of the PK endogenous money theory is the identification of a number of cost of capital channels of transmission linking monetary policy and real sector activity. Conventional literature identified these as cost of capital short term debt (through the money market),

cost of bank loans (through the banking sector) including bank loans and money market debt instruments (more than the cost of Keynesian bonds channel), and assets prices channel. In this section PK Accomodationist and the PK Structuralist endogenous money theories.

2.3.3.1 Post Keynesian Accomodationist / Horizontalist Theory.

Prominent proponents of Horizontalism include Moore (1988) and Lavoie (1984, 1996, 2006). The central tenet of PK Horizontalists contribution to the endogenous money theory is the incorporation of bank loans in the money supply process. Money supply is argued to be exclusively credit driven. The modelling of the financial sector and the determination of interest rates focuses on the banking sector and the bank loan rate. Accomodationists theory therefore traditionally ignore financial markets and asset price determination (Palley, 2008). Functionally, the CB's power to set interest rates (overnight rates) and provide reserves to commercial banks is a central tenet of PK Accomodationist model. Accordingly, the Accomodationists assume an exogenous setting of the policy interest rate by the central bank (Pollin, 1991, 1998). With respect to the supply of reserves, CBs are postulated to make funds available to the banking system at a fixed rate, according to a perfectly elastic supply curve. Accordingly, the banking system faces no liquidity constraints. The CB is postulated to set interest rates (overnight rates) and is forced to accommodate increases in demand for reserves caused by increases in bank lending. There are two alternative Accomodationist models on how interest rates (bank loan rate) are determined; (1) bank loan rate as are fixed as a mark-up on the CB overnight rate and (2) bank loan rates are variable, dependent on the volume of lending and associated perception of exposure to credit risk. Palley (2008) called these two models-strong form and weak form Accomodationists models respectively. Palley (2013) synthesised the Accomodationist endogenous money theory using the following simplified model:

$$i_L = (1 + m)i_F \tag{2.33}$$

$$L^D = L(i_L \dots\dots\dots) \quad L_{iL} < 0 \tag{2.34}$$

$$L^S = L^D \tag{2.35}$$

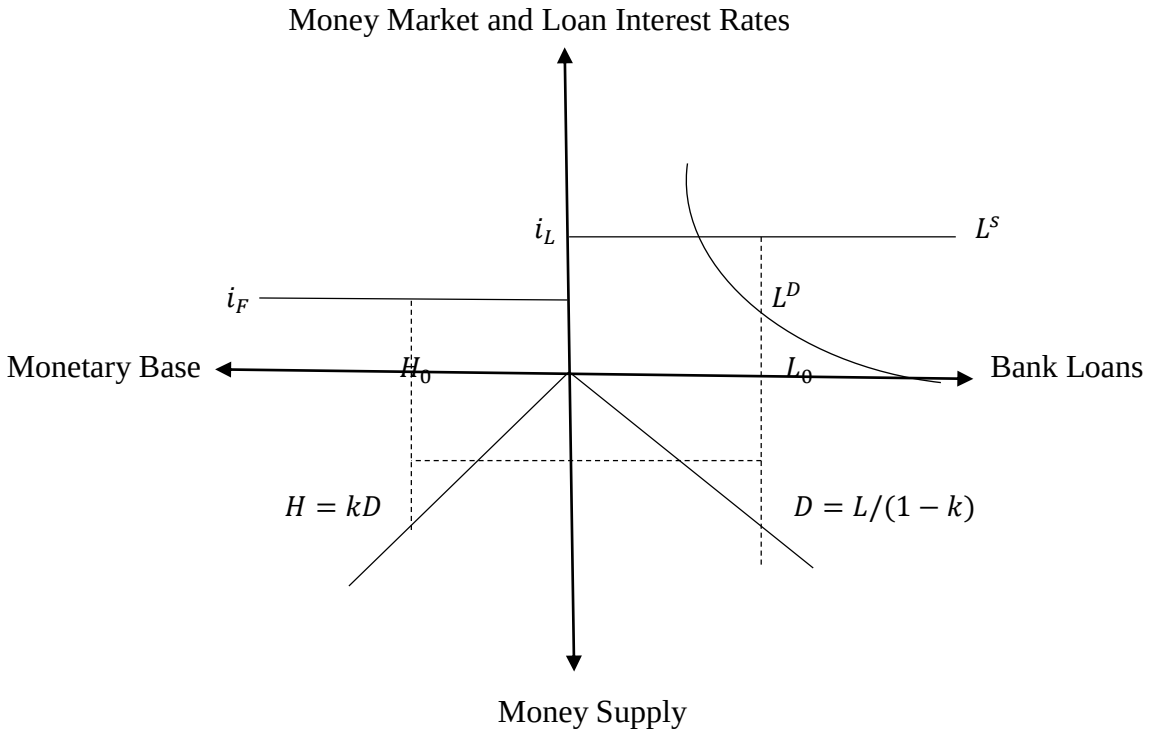
$$L^S + R = D \tag{2.36}$$

$$R = kD \qquad 0 < k < 1 \tag{2.37}$$

$$H = R \tag{2.38}$$

Where i_L is the loan rate, m is the bank loan mark-up, i_F money market rate set by policy, L^D is the loan demand, L^S is loan supply, R is the required reserves, k is the required reserve ratio and H is the monetary base. Equation (2.33) provides that bank loan is a mark-up on the overnight rate, which is the cost of finance faced by banks, set by the CB. Equation (2.34) is the loan demand function, providing that loan demand is a negative function of the loan rates and other unspecified factors. Equation (2.35) provides that loan demand equals loan supply. Equation (2.36) represents the banking sector's balance sheet, with Loans and reserves held with the CB as assets and deposits as liabilities. Equation (2.37) determines banks holdings of reserves, which is equal to the required reserves. Equation (2.38) defines the monetary base, which is equal to the supply of reserves. Palley (1994) extended this model by incorporating *bank excess reserves, time deposits* and *currencies held by non-bank public*.

Figure 3. The Accomodationist Model of the Money Supply Process.



Source: Palley (2013).

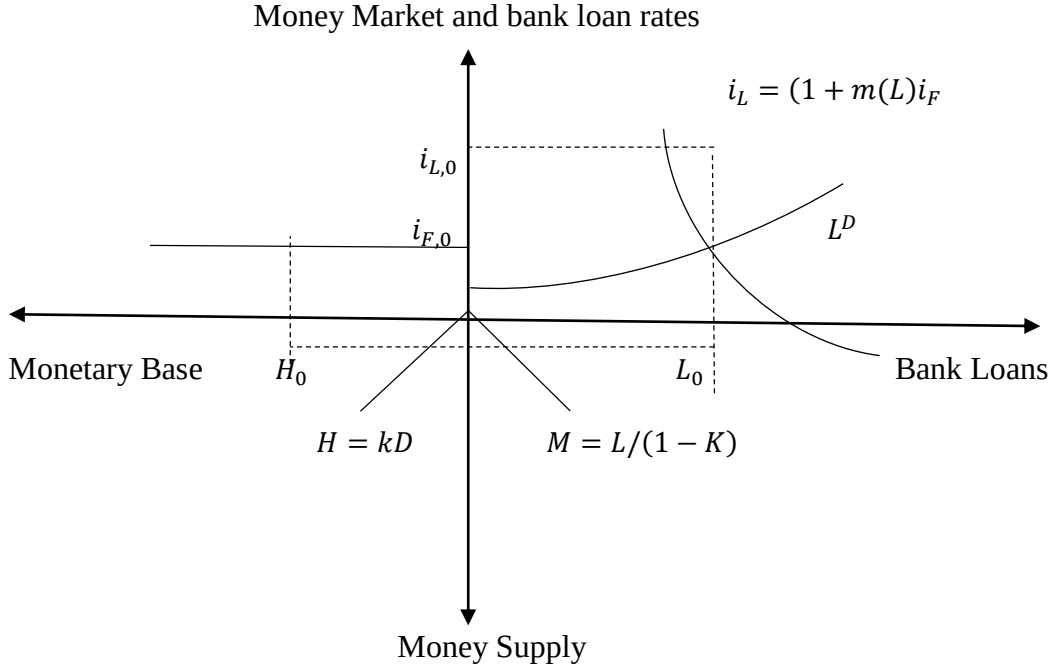
The Accomodationists postulate that the supply of the monetary base, which is equated to the supply of reserves ($H = kD$), is infinitely elastic at the CB policy determined rate (overnight rate). This supports the neo Keynesian position under interest rates targeting. Given the loan rate is postulated to be a mark-up on the CB policy determined rate, the banking system loan supply schedule is infinitely elastic (Moore, 1998) at the loan rate and thus, postulated to be horizontal. Bank lending determines deposit creation and hence money supply (Palley, 2013). The supply of the monetary base (central bank reserves) responds to loan demand (deposits created). This is done through open market operations (buying / selling bonds from non-bank economic agents). From the household portfolio optimisation framework, an open market operation of buying bonds from the non-bank economic agents would bid up the prices of bonds, thus causing bond interest rates to fall. This lowers the opportunity cost of holding real money balances thus motivating the households to increase their portfolio real money balances. The main difference between the strong for Accomodationists and the weak form Accomodationists is the determination of loan rates. While the strong form postulate the

loan interest rate to be a fixed mark-up on the overnight rate ($i_L = (1 + m)i_F$), the weak form Accomodationists argue that the loan rate mark-up varies with the lending volume, to reflect risk (Lavoie, 1996). Thus the weak form Accomodationists loan rate function is as:

$$i_L = (1 + m(L)i_F \qquad m_L > 0 \qquad (2.39)$$

Where *L* represents the volume of lending.

Figure 4. Weak Form Accomodationist Model with Variable Loan Rate Markup.



Source: Palley (2013)

A fundamental theoretical postulate of the Accomodationists models is that financial institutions / banks do not face liquidity pressures. The supply of CB reserves is argued to be infinitely elastic at the exogenously determined fixed overnight rates (Moore, 1988). The Accomodationists theory postulate that commercial banks face a constant supply price of finance at which there is an infinite supply of CB reserves. Accordingly, banks do not face liquidity constraints. Under assumption of profit maximisation bank loan rates are conditional on the policy rate, set as a fixed mark-up over the overnight rate or a variable mark-up linked to the volume of lending and perception of default

risk (Lavoie, 1996). The determination of long term interest rates in the Accomodationists models are underscored by the expectations theory of interest rates (Palley, 2013). This postulates that long term interest rates are a function of current short term rate and expectations of future short term rate. The arbitrage behaviour of bank across market periods, based on their expectations of future short term interest, determines their long term interest rates. Thus the Accomodationist theory provides that the term structure of interest rates should reflect expectations of future short term interest rates (Moore, 1991). Empirical regularities on the term structure of interest rates however, conjects the Accomodationist expectations theory of long term interest rates determination (Shiller, 1990). Pollin (1991, 2008) delivered an empirical critique of the PK Accomodationists theoretical exposition of interest rates determination, in which the author opined that interest rates determination is rather complex, exhibiting multi-directional causality. Pollin further opined that long term interest rates exhibit significant endogeneity. Effectively, the PK Accomodationists account of interest rates formation is not only one dimensional (focusing only on a single interest rate (loan rates) but also the exposition of long term interest rates formation is empirically disputed (Fontana, 2007). Additionally, the Accomodationist models such as Moore (1988) completely ignored money demand / liquidity preference (Goodhart, 1989, 1991 and Howells (1995).

2.3.3.2 Post Keynesian Structuralist Theory.

The PK structuralist theory, broadly embraces the core Accomodationist theoretical postulate that bank loans create deposits, and therefore bank credit forms a critical component of the endogenous money supply. However, the PK structuralist theory incorporated multi interest rates and money demand, thus the effect of liquidity preference on interest rates. Palley (2013) opines that the PK structuralist framework fills the omission and oversights of the Accomodationists arguments (Palley, 2013). These omissions include the incorporation of money demand (liquidity preference) and a multi-dimensional approach to interest rates, all endogenously determined. Within the Accomodationists frameworks, the overnight interest rate is exogenously determined by the CB (See

for example Moore, 1988). On the questions of determination of complex interest rates and asset prices, the PK structuralists theory motivates a multi-market equilibrium approach to interest rates determination. This means that PK structuralist model is a multi-interest rates model. This contrasts with the PK Accomodationists focus on the bank loan market, where bank loan rates are a fixed mark-up on the overnight rate or a variable mark-up on the lending rate. The PK structuralists combine the market for reserves, bank credit market and the assets markets. Interest rates and assets quantities are therefore argued to be a function of a number of structural factors. The structure of demand for and supply of financial assets, including money supply, determines interest rates and asset prices. Demand for assets is a function of portfolio preferences, transactions needs, transactions costs, expectations and underlying economic environment (Palley, 2008). Supplies of financial assets (including money supply) endogenously responds to asset demand and the dynamics of response is significantly influenced by the stance of monetary policy (overnight interest rate). A simplified version of Palley's exposition of the structuralist theory (Palley, 1988) in synthesised herein. The model is described by the following equations:

$$M = M(i_M, i_B, Y, E, X) \qquad M_{iM} > 0, M_{iB} > 0, M_Y > 0, M_E > 0, M_X > 0 \tag{2.40}$$

$$L = L(i_L, y, A) \quad L_{iL} < 0, L_y > 0 \tag{2.41}$$

$$L + kM = M + B \tag{2.42}$$

$$i_L = (1 + m(L)i_F + c \qquad m_L > 0, c > 0 \tag{2.43}$$

$$i_M = (1 - k)i_F - Z \tag{2.44}$$

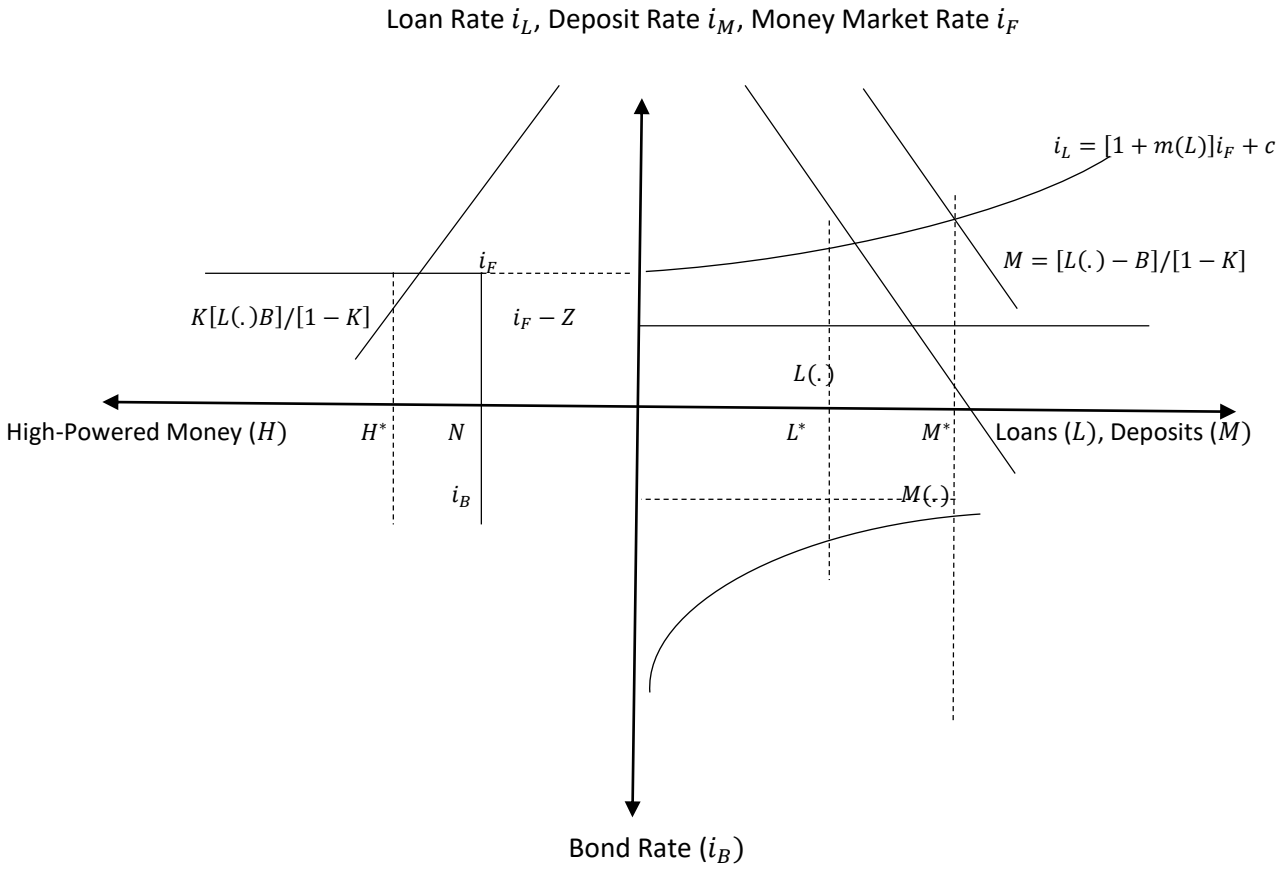
$$H = N + B = kM \tag{2.45}$$

Where M is demand for real money balances (bank deposits), i_M deposit interest rate, i_B is interest rates on bonds, y is real income, E is a vector of expected future interest rates, X is a liquidity

preference shift factor, H is supply of high-powered money, L is real loan demand, k is reserve requirements on deposits, N is non-borrowed reserves, B is borrowed reserves, i_L is loan interest rate, c is the bank cost per dollar of making loans, and Z is cost per dollar of supplying loans. The incorporation of the money demand function is one of the expositional differences between the PK Accomodationists of Moore (1988) and the PK structuralists' models of Palley (2008). The PK structuralist incorporated a money demand (demand for bank deposits) as a determinant of bank loan interest rates. The PK structuralists postulate that money demand (demand for bank deposits) is a positive function of the deposit interest rate (i_M) and income (y) and a negative function of bond rates (i_B), Equation (2.38) provides that real loan demand (L) negatively depends of bank loan rates (i_L) and a positive function of income (y). Equation (2.40) postulates the banking sector balance sheet identity, with loans (L) and required reserves (kM) constituting assets while deposits (M) and borrowed reserves (B) constituting liabilities. The incorporation of the borrowed reserves signifies the role of money markets (interbank market) in the PK structuralist framework. Banks borrow in the money markets at the money market rate. Equations (2.41) and (2.42) define the functional determinants of the bank loan rates and deposit rates. The PK structuralists' model determined the bank loan rate as a function of a variable mark-up over the money market interest rate and an increasing function of the volume of lending $(1 + m(L)i_F)$ plus the cost of per dollar (c) of making loans. The deposit rate on the other hand, is determined as a mark-down over the money market cost of funds $(1 - k)i_F)$ and the costs of administering deposits (z) and holding reserve requirements (k). Equation (2.43) represents money market equilibrium condition in which the supply of high-powered money equals demand for money. The demand for high-powered money consists of required reserves. A key postulation of the PK structuralist, as is with the postulations of the PK Accomodationists is that money supply is endogenous, driven by money demand. The exposition of the PK Structuralist model as synthesised by Palley (2013) is shown in figure 5 below.

Figure 5. PK Structuralist determination of high powered money, money supply, bank lending and interest rates.

and interest rates**.**



Source: Palley (2013).

Figure 5 shows the multiple interest rates dimension of the PK structuralist exposition of the endogeneity of the money supply process. Effectively, the reserves market, the credit market and the assets market motivate a multiple rather than the PK Accomodationist single interest rate (bank loan rate) exposition. The credit market determines the bank loan rates. A fundamental postulation of the PK structuralist model is that there are two sets of interest rates; a short term interest rate and a long term interest rate. The short term interest rate is exogenously determined by the CB (policy authority). The long term interest rate is postulated to be endogenously determined by the money markets. The theoretical exposition of the determination of long run interest rates and its subsequent effect on aggregate demand and prices differs from the PK Accomodationists. Whereas the PK

Accomodationists provide that long term interest rates are determined by expectations about future short term interest rates, the PK structuralists developed on this by postulating that long term interest rates are a function of the dynamics of liquidity preference and expectations about future short term interest rates. This provides that long term interest rates are influence by money demand as functionally determined by the opportunity cost (interest rates on bonds). An increase in liquidity preference (increase in money demand), shifts the money demand function, causing the prices of bonds to fall, thus the interest rates on bonds to rise. Palley (2013) motivated loan demand (liquidity preference) and bank loan rates as positive functions by bond rates.

$$L = L(i_L, i_B, y, A) \qquad L_{iL} < 0, L_{iB} > 0, L_y > 0, L_A > 0 \tag{2.46}$$

$$i_L = [1 + m(L, i_B]i_F + C \qquad m_L > 0, m_{iB} > 0, m_c > 0 \tag{2.47}$$

This specification provides that the PK Structuralists determine the money supply process as driven by the market for reserves, credit market conditions (demand for money) and asset market. This means a multi-market equilibrium approach to interest rate determination. Long term interest rates as a function of expectations about future short term interest rates embodies the PK Accomodationists theory.

2.3.4 Channels of Monetary Transmission: Post Keynesian Theories.

A key structural implication of the broader PK endogenous money theory is the postulation that monetary policy is transmitted to the real sector through a number of channels of transmission. These PK channels of transmission largely derive from the structural role of the financial system in the MTM and monetary policy. The literature on the MTM and monetary policy identified three PK endogenous money channels of monetary transmission; the cost of capital (interest rates) transmissions channel, the bank credit channels and the asset prices channel (Mishkin, 1995). In this section, we review the endogenous channels of monetary transmission.

2.3.4.1 Interest Rates (Cost of Capital) Transmissions Channel.

A central tenet of the broad PK endogenous money theory is the significance of the financial system as a key institutional component of the MTM and monetary policy. The financial system is postulated to serve as a systematic link between monetary policy and the real sector. One such channel is postulated to be through interest rates (cost of capital) channel. The PK endogenous money theoretical framework identifies the 'cost of capital', conventionally referred to as the 'user cost of capital' as one such channels (Boivin, Kiley and Mishkin, 2010). The PK endogenous money framework has been widely accepted as the theoretical benchmark model for explaining the monetary effects of interest rates changes on aggregate demand (Hubbard, 1995). The cost of capital is therefore postulated to be a key channels through which the effect of monetary policy (policy rate) are transmitted to determined aggregate demand (Boivin, Kiley and Mishkin, 2010). Changes in the policy rate is postulated to cause the cost of capital to change, thus influencing demand for money and hence consumption and investment spending. The cost of capital channel is postulated to operate through changes in nominal or real cost of capital (Walsh, 1998; Svensson and Woodford, 2000) or changes in the term structure of interest rates (Smets (1995), Taylor 1995).

The theoretical models of the cost of capital channel, within the broader MTM theoretical frameworks can broadly be divided into; (1) the neo-classical models of investment in the traditions of Jorgenson (1963) and Tobin (1969) and, (2) Keynesian framework (Keynes, 1936) as developed and extended in the broader PK endogenous money theory (Palley, 2013). The theoretical expositions of these theoretical frameworks postulate that changes in the CB policy rate affects the cost of financial assets (money market debt instruments, bank loans, bonds and other securities). The theoretical framework of the interest rates transmission channel constitutes the following key relationships:

$$i_t = f(R_t) \qquad \frac{\partial R}{\partial i} > 0 \tag{2.48}$$

$$M_t^D = f(i_t) \quad \frac{\partial i}{\partial M^D} < 0 \tag{2.49}$$

$$I_t = f(\, i_t) \quad \frac{\partial i}{\partial I} < 0 \tag{2.50}$$

$$y_t = f(i_t,) \quad \frac{\partial i}{\partial y} < 0 \tag{2.51}$$

$$\pi_t = f(i_t,) \quad \frac{\partial i}{\partial y} < 0 \tag{2.52}$$

Equation (2.48) provides that market interest rates (i_t) is a positive function of the CB policy rate. Increases in the CB policy rate (R_t), causes increases in the market interest rates (i_t), which constitutes the short money market rates, bank lending and deposit rates, and returns on securities such as bonds. Both the PK Accomodationist and Structuralists postulate that market interest rates positively respond to changes in the CB policy rate (Moore, 1988, Palley, 2008, 2013). Equation (2.49) provides that demand for money (M^D) is a negative function of market interest rates, such that rises in market interest rates causes demand for money to fall. Equation (2.50) is an investment function, which provides that investment (I_t) by the representative household and business, is a negative function of interest rates (i_t). Equations (2.51) and (2.52) both provide that output (y_t) inflation (π_t) are negative functions of the market interest rate (i_t). The structural exposition of the cost of bank loans channel can thus be functionally represented as:

$$\Delta R \rightarrow \Delta \boldsymbol{i} \rightarrow \Delta I \rightarrow \Delta(\pi/y) \tag{2.53}$$

Where ΔR is the change in the monetary policy rate, Δi_L is the interest rate on bank loans (cost of bank loans), ΔI is change in household and business investment spending and $\Delta(\pi/y)$. While the PK Accomodationist theory postulates a single market (banking sector) interest rate (bank loan rates),

the PK Structuralist endogenous money theory postulates a multi-market (money market, banking sector and securities market) and hence multi-interest rates transmission mechanism; identifying a money market interest rates, bank loans rates channel and bond interest rates channel (Palley, 2013).

2.3.4.1.1 Cost of Bank Loans Channel.

The PK Accomodationist and Structuralist endogenous money theories identify the banking sector as a key institutional component of the money supply process in their capacity as financial intermediaries. Under assumption that economic agents rely on bank loans to finance investment spending, the cost of bank loans becomes an intermediate targeting for monetary policy. Hence, the cost of bank loans is postulated to be a key channel through which monetary policy shocks are transmitted to influence aggregate demand (household and business investment spending). The broader theoretical framework of the 'cost of bank loans' channel has been described in Bernanke and Blinder (1988) as; (1) The central bank influence demand for reserves from the banking system through the policy rate, (2) banks capacity to create more money (through creating deposits or purchasing securities from households) is altered; (3) the changes in liquidity in the banking system relative to demand from households, changes retail interest rates; (4) changes in market interest rates and liquidity conditions change aggregate spending. Two key institutional linkages in the 'cost of bank loans' channel include; (1) the relationship between the monetary policy (policy rate) and bank loan rates, (2) the effect of bank loans rates on demand for bank deposit by economic agents (business and households). The broad endogenous money theoretical exposition is that the policy interest rate (monetary policy) has a positive causative effect on bank loan rates. The PK Accomodationists exposition is that the bank loan rate is a positive mark-up on the policy rate, which is exogenously determined by the CB (monetary policy authority). The strong form PK Accomodationists postulate the relationship between of monetary policy (the policy rate) and the bank loan rates using the following functional specification (Palley, 2013):

$$i_L = (1 + m)i_F \quad m_{iF} > 0 \tag{2.54}$$

Where i_L represents the bank loan rate, m is the mark-up, i_F is the policy interest rates. The PK Accomodationists determines bank loans rate as a fixed mark-up on the policy rate, and hence postulate a positive relationship between the policy rate (monetary policy) and the nominal interest rate on bank loans. The weak form PK Accomodationist link monetary policy with the nominal bank loan rates as:

$$i_L = (1 + m(L)i_F \quad m_{iF} > 0 \tag{2.55}$$

The weak form PK Accomodationists postulates a positive relationship between the policy rate and the nominal bank loan rate. However, the PK strong form Accomodationists determine the bank loan rate a variable mark-up determined by the policy rate and a default risk premium linked to the volume of lending to economic agents. The weak form PK Accomodationists therefore provide that an increase in the policy rate leads to an increase in the nominal bank loan rates. Equally, increase in the volume of bank lending causes the bank loan rates to increase. The PK structuralist postulate that monetary policy rate has a positive effect on the bank loan rates, in the functional structure:

$$i_L = (1 + m(L))i_F + c \quad m_L > 0, m_{iF} > 0, c > 0 \tag{2.56}$$

Bank loan rates are postulated to constitute a variable mark-up on the policy interest rate, the volume of lending and the cost of administration of the loan. The PK structuralist therefore postulate that the cost structure of the banking sector or of an individual bank, becomes an institutional factor in determining the cost of bank loans and potentially the response bank lending rates to the policy rates and hence, their effects on demand for money (loans). The literature provide that the costs determinants of bank loans can be direct costs or indirect costs. The cost of bank loans may be fixed as a sum of the costs (indirect and direct costs):

$$i_L = \tau_L + C_L = (1 + m_L)C_j \qquad (2.57)$$

Where i_L represents the bank loan rate, $\tau_L$is the indirect cost, c_L is the direct costs and m_L is the mark-up. The effect of a change in any of the costs on the bank loan rate depends on amongst other factors, the banks objective. Under a profit-maximisation assumption, Sawyer (1983) showed that institutional factors such as the elasticity of demand, degree of concentration and the interdependence of firms determined the cost effect of mark-up. However, other institutional factors have been identified as determinants of banks pricing behaviour and hence interest rates pass-through to the cost of bank loans, induced by a monetary policy shock. Greenwood-Nimmo et al (2010) opined that these institutional and macroeconomic factors include both banking sector, bank specific and systematic risk factors. These factors are postulated to be determinants of interest rates pass-through, described as the degree of changes in the policy rate that is transmitted to the bank loans (Fontana, 2007). The institutional and macroeconomic factors pertain to banking sector factors (competition, concentration), risk perception, liquidity factors (balance sheet) and macroeconomic/ systematic risk factors (Sawyer, 1983). The institutional and structural factors are postulated to influence the cost of bank loans and their responsiveness to monetary policy shocks. Gambacorta (2007) for example, opined that institutional / structural features of the banking sector, as well as bank specific factors influence the dynamics of bank loan rate and their responsiveness to monetary policy shock, and hence the effectiveness of the cost of bank loans channel. Cecchetti (1999) provided that the strength and scope of the banking system influences the effects of monetary policy innovation on the cost of bank loans. Mojon (2000) identified four banking sector factors as determinants of interest rate pass through. These factors include competition amongst banks, competition from non-bank financial sector, dynamics of bank costs. Cecchetti (1999) argued that differences in the size, concentration, balance sheets strengths and the availability of non-banking sector could explain policy induced interest rates transmission asymmetries on inflation and output in the Eurozone. (See also Corvoisier

and Gropp, 2001, banking sector concentration impacts on interest rates dynamics. In line with the Tobin Q theory (Tobin, 1963), Markovic (2006) provides that to the extent that banks borrow capital in the money markets, the strength of their balance sheet (liquidity, assets to liability ratios, profitability) will determine their interest rates they face and by implication, how much of this is passed on to borrowers at the retail level. The stronger a borrowing bank's balance sheets, the lower the external finance premium they face in the money market (Markovic, 2006), and the more competitive the retail level interest rates they are able to pass on the households and firms. Equally, according to the lending view, monetary policy affects the reserves of banks. Banks with strong balance sheets will be able to adjust to monetary policy induced changes in reserves, without much impact on loans supply or the cost of funds. Gambacorta (2007) argued that to the extent that bank loan demand in not perfectly elastic, the monetary policy on retail bank level interest rates is more pronounced for small, low-liquid and low capitalised banks. The implication is that changes in the financial structure, particularly in the structure of banking sector, could have structural implications for the monetary transmission mechanism and for the effect of monetary policy. The empirical literature also postulated the view that differences in the institutional structure of the banking sector contributes to cross country differences in pass-through through the cost of bank loans (De Bondt et al, 2005; Sander and Kleimeier, 2004) as well as a degree of sluggishness in the reaction of retail level interest rates to changes in both the policy rate and the money markets rates. For example, De Bondt et al (2005) and Gambacorta (2005) pointed out lags of between one and three months in the Euro zone. Research in the Euro Zone also find differential adjustment rates; with the rates on long term enterprise loans, personal loans, mortgage loans and time deposits more sluggish that short term loans to firms attributed to differences in financial structure, including the banking sector (De Bondt et al, 2005). Lowe and Rohling (1992) and Nabar et al (1993) found that relative adjustment cost of retail levels interest rate is a significant determinant of changes in policy or money market interest rates. This is premised on the argument that banks analyse the cost and benefits of adjustment, by

evaluating whether the revenues from squaring their target or optimal rate with the current rate, exceeds the costs in term of labour cost, cost of computing, notifying customers and the agency costs arising from asymmetric information between banks and borrowers (Nabar et al, 1993).

2.3.4.1.2 Interest Rates on Bonds (Debt) Channel.

An institutional feature of the PK Structuralist endogenous money theory is the multi-market interest rates transmission mechanism. In addition to the money markets and the banking sector, the securities (bond) market and the interest rates on bonds is postulated to provide a key channel through which monetary policy shocks are transmitted to the real sector (Palley, 2008, 2013). Under a theoretical postulation that business and corporation borrow capital by issuing bonds and that bond holdings constitute a key asset in representative household portfolio, monetary policy induced changes in the returns on bonds and the as a cost of capital channel. Changes in bank loan rates and returns on bonds on demand for bank deposits and bond holdings by households / bonds issues by businesses respectively, Hence, under assumption that economic agents are assumed to rely on external capital (bank loans and bonds) fund investment spending, demand for capital is postulated to be a function of interest rates (cost of capital) on bank loans (including mortgage loans, personal loans etc.) and bonds, which are assumed to be the traditional investment financing instruments for economic agents (households and businesses. Functionally, determinants of money demand are generally represented as:

$$M^D = f(\, i_L, i_B, Y,) \qquad (2.58)$$

Where M^D is demand for money by economic agents, i_L is the interest rates on bank loans, i_B is the interest rates on bonds, Y is income. From the context of the endogenous money theory, equation (2.58) identifies two main cost of capital channels; the cost of bank loans channel (i_L) and the cost of bonds channels (i_B) as providing channels through which monetary policy (CB policy rate)

influences demand for money by economic agents, and hence household and business investment spending in an economy.

2.3.4.2 Post Keynesian Theory: Credit Channel.

The central tenet of the bank credit channel of monetary transmission is the postulation that policy induced monetary policy is transmitted to the real sector through changes in bank loan supply dynamics. The foundation of the bank credit channels broadly emerged from the NK endogenous money theory, which provided that bank credit is a key component of the endogenous money supply process. The central theoretical postulation is that bank credit creates deposits, thus aggregate demand (Moore, 1988, Palley, 2008; 2013). Palley's (2013) PK endogenous money model for example, links bank loan supply equation, as a key structural component of the money supply process and hence the MTM.

$$L = L(i_L, y, A) \qquad L_y > 0 \tag{2.59}$$

Where L represents the bank loan supply, i_L is the interest rate on loans, y is income. The theoretical framework of the bank credit channel of monetary transmission is underscored by the postulated special role of bank loan supplies, as imperfect substitutes to bonds. Bank loans are postulated to be alternative source of capital to bonds and hence, lumping all financial assets into 'bonds' in the portfolios of economic agents has been criticised by amongst others, Bernanke and Blinder (1988). The bank credit channel however is postulated to supplement the cost of capital channel, rather than being an alternative channel (Bernanke and Blinder, 1988). Theoretical expositions of bank credit are underscored by the distinct role played by bank assets and liabilities (Walsh, 1998). The effect of monetary policy on the real economy is postulated to be transmitted through the dynamics effect on bank loan supplies. Central to the theoretical exposition of the bank credit channel is the presence of market imperfections, including information asymmetries (Bernanke and Blinder, 1988), credit rationing (Stiglitz and Weiss, 1981). Central to the market imperfection theory and hence the

theoretical exposition of the bank credit transmissions channel, is postulation on the existence of imperfect information between lenders (banks) and non-bank borrowers. Imperfect information between the parties is postulated to affect; the nature of credit contracts, the ability of credit markets to efficiently match borrowers and lenders; the role interest rates play in allocating credit amongst borrowers. Accordingly, the presence of credit market imperfections can determine how an economy responds to shocks and how these are transmitted to the real sector (Walsh, 1998).

The central tenet of the concept of imperfect credit markets, is the existence of asymmetric information between lenders and borrowers and its influence on lending decisions. The theories postulate that imperfect information between borrower and lender leads to falls in the expected returns / profits for the lender, which in turn negatively impacts on its capacity to lend. The conventional literature traditionally identified four main imperfect market theories, which cause credit rationing as an equilibrium phenomenon; adverse selection (Jaffee and Russell (1976) and Stiglitz and Weiss (1981), moral hazard (Stiglitz and Weiss, 1981), monitoring costs (Williamson, 1986, 1987a, 1987b) and agency costs Gertler (1988) and Bernanke and Gertler (1989). Adverse selection is driven by imperfection information about the pool of borrowers a lender serves. Adverse selection is postulated to arise when changes in the term of a bank loan (interest rate, loan amount, collateral) leads to a lender being adversely selected against by borrowers with a high probability of default. Under assumption the expected return on a loan is a function of the interest rates and the probability of default, Jaffee and Russell (1976) and Stiglitz and Weiss (1981) have shown that with the incidence of adverse selection the expected return on a loan declines due to adverse selection, even if the interest rate on the loan increases.

Stiglitz and Weiss developed a model demonstrating the negative effect of adverse selection of expected return of banks and hence their capacity to supply loans. The authors assume two borrower types, 'A' and 'B': Borrower types 'A' repays with a probability of q_g, and borrower types 'B' repays with a probability $q_b < q_g$. Under a perfect information setting, each borrower type will be charged

a rate of interest commensurate with their probability of repayment. Under assumption that the supply of credit is perfectly elastic at the opportunity cost of r, and under further assumption that lenders are risk neutral and able to lend to a large pool of borrowers, the borrowers 'A' will be charged r/q_g and borrowers 'B' will be charged $r/q_g < r/q_b$. Under such hypothetical perfect information condition, the lenders expected return equals the opportunity cost r. Under such assumptions, no credit rationing occurs. Under assumption of imperfect information, the lender does not know the repayment probabilities or default risk profiles of the borrowers. Changes in the loan interest rates, could change the profile mix of the borrowers the lender attracts. An increase in the loan rate may increase the number of borrower types 'B', who have a lower probability of repayment compared to borrower types 'A', thus lower the expected return of the lender. Stiglitz and Weiss (1981) further that with a give fraction (g) of the borrower types 'A', and lender charging a loan rate r_l such that the expected return of the lender is:

$$gq_g r_l + (1-g)q_b r_l = r \tag{2.60}$$

OR

$$r_l = r/\left[gq_g + (1+g)q_b\right] \tag{2.61}$$

Since $r/q_g < r_l < r/q_b$ the lender will more likely attract borrower types 'B' and thus the problem of adverse selection. Adverse selection is postulated to lower banks' expected rate of return and hence their profits and capacity to lend. Monetary policy which causes the interest rates on loans to rise, can motivate adverse selection problems with a subsequent effect of bank loan supply and hence investment spending. The theory of moral hazard is linked to the adverse selection theory, and the framework is underscored by imperfect information in credit markets and its impact on the credit supply. According to Walsh (1998), moral hazard can arise in credit markets when borrower's behaviour is influenced by the terms of the loan. That is, the behaviour of the borrower in terms of risk, can be influence by the terms (interest rate, loan amount, collateral required) of the loan. To the

extent that risky behaviour on the part of the borrower is motivated by the terms of the loan, moral hazard problems arise. Moral hazard problems lower the expected return on bank loans, hence their profitability and capacity to supply loans. It can cause credit rationing in the credit markets. Stiglitz and Weiss (1981) developed a model in which it is assumed that borrowers have a choice of projects to invest in and borrower from bank to finance the choice of investment. Borrowers differ in term of the riskiness of their proposed investment project and that lenders cannot monitor this variable risks. Higher loan rate leads borrowers to invest in high risk project with high expected returns. Investing in high risk project lowers the expect returns on bank loans.

Imperfect credit market conditions are postulated to arises as a result of monitoring cost (Williamson, 1987) on the part of the borrower. While adverse selection and moral hazard arise due to the lenders lack of perfect information about the borrowers or their projects, Williamson (1987) has shown that even with capacity to monitor, debt contracts and credit rationing in credit markets can arise. To the extent that lenders incur cost to monitor borrowers. On the other hand, imperfect credit market conditions are postulated to arise, and thus increase the cost of external funding, due to agency costs (Gertler, 1988) and Bernanke and Gertler (1989). To the extent that lending is interpreted as 'the lender delegating the management of resources (the loan) to a borrower', the inability of the lender to monitor the borrowers or share in their information gives rise to agency costs (Bernanke and Gertler, 1989). Against the theoretical back drop of imperfect credit market conditions, bank credit is postulated to be a mechanism through which monetary policy shocks are transmitted to the real economy (Bernanke and Blinder, 1988, Kashyap and Stein, 1995, Markovic, 2006). For example, Bernanke and Blinder (1988) described the bank credit transmission mechanism as …when the monetary policy authority reduces the volume of reserves, bank loans falls, causing spending by economic agents who rely on bank credit to fall and hence aggregate demand falls. The authors specify that monetary policy works by affecting bank assets and liabilities (loans and deposits respectively). Bernanke and Blinder (1988) developed a simple, modified version of the IS-LM

model which highlights the macroeconomic implications of credit under conditions of imperfect markets. As opposed to the standard two asset IS-LM framework of money and bonds, the authors modelled money, bonds and bank loans in the portfolio of a representative bank. The representative bank's balance sheet is thus:

$$B + L + R = D \tag{2.62}$$

Where the assets side of bank balance sheet consists of bonds (B), loans (L) and reserves (R). Bank liabilities constitute deposits (D). The model assumes that bank reserves are only held to meet a legal reserve requirement subject to deposits:

$$R^d = \sigma D \tag{2.63}$$

Where σ represents the required reserve ratio on deposits. Bank's holding of bonds (B) and loans (L) sums up to $(1 - \sigma D)$. Accordingly, Bernanke and Blinder determined bank's portfolio demand for bonds and loans are determined to be functions of $(1 - \sigma D)$ and the interest rates on bonds (i_B) and loans (i_L). Proportion of bank's total assets net of required reserves held in bonds is functionally determined as:

$$\frac{B}{(1 - \sigma D)} = b(i_B, i_L) \qquad b_B \geq 0, b_L \leq 0 \tag{2.64}$$

Where i_B represents the interest rates on bonds and i_L is the interest rates on loans. The model provides that portfolio demand for bonds is a positive function of interest on bonds and a negative function of bank loan rate. Bank's portfolio demand for loans is determined as:

$$\frac{L}{(1 - \sigma D)} = 1 - b(i_B, i_L) \equiv l^s(i_B, i_L) \qquad l_B^s \leq 0, l_L^s \geq 0 \tag{2.65}$$

Bernanke and Blinder (1988) equate portfolio demand for loans as equal to the bank loan supply meaning. This provides that bank's loan supply is a negative function of interest rates on bonds and a positive function of interest rates on loans. In equilibrium, bank reserve demand must equal the reserve supply and the level of bank deposits supported by the supply of reserves must equal the demand for deposits by the non-bank economic agents. Assuming R^s represents loan supply and further assuming that deposit demand is a positive function of output and a negative function of interest rates on bonds. Then by equating reserve supply to reserve demand, the model approximated deviations around steady state as:

$$r^s = y - ci_b + \varepsilon \tag{2.66}$$

Where r^s, y and i_B are percentage deviation of R^s, output and interest rates on bonds around their steady state values. v represents a money demand shock. The Bernanke- Blinder model assumed Loan demand (L^d) to be a function of the interest rates on loans (i_L) and the output (Y):

$$L^d = l^d(i_L, Y), \qquad l_L^d \leq 0, l_Y^d \geq 0 \tag{2.67}$$

Loan demand is a negative function of interest rates on loans and a positive function of output. In the absence of credit rationing, equilibrium in the loans markets would satisfy:

$$l^d(i_L, Y) = l^s(i_B, i_L)(1-\sigma)D = l^s(i_B, i_L)\left(\frac{1-\sigma}{\sigma}\right)R^s \tag{2.68}$$

Equation (2.67) can be approximated around the steady state as:

$$l_L^d i_L + l_y^d y = l_B^s i_B + l_L^s i_L + r^s + \omega \tag{2.69}$$

The Bernanke and Blinder's (1988) partial equilibrium and the general equilibrium models supported the general theoretical and empirical view that bank credit provides a complementary channel through which monetary policy actions are transmitted to the real sector. The central tenet of the

theoretical exposition of the credit market channel is the postulation that credit markets are imperfect. The imperfect credit market postulate is embodied on the incidence of imperfection information between banks (lenders) and borrowers (economic agents) leading to adverse selection, moral hazard, monitoring and agency costs problems. Imperfect information therefore, is argued to distort risk pricing, leading to credit rationing, which affects the cost and availability of credit and hence investment spending and output (Walsh, 1998). Bernanke and Blinder (1988) imperfect information drives a wedge between the cost of external finance and internal funds. The bank credit channel traditionally postulated to operate through two mechanisms; (1) Balance Sheet Channels, and (2) Bank Lending Channel (Bernanke and Gertler, 1995). The theory of the balance sheet channel is predicated on a theoretical postulate that the cost and availability of bank credit is distorted by imperfect information about the balance sheet strength of borrowers (corporations and banks). The balance sheets channels are further partitioned into two broad theories; the corporate balance sheet channel (Bernanke Gertler and Gilchrist, 1999, Carlstrom and Fuerst, 1997) and the bank balance sheet channel (Adrian and Shin, 2008; Curdia and Woodford, 2009; Gertler and Karadi, 2009; Gambacorta, 2009). The bank lending channel on the other hand, postulates that under assumption of imperfect markets, monetary policy actions are transmitted to the real sector through the effects of change in bank loan supply schedules on investment spending (Kashyap and Stein, 1995). In the next sections, we review the theoretical frameworks of the balance sheet channels and bank lending channels.

2.3.4.2.1 Financial System: Balance Sheet Channels.

The balance channel of the bank credit view is predicated on theoretical postulations that monetary policy effects are transmitted to the real sector via the credit market effects of imperfect information about borrower net worth / balance sheet strength (Bernanke and Blinder, 1988; Bernanke and Gertler, 1989). Changes in the balance sheets of private sector agents is driven by dynamics changes cash flows, liquid assets, assets and liability structures, cost of debts etc. Under an institutional

feature that borrowers rely on external financing to finance investments, imperfect information about their balance sheet strength is postulated to drive a wedge between the cost of internal funds and the cost of external funds. Bernanke and Gertler (1995) called this an External Finance Premium (EFP). EFP has been described as the difference (spread) between the cost of internal funds and external funds (Bernanke and Gertler, 1995). EFP is a cost levy on external finance, driven mainly by imperfect market information about the in the balance sheet strength of borrower's. Effectively, the EFP is the cost of uncertainty (due to imperfect information) levied on external finance relative to the cost of internal funds, driven by potential incidence of adverse selection, moral hazard, monitoring and agency cost. Bernanke and Gertler (1995), for example provided that the external finance premium is determined by lender's expected costs associated with evaluation, monitoring and collection; a premium resulting from the borrower knowing more about its prospects than the lender (labelled lemons premium); a premium due to moral hazards or restriction to curb it. There are two main theoretical framework of the balance sheet channel; *corporate balance sheet channel* (Bernanke, Gertler and Gilchrist, 1999, Carlstrom and Fuerst, 1997) and *Bank Balance Sheet Channel* (Lown and Peristiani, 1996; Hubbard et al, 2002; Angeloni et al, 2003; Markovic, 2006).

2.3.4.2.2. Corporate Balance Sheet (Financial Accelerator) Channel.

On the assumption that corporations rely on external bank funding to finance part of their investment and production activities, the effect of monetary policy on corporate balance sheet (financial accelerator) is postulated to be significant in transmitting policy induced monetary shocks to the real economy. The financial accelerator is based on the theoretical postulations that endogenous development in credit markets propagate and amplify monetary shocks (Bernanke, Gertler and Gilchrist, 1999). Models of the corporate balance sheet channels focus on the demand side of credit markets (Markovic, 2006). Notable empirical models of the corporate balance sheet channel include Carlstrom and Fuerst, 1997; Kiyotaki and Moore, 1997; Bernanke, Gertler and Gilchrist, 1999. Under assumptions of information asymmetries giving rise to imperfect credit markets, the corporate

balance sheet channel is predicated on the theoretical postulation that policy induced monetary shocks are transmitted to the real economy through the effects of dynamic changes in corporate balance (changes in cash flows, liquid assets, short- term debt, value of assets etc.) on the external finance premium they face on borrowing from banks. Changes in external finance premium (cost of borrowing) in turn affects corporate capacity to invest (Bernanke and Gertler, 1989) and production decisions (Christiano and Eichenbaum, 1999). Effectively, policy induced monetary policy shocks affects the balance sheet value of corporation. In line with the Tobin Q theory (Tobin, 1970) changes in the balance sheet value of firms influence the cost of capital they face in credit markets. However, under imperfect credit market setting, an external risk premium is factored in this cost (Bernanke and Gertler, 1989). Borio et al (1994), argued that monetary policy influences corporate balance sheets in two ways; Capital structure and asset prices. Where corporate capital structure is dominated by short term or floating debt, a monetary policy contraction raises the cost of financing these debts due to increase cost of interest payments. Equally, given the negative relationship between interest rates and assets prices, a monetary policy tightening (rises in interest rates) leads to fall in corporate assets prices and hence their overall net worth. The framework provides that there is a positive relationship between monetary policy and external finance premium. A monetary contraction leads to a deterioration is firms balance sheet / net worth, and an increase in the external finance premium they face. A monetary expansion has the opposite effect.

There has been a number of empirical researches on the non-financial corporate balance sheet channel which examined the empirical link between monetary policy and corporate balance sheets, and between monetary policy and corporate investments and production levels. For example, Oliner and Rudebusch (1996) found evidence a 'broad credit channel by studying changes in the investment behaviour of small and large firms after changes in monetary policy. Under assumptions of information asymmetries and imperfect substitutability between external and internal funds, the

authors argued that a monetary policy tightening induces a premium on external funding that is driven by deterioration in firms' balance sheets (De Graeve, 2006).

2.3.4.3 Bank Balance Sheet Channel.

The theoretical and empirical frameworks of the bank balance sheet channel are predicated on the role of supply side of the credit market (dynamics bank balance sheets) in the transmission of monetary shocks or in the propagation of business cycles (Markovic, 2006). While some empirical researches of the early 1990s largely used aggregate data failed to find evidence of a bank balance sheet channel, subsequent researches using bank specific microdata found evidence of bank balance sheet channels (Hubbard et al, 2002; Angeloni et al, 2003). For example, Hubbard et al (2002) found evidence that bank capital dynamics influences loans interest rate during banking crisis. Within the European Union, Jiménez, Ongena, Peydro and Saurina (2010) found evidence for Spain that banks with lower capital or liquidity ratios reduce loan granting or levy higher interest rates during economic downturns or monetary contractions. The theoretical framework of the bank balance sheet channel, under an assumption of credit market imperfection, postulates that banks utilise external capital (external capitalisation) to meet minimum capital adequacy requirements or shore up their balance sheets in periods of low liquidity, and thus face external finance premium on external funds (Markovic, 2006). The external finance premium associated with the costs of external capital feeds into interest rates on bank loans to private sector agents. Monetary policy shocks are argued to be transmitted to price levels and economic activity, through the bank balance sheets effect of the dynamics external finance premium on bank loan rates to private sector agents (Markovic, 2006). A change in monetary policy affects bank's balance sheet by amongst other channels, changing the value of bank assets, costs of bank liabilities, bank liquidity etc. Markovic (2006) postulated that the external risk premium of external capital reliant banks, under imperfect markets conditions is driven by the dynamics of 3 capital factors; (1) capital default *risk channel* (probability of bank defaulting on their capital), (2) bank capital *adjustment cost channel* (adjust cost of risk premiums linked to

asymmetric information on bank capital status, in the event of need to raise fresh capital) and (3) bank *capital loss channel* (loss in the value of banks assets). As result of information asymmetries due to imperfect markets, monetary policy induced changes in external capital reliant bank balance sheet fundamentals of external capital reliant banks, motivates lenders and potential shareholders to require risk premium (external finance premium). Banks therefore have to either raise fresh capital at the higher cost or reduce their loan supply (Bernanke and Blinder 1992; Kashyap, Stein and Wilcox, 1993; Gibson, 1995; Hubbard et al, 2002; Markovic, 2006), with a knock on effect on loan interest rates to household and firms' consumption and investment spending.

2.3.4.3.1 Bank Credit: Bank Lending Channel.

The theoretical framework of the bank lending channel of monetary transmissions is predicated on the postulations that monetary policy shocks are transmitted to price levels and economic activity through changes in banks loan supply schedules to private sector agents (Bernanke and Blinder, 1989; Bernanke and Gertler, 1995, Kashyap and Stein, 1995; Kashyap, Stein and Wilcox, 1995, Kashyap and Stein, 1997). The role of banks is underscored by their financial intermediation function characterised as holders of reserve-backed deposits and originators of loans to private sector agents. Monetary policy action that changes bank holdings of loanable reserves is argued to change banks capacity to supply of loanable funds. A monetary policy tightening by way of reduction in bank reserves is argued to reduce bank loan supplies to firms and households thus dampening aggregate consumption and investment spending. A loose monetary policy which increases loanable reserves available to banks is argued to increase the volume of loan supplies to private sector agents for investment and consumption spending. Monetary policy shocks are transmitted to price levels and economic activity through the dynamics impact of changes in bank loan supplies to the private sector. As pointed out in Kashyap, Stein, and Wilcox (1993), the bank lending channel makes a key prediction that after a monetary tightening, the supply of bank loans should decline *by more* than the supply of other types of debt (such as commercial paper and finance company loans).

The theoretical arguments on the structural constraints on bank's inability to replace lost reserves and thus the very existence of a bank lending channel has been a subject of conjecture. A key implication is that the bank lending channel is more effective through banks that largely rely on customer deposits as sources of loanable funds. Kashyap and Stein (1995) buttressed this point by arguing that the bank lending channel should be important for small banks with simple capital structure and financed almost exclusively with customer deposits and common equity. The bank lending channel should also be important for banks with low capital and less liquid assets (Kashyap and Stein, 2000; Kashyap et al, 2002). Banks that are poorly capitalised are more sensitive to monetary policy induced changes in their reserves, as they have less access to markets for uninsured funding (Peek and Rosengren, 1995; Van Den Heuvel, 2001). Under assumptions of credit market imperfection, the theoretical framework provides that capital based of banks that are largely deposit dependent are sensitive to monetary policy induced losses in bank reserves, leading to a reduction in the supply bank loans to private sector agents (firms and households). The resulting impact is changes in household and firm consumption and investment spending (Blinder and Stiglitz, 1983; Blinder 1987). Kashyap and Stein (1994) developed a theoretical model in which, transaction costs associated with raising non-deposits capital influences the supply of bank loans. The authors argued that the inability of banks to replace lost deposits is not a necessary requirement for a backward shift in bank loan supply. To the extent that banks use managed liabilities such as Certificates of Deposits to raise short term funds to replace lost deposits, they face transactions cost associated with the issuance of these liabilities. Kashyap and Stein (1995) further argued that the relative illiquidity of some managed liability instruments coupled with the lack of full deposit insurance associated with some money market instruments means that transaction costs can be significant. These cost put a backward pressure on the volume of bank loan supplies and / or an increase in the cost of bank loans for bank de. Under such conditions, a monetary policy induced reduction in bank reserves / deposits will reduce bank loan supply schedule and increase the cost of bank loans to households and firms. Under

such market conditions, bank loan dependent households and corporations face increased external finance premium. A number of research paper, have questioned the theoretical soundness of the claim of banks' 'inability to replace lost deposits' as the driving force behind a backward shift in bank loan supply schedules, which was central in for example Bernanke and Blinder (1988). Generally building on the Modigliani-Miller logic on the banking firm, these researches are of the view that there should not be any correlation between shocks to the liability side of banks' balance sheet (deposits and manage liabilities) and their 'real side' behaviour (loans supply) at a given interest rates. For example, Romer and Romer (1990) amongst other, argued that the post 1980 reforms and innovations means that banks are frictionless able to replace lost deposits by issuing managed liability instruments such as large Certificates of Deposits. The authors conducted research on the bank lending channel by examining the behaviour of financial variables and the real economy during bouts of large monetary policy shifts by the Fed. The concluded that the evidence supported the money rather than the lending view. See also Fama (1985) and King (1986). A number of empirical researches however, supported the existence and theoretical framework of the bank lending channel. One such leading research was Bernanke and Blinder (1992). The authors studied how aggregate bank balance sheet and non-policy variables responds to a shock in the Federal Funds rate, as the representative innovation in monetary policy within a VAR framework. They concluded that bank loans, as well as bank deposits, do respond to monetary policy shocks. Bank loans however, respond more slowly but eventually respond substantially to shocks to federal funds rates. Kashyap and Stein (1995), used disaggregated data to test the existence of a bank lending channel, and specifically tested the hypothesis that the balance sheets of small banks and large bank would respond differently to a monetary policy shock. Using a theoretical model based on the impact of bank transaction costs related to non-deposit financing, the authors concluded that a bank lending channel exists and that this channel is more important for small banks than large banks. A number of research papers also focused on testing the bank lending channel for the Euro area. For example, using a panel data approach, Altunbas, Fazylov

and Molyneux (2002) tested for a bank lending channel in Europe using bank balance sheet data for the period 1991-1999. The authors found that within the Euro area, undercapitalised banks respond more to changes in monetary policy. See also De Bondt (1999) and Gambacorta (2004).

2.3.5 Endogenous Money Theory: Implications and Prescriptions for Monetary Policy.

The Post Keynesian endogenous money theory postulates the macroeconomic structure of the monetary transmission mechanism as a structural relationship between short term interest rates and inflation and output. The structural tenets of PK Keynesian endogenous money frameworks therefore underscore the New Keynesian and NCM exposition of the macroeconomic structure of the monetary transmission mechanism. The expositional highlight of the NCM is that long run outcomes of output and employment are monetary policy neutral (are supply driven); that inflation should be the overriding objective and the short term interest rates as the sole instrument of monetary policy (Fontana, 2007). The macro-structural implication of the New Keynesian and NCM is that the macroeconomic structure of the monetary transmission mechanism is fully described by the relationship between short term interest rates and that (monetary policy), inflation and output. Setterfield (2006) provided that the key elements of the NCM framework are assumptions of real wage bargaining, money neutrality, supply driven equilibrium and demand determined inflation. Clarida et al (1999) and Meyer (2001) represented these elements in a 3 equation model, which by assumption and implication, fully explains the macroeconomic structure of the monetary transmission mechanism. The PK and for that matter NCM exposition of the macroeconomic structure of the monetary transmission mechanism represented by a Phillips curve (PC), IS curve and an interest rate based monetary policy (MR) of the following general functional form:

$$\boldsymbol{\pi_t} = \beta\pi_{t-1} + \rho(y_{t-1} - y^*_{t-1}) + v_t \qquad (2.70)$$

$$\boldsymbol{y_t} = \alpha y_{t-1} + \theta(R_{t-1} - \pi_{t-1}) + d_t \qquad (2.71)$$

Where equation 2.69 is a Phillips curve equation in which, current periods inflation (π_t) dynamics is assumed to a function of lagged inflation ($\beta\pi_{t-1}$), the lagged output gap $\rho(y_{t-1} - y^*_{t-1})$ and cost push shock (v_t). Equation 3 is an IS curve equation in which, current period's output (y_t) is assumed to be a function of lagged output (y_{t-1}), real interest rates ($R_{t-1} - \pi_{t-1}$) and a demand shock (d_t). The monetary policy rule adopted, which defines the structural representation of the monetary policy variable, is determined by the view of the monetary transmission mechanism. Where there is a passive money view of the monetary transmission mechanism, the monetary policy tools are generally innovations in short term interest rates. A standard Taylor type monetary policy rule of the following functional form is traditionally incorporated in passive money framework:

$$\boldsymbol{R_t} = \beta\pi_{t-1} + \gamma(y_{t-1} - y^*_{t-1}) + \varepsilon_t \qquad (2.72)$$

Where R_t represents monetary policy, π_{t-1} represents the rate of inflation, $(y_{t-1} - y^*_{t-1})$ is the output gap. β and γ are the coefficients signifying the effect of monetary policy on inflation and output respectively. These above three equations, while summarising the dynamics of inflation, output (or output gap) and interest rates (Fontana, 2007), are postulated to fully represent the macro-structural dynamics of the monetary transmission mechanism. A rich literature on the monetary economics that presented the monetary transmission mechanism as a reduced form structure. Many Vector Autoregressive (VAR) based empirical frameworks for example have generally used the following representative reduced form structure of the monetary transmission mechanism:

$$[\pi_t, y_t, R_t] = \alpha + \beta\pi_{t-p} + y_{t-p} + R_{t-p} + \varepsilon_t \qquad (2.73)$$

The theoretical frameworks of these structural variables have presented monetary policy as having a causative effect on inflation and output, which traditionally are the targets of monetary policy. A monetary policy tightening is argued to lead to a decline in both inflation and output while a monetary policy easing induces a rise in both inflation and output (Bernanke and Gertler, 1995; Christiano,

Eichenbaum and Evans, 1999). Bernanke and Gertler (1995) presented this theoretical provision as stylised facts, providing that while unanticipated tightening of monetary policy has transitory effects on interest rates, a monetary policy tightening is followed by a sustained decline in real GDP and price level (See also Christiano, Eichenbaum and Evans, 1999). See Bryant, Hooper and Mann (1993) for a survey of central bank interest rates based policy reactions functions.

2.4. Open Economy Theory: Exchange Rate Transmissions Channel.

The open economy theory provides that there is an external dimension to the monetary transmission mechanism. The dimension provides a link between external shocks and domestic macroeconomic developments. The structural significance of this external dimension, and for that matter the significance of the transmission of external shocks, depends on the degree of external openness of an economy. Fundamentally, the open economy theory provides that external monetary policy shocks are transmitted to a domestic economy, depending on the nature of financial and trade flows, and the type of operational exchange system between two countries. A transition from a closed to an open economy, which influences the financial and trade relationships, as well as the exchange rate system, will fundamentally alter the complexity and structure to the monetary transmission mechanism (Bofinger, 2001). In open economies, with capital account convertibility and liberalised trade accounts, exchange rate movements can be significant in driving the dynamics of domestic inflation prices and economic activity (Smets and Wouters, 1999; Svensson, 2000; Taylor, 2001; Edwards, 2006). Exchange rate movements have been identified as a key mechanism for the transmission of international macroeconomic and monetary shocks to domestic prices and economic activity. Smets and Wouters (1999) for example, provided that 'understanding the role of the exchange rate in the monetary transmission mechanism is important because the timing and the magnitude of the effects of a change in the exchange rate on output and inflation may be quite different, thereby affecting optimal policy'. (See also Ho and McCauley, 2003; Frankel et al, 2005). The open economy theory thus postulates the existence of an exchange rate transmission channel. This theory provides that the effects of external shocks (financial, monetary and trade shocks) are transmitted into a domestic economy through exchange rates. The literature posits that response of exchange rates to monetary policy shocks affects the real economy through two channels; a purchasing power parity theory (net exports effect) and uncovered interest parity effect. In the following sections, we provide a synthesis of the structure of these two channels.

2.4.1. Purchasing Power Parity (PPP) Theory.

Within an open economy with a flexible exchange regime, the exchange rate is argued to influence price level in two ways; directly, via the purchasing power theory (PPP) and indirectly via expectations channels (Bofinger, 2001). Changes in inflation differentials between the two countries, is central to the mechanism of the PPP. The relative PPP theory provides that changes in exchange rates between two currencies (a domestic currency and a foreign currency) is a function of their respective inflation differentials:

$$\Delta e = \pi - \pi^* \tag{2.74}$$

Where Δe represent the change in exchange rate, π is the domestic inflation and π^* the foreign inflation. The implication of the relative purchasing power parity theory is that inflation can be transmitted from one country to another via the adjustment of the exchange rate. To the extent that exchange rate movements affect the costs of exports and imports, foreign inflation induced movements in exchange rates are shifted on to domestic import and export prices (Dornbusch, 1982, Bryant, Hooper and Mann, 1993; Taylor, 1993). Change in exchange rates influence domestic prices levels of imports and volume of economic activity (Dornbusch, 1982). Change in the exchange rates causes the prices of imports and exports to changes, with the changes being passed on to prices of imported and exported, thus affecting domestic prices and economic activity.

2.4.2 Uncovered Interest Parity (UIP) Theory.

The theory of the Uncovered Interest Rate Parity (UIP) theory describes the interrelationships between the domestic and foreign interest rates and the expected change in the exchange rate (Bofinger, 2001). Since the work of Dornbusch (1976) the theoretical link between exchange rates and monetary policy in conventional macroeconomic models has mainly been underscored by the UIP condition (see also Frankel, 1979). The conventional framework of the UIP provides that

expected change in exchange rates equals the interest rate differentials between domestic and foreign assets:

$$E\Delta(e_t) = i_t - i^* \tag{2.75}$$

Where $E\Delta(e_t)$ represents the expected change in exchange rate, $i_t - i^*$ is the interest rate differential between domestic assets (i_t) and foreign assets (i^*). Dornbusch (1980) for example motivated the framework of interest rate differentials in exchange rate determination as:

$$e = \alpha(m - m^*) + h(i - i^*) - \gamma\,(y - y^*) \tag{2.76}$$

Where $(m - m^*)$ is the net money supply, $(i - i^*)$ is the interest rate differentials between homogenous domestic and foreign currency denominated assets and $(y - y^*)$ is the relative output of the domestic and foreign country. Monetary policy induced change in either interest rate (domestic or foreign) will motivate a short term cross border capital flow, which drives change in the exchange rate. To the extent that monetary policy affects domestic interest rates relative to foreign interest rates, the UIP condition implies that monetary policy is linked to exchange rates via the interest rates.

A relative monetary policy induced rise in domestic interest rates will cause an appreciation of the currency due to increases in the short term inflow of capital. A relative monetary policy induced fall in domestic interest rates will cause the exchange rate to depreciate. Monetary policy induced changes in exchange rates are transmitted to domestic prices and economic activity through the net export effects and changes in demand and supply of domestic financial assets. Dornbusch (1985) postulated that exchange rate changes are reflected in both absolute and relative prices in U.S. Various theoretical models explained how exchanges rate changes feed into domestic inflation, through the phenomenon of import price inflation. Obstfeld and Rogoff (1995) explain the transmission of exchange rates into domestic prices using the 'producer currency pricing' model. Under monopolistic or imperfectly competitive markets, producers or importers are postulated to

pass on the full cost of exchange rate changes into domestic prices of their products. Thus in a more competitive market setting, the cost effects of exchange rate changes on imported raw materials or goods are postulated to feed into domestic prices via 'pricing to market' (Krugman, 1987). Taylor (2001) provides that low inflationary environment leads to low exchange rate pass through. The implication of the Taylor provision is that monetary policy can be used to lower the inflationary impact of exchange rate pass through. Empirical regularities on the exchange rate transmission channel fundamentally draws on these theoretical structural constructs of the PPP and UIP. These can broadly be divided into researches that assess / examine the relationship between (1) monetary policy shocks and exchange rate pass through (Gagnon and Ihrig, 2004), and (2) between exchange rate, and inflation and output (Fisher, 1989; Taylor, 2008). Exchange rate pass-through has been identified as dependent on other structural variables, including indicators of exporter and importers cost structures, trade restrictions, pricing determinants, quantities etc. For example, Campa and Goldberg (2003) attributed changes in exchange pass through to changes in domestic market structure and its impact on pricing behaviour of domestic firms, the commodity composition of trade or changes in trading partners. (See also Taylor, 2000). Parsley (2003) pointed out that change in trade patterns and trade composition as determinants of exchange rate pass-through. Knetter (1989, 1993) used export pricing indicators, income and competitor's prices in destination markets.

2.4.3 Exchange Rate Transmissions Theory: Implications for Monetary Policy (Frameworks and Tools).

The theoretical significance of exchange rate movements on macroeconomic (inflation and economic activity) dynamics means that exchange rate targeting by CBs has generally formed an important component of the monetary policy frameworks in small open economies. The broad exchange rate targeting framework is thus underscored by the PPP and UIP exchange rate transmissions theories. Within the framework of monetary policy exchange rate targeting thus generally become an important policy tool for promoting macroeconomic stability broadly involving controlling or influencing exchange rate movement at or towards a desired level. Bofinger (2001) identified three types of exchange rate targeting, with relevance to developing countries; (1) Exchange Rate as an operating target, (2) Exchange rate as an intermediate target and (3) Exchanges rate as a final target.

2.4.3.1 Exchange Rate as an Operating Target.

The basic framework of adopting exchange rate as an operating target involves the Central Bank attempting to control or influence the exchange rate through direct interventions (selling or purchasing domestic currency) on the domestic foreign exchange market. The framework of using the exchange rate as an operating target is similar to an OMO, involving the Central bank directly buying or selling foreign assets on the foreign exchange market. If a CB aims to prevent a depreciation of a currency, which may have implications for inflation and output dynamics, it directly intervenes by buying the domestic currency, using its FOREX reserves (plus credit lines with other CBs or the IMF). Alternatively, if a CB aims to avoid an appreciation of the domestic currency, it directly intervenes by selling the domestic currency to bolster its FOREX reserves. Fundamentally, using the exchange rate as an operating target has implications for the dynamics of the monetary base. An open market purchase of the domestic currency reduces the monetary base, while an open market sale increases the monetary base. A concurrent policy of 'sterilisation' may be adopted, which is designed to sterilise the effects of any increases in the monetary base. From an institutional

(markets) perspective, a framework of targeting exchanges as an operating target only requires a functional formal domestic foreign currency, where the CB operations will have a direct impact on the exchange rates and the balance sheets of market participants. Hence, the institutional frameworks of developing countries generally support using the exchange rate as an operating target of monetary policy.

2.4.3.2 Exchange Rate as an Intermediate Target.

The theoretical basis of exchange rate as an intermediate targeting is the UIP theory, which postulates that differentials between underlined by between domestic and foreign interest rates, under a capital account convertibility regime, causes changes in exchange rate expectations. Fundamentally, under assumptions of very short-term term market imperfection, short term interest differentials create short term arbitrage opportunities motivating short term capital flows in the direction of the relatively higher interest rate asset. Fundamentally, a rise in domestic interest rates relative to foreign interest rates causes short term capital flows in the direction of the domestic asset, and short term appreciation of the domestic currency in the FOREX market. Falls in domestic interest rate relative to foreign interest rates has the opposite effect. Under assumption that a CB can control domestic interest rates, it provides a lever for it to influence the exchange rate. Intermediate targeting of the exchange rate assumes that the CB is capable of such, and the institutional structure of integration between the domestic and international capital markets, which supports a link between the CB policy rate, rates on domestic assets and exchange rates. The framework of adopting the exchange rate as an intermediate target involves targeting the exchange rate indirectly through, changes in the policy rate (short-term interest rates). If a CB objective is to target the exchange rate at a certain level or in a certain direction, it may increase (lower) its policy rate. Increasing the policy rate temporarily increases the domestic interest rates relative to foreign interest rates, thus motivating demand for the domestic currency (due to short term capital inflow) and hence an appreciation of the domestic currency in the FOREX market. Lowering the policy rate causes the domestic interest rates to fall

relative to foreign interest rates. This causes a depreciation of the domestic currency in the FOREX market.

2.5. Monetary Transmission Mechanism in Developing Countries.

A key feature of developing countries, given the institutional and structural contexts of the monetarist and Wicksellian paradigms, as well as the open macroeconomic theory of the monetary transmission mechanism, is their inherent structural limitations. This particularly includes limitations in the financial system and the general macroeconomy. This is especially true with the limitations of the financial system, which tend to be bank dominated. The formal money markets are generally poorly developed and capital / securities markets largely non-existent. On the macroeconomic structural idiosyncrasies, Frankel (2012) characterised developing countries as traditionally experiencing; greater exposure to supply shocks and trade volatilities, procyclicality of both domestic fiscal and international finance, lower credibility with respect to both price stability and default risk. The implications of the limitations of the financial systems, is that aspects of the Post Keynesian institutional and structural conceptualisation of the monetary transmission mechanism are rarely applicable in developing countries. Consequently, the associated short-term interest rates based (New Consensus Macroeconomic) monetary policy prescriptions are largely absent in developing countries. The pervasive nature of these limitations means that the frameworks of the monetarist paradigm, and the open macroeconomic frameworks and their respective monetary policy prescriptions are widely operational in developing countries. Monetary policy frameworks are dominated by combinations direct and or indirect liquidity management, and exchange rate targeting. In this section, key features of the monetary transmission mechanism in developing countries are discussed. Section 2.5.1 discusses the financial structure in developing countries. Section 2.5.2 provides an exposition of Montiel's (1990) model of the structure of MTM in developing countries. Section 2.5.3 discusses monetary policy in developing countries.

2.5.1 Limitation of Financial System in Developing Countries.

The structure of the financial systems in developing countries generally exhibit financial dualism (Minsky, 1985). See also Demery (2001). Thus, the financial structure in developing countries are described as comprising of organised money markets (OMM), which is mainly the banking system, and the unorganised money market (UMM) (Ghatak, 1975; Taylor, 1983; van Wijnbergen, 1983a). The formal organised financial sector in most cases may comprise of a commercial banking sector and savings institutions. The unorganised money market is traditionally a collection of informal money lenders (Ghatak and Sanchez-Fung, 2007). Mehran et al (1998) opined that in additions to financial dualism, institutional weaknesses in the developing country financial systems also manifested in the lack of functional formal money markets, weak banking systems and no capital markets. The banking sector in developing countries are generally predominant the only formal financial sector, comprising of commercial banks and savings institutions. The banking sectors are generally very highly concentrated, with data on 5-firm concentration ratios on total bank assets, indicating an average between 80 to 90%. The business of banking in developing countries is predominantly based on traditional intermediation and maturity transformation, mobilising deposits from savers and lending (term lending) to borrowers (Ghatak and Sanchez-Fung, 2007). Typically, bank balance sheet mainly comprise of customer deposits and shareholder capital. Accordingly, commercial bank liabilities are mainly demand deposits (Gurley and Shaw, 1960) and credit from central banks (Montiel, 1991). Nissanke and Aryeetey (1998); Agenor, Aizenman and Hoffmaister (2004) and Saxegaard (2006) all opined that a key feature of the banking sector in developing countries is the holding of high volumes of excess non-statutory reserves These excess reserve balances are reserves in excess of statutory reserve requirements and precautionary reserve balances (Saxegaard, 2006) In study the incidence of excess liquidity for the CEMAC region, Nigeria and Uganda, Saxegaard (2006) argued that excess liquidity in the commercial banks weakens the effectiveness of monetary policy in the countries looked at. In using measure of non-remunerated

excess reserves as determinants of whether the East Asian post 1997 crisis credit crunch was demand or supply driven Agénor, Aizenman and Hoffmaister (2004), opined that where there are balances of liquidity in excess of requirements, using reserve requirements to regulate liquidity and stimulate aggregate demand will prove largely ineffective. Saxegaard (2006) found that high liquidity in the banking sector of Sub-Saharan African countries contributes to the weakness of the bank lending channel (see also Sacerdoti, 2005; Montiel, Adam, Mbowe and O'Connell, 2012). Similarly, Nissanke and Aryeetey (1998) argue that in the presence of excess bank liquidity, it becomes difficult to regulate the money supply using the required reserve ratio and the money multiplier, so that the use of monetary policy for stabilization purposes is undermined. In other words, one would expect excess bank liquidity to weaken the monetary policy. The weakness in bank credit supply to the private sector in developing is generally attributable to a number of structural factors, not least asymmetric information, and credit rationing and crowding out by public sector borrowing. Sacerdoti (2005) pointed to lack of credit availability from the banking sector to the private sector as a major weakness in the credit channel of the monetary transmissions. Despite the bank based formal financial systems (dominance of banks in the formal sector) and the fact that banks in many developing countries remain highly liquid, banks are not for being unwilling to provide sufficient credit, except to the most credit worthy borrowers (Sacerdoti, 2005). For example, Mishra and Montiel (2010) also provided that the domestic institutional context and the structure of the banking systems are key contributing factors to the weaknesses of the bank lending channels in Low Income Countries.

There are generally no formal money markets in developing countries, and where they exist, are generally underdeveloped and rudimentary, with very low asset coverage/depth and low market liquidity. The banking sector plays a fundamental role in the formal money market (for short term instruments) generally include the interbank market for deposits and foreign exchange. Debt markets

are generally limited to the primary market for government Treasury bills. Generally, low financial and markets development in developing countries mean that the menu of non-money assets available to economic agents' portfolio investment purposes is limited. Montiel (1990) for example, alluded to these structural idiosyncrasies by arguing that the mechanics of the private sector portfolio optimisation theory in a developing country become problematic due to the dearth on the menu of assets as alternatives to money balances.

2.5.1.3 External Openness and Monetary Transmission Mechanism in Developing Countries.

A key feature of small, open, trade dependent developing countries is the exposure to exogenous shocks, linked to supply, trade, financial and monetary developments. Frankel (2012) for example, opined that developing countries traditionally experience greater exposure to supply shocks and trade volatilities, procyclicality of both domestic fiscal and international finance, lower credibility with respect to both price stability and default risk. With flexible exchange rate regimes, the exchange rates become a significant component of the transmission mechanism of monetary policy in developing countries. Hence, mechanism to stabilise the price of a domestic currency in the foreign currency market is generally a significant aspect of monetary policy in developing countries.

2.5.2 Modelling of Monetary Transmission Mechanism for a Developing Country: Montiel (1991).

Constructing models of the monetary transmission mechanism involves blending of theoretical provisions, local knowledge and econometric methods (Boyd and Smith, 1999). This is particularly relevant to developing countries whose institutional and macroeconomic structures do not fit conventional narratives of the MTM. The implication of the structural idiosyncrasies of developing countries, especially of the financial system, means that the structure of the MTM transmission structure does not quite fit the conventional narrative of the endogenous money theory. With the banking system traditionally dominant, it is the main platform for the implementation of monetary policy. Frankel (2011) for example argued that models of dynamic inconsistency for monetary policy should be constructed for developing countries because of their structural deficiencies / instabilities. Montiel's (1991) model assumes a small open economy financial markets comprising of four types of agents; households, government, central bank and the rest of the banking system. The authorities are assumed to maintain an official exchange rate and restricting international capital mobility. The incorporation of a commodity market transforms the model into a Mundell-Fleming framework.

- **Private Households' financial portfolios.**

Private households are assumed to have access to five assets: domestic currency (Z), bank deposits (D), curb market loans, formal banking sector loans (C) and foreign currency(f_p). The menu of assets reflects a feature of a typical developing country financial structure, no effectively functional financial asset markets (for bonds and securities). The stock of physical assets is assumed to be constant and bank loans and curb markets loans are assumed to be perfect substitutes. Value of household portfolio (A):

$$A = Z + D + C + sf_p \qquad (2.77)$$

Where s represents the domestic currency price of foreign exchange traded in the free (parallel) market.

- **The Banking System.**

The Montiel (1991) framework assumes that banks assets comprise of reserves held at the central bank (R) and bank loans to households (L_H). Banking system liabilities include customer deposits (D) and credit from the central bank (L_{CB}). Balance sheet of the banking system is thus:

$$R + L_H = D + L_{CB} \tag{2.78}$$

Under assumption of no excess reserves, reserve holding of the banking system is given by:

$$R = \sigma D \tag{2.79}$$

Where σ represents the required reserve ratio imposed by the monetary authorities. Reserves held with central bank pays no interest, but central bank credit to the banking system attracts interest /cost. The framework sets a zero-profit condition for the banking systems as:

$$i_c = i_m(1 - \sigma) \tag{2.80}$$

The model structure of the banking system reflects the lack of money market capital in bank's balance sheet. A potential drawback of the framework's banking system structure is the emerging empirical research evidence that banks in developing countries hold excess reserves, beyond the statutory required reserves (Nissanke and Aryeetey, 1998; Agénor, Aizenman and Hoffmaister, 2004; Saxegaard, 2005).

- **The Central Bank.**

The Montiel (1990) model assumes that exchange rate is important in the transmission mechanism of developing countries, with the main transmission channel being through the net exports effect or purchasing power parity. The central bank is assumed to be active in the foreign currency market as a lever of monetary policy. Exchange rates are assumed to be fixed, with the Central bank assumed to peg the official exchange rates ($\bar{s}$), at which all international transactions are settled. The exchange rate channel is assumed to be underscored by the dynamic relationship between foreign exchange and the net exports. The central bank assets are assumed to include foreign currency reserves and credit to commercial banks and its liabilities consist of cash and reserves of the banking system held with the central bank.

- **Commodity Market Equilibrium.**

Montiel's (1990) structural model of the monetary transmission mechanism in developing countries reflects the structural limitations, in contrast to the conventional narrative in more developed economies. The model implies that the bank based transmission channels and the exchange rate channel are important channels of transmissions in developing countries, and the money supply (monetary base) is an important channel to influence household portfolio optimisation and hence aggregate demand. Central bank targets bank reserves to regulate money supply and aggregate demand, and the exchange rate to mitigate the effects of net exports on domestic prices and economic activity.

2.5.3 Monetary Policy in Developing Countries: Frameworks and Tools.

Monetary policy in developing countries, like in advanced economy, is concerned with attempts to motivate macroeconomic stability (mainly inflation and output), using the tools available to the Central banks. The institutional and structural limitations of the financial system however, limits the choices of tools available to Central banks. Addison and Demery (2001) opined that the interactions between the formal and informal financial sectors in developing countries is one of the complexities in the money markets in developing countries. These structural limitations have therefore either limit the number of channels of monetary transmissions or limit their effectiveness. Accordingly, Montiel (1991) argued that due to structural deficiencies in financial structure, restrictive regulatory controls on both credit markets and international capital and trade flows, the connection between monetary policy and aggregate demand dynamics is not obvious. As a result, interest rate based policy instruments espoused by the endogenous money theory are not as important in developing countries (Ghatak and Sanchez-Fung, 2007).

While the informal money market is a significant component of the broader financial sector, it is traditionally not considered in monetary policy/ programming frameworks in developing countries (Ghatak, 1975; van Wijnbergen, 1983). The organised money market, and more specifically the banking sector in developing countries is the main platform for the implementation of monetary policy. As a consequence, monetary policy in developing countries, is traditionally dominated by frameworks based on the key concepts of the monetarist paradigm, and open macroeconomic theory. This traditionally involves a significant role for liquidity management (money supply) on domestic monetary policy, and exchange rate targeting to deal with external shocks. Unlike the explicit objective of price stability in developed economies, the objectives of monetary policy in developing countries vary widely. This variance is demonstrated in Table 1, from an IMF desk survey of monetary policy objectives in developing countries.

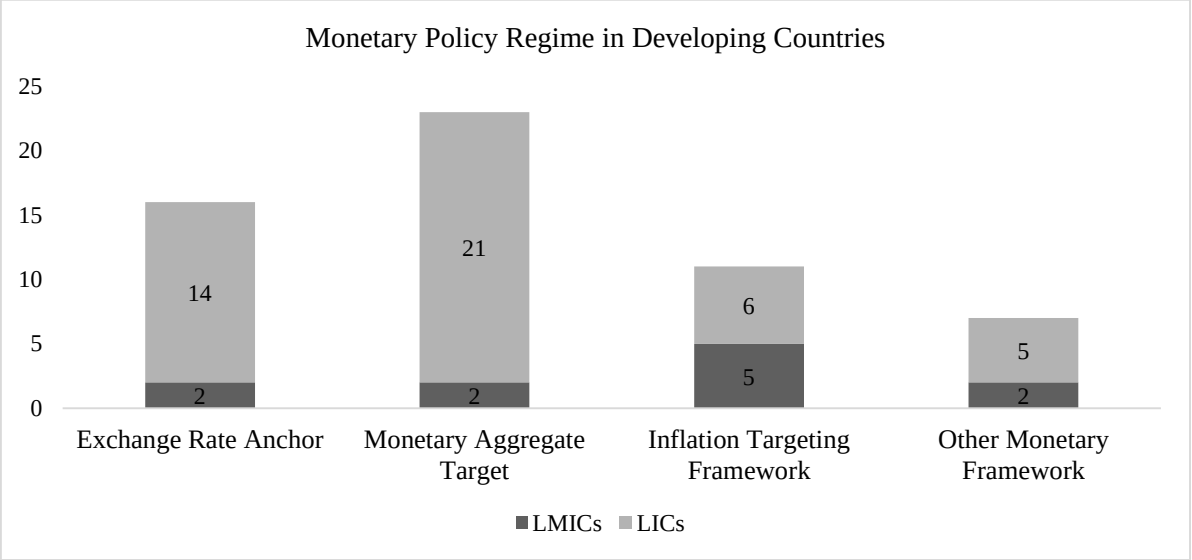
Table 2. Primary Objectives of Monetary Policy in LLMICS.

		Exchange Rate Anchor	Money Aggrega Targeting	Inflation Targeting	Other
Single Objective	Price Stability	Burundi Morocco Sao Tome and Principe	Congo Mozambique Sierra Leone Sri Lanka Sudan Ukraine Uzbekistan	Armenia Georgia Ghana Guatemala Kenya Moldova	Egypt
	Exchange Rate	Cape Verde			
Dual Objectives	Price and Exchange Rate	Liberia Tanzania	Afghanistan Madagascar	Indonesia	Kyrgyz Rep.
	Price and Growt	Cambodia	Guinea	India Philippines	
	Exchange Rate And Other	Nicaragua			
	Price and Other	Bolivia Guyana Honduras Timor Leste	Tanzania	Paraguay Romania Uganda	Vanuatu
Multiple Objectives	Price, Growth, Exchange Rate	Ethiopia	Bangladesh		
	Price, Growth, Other	Vietnam	Malawi Myanmar		Mongolia Papua New Guinea
	Price, Exchange Rate, Other		Nigeria Yemen Rep. of		
	Price, Other	Solomon Islands			
	Price, Growth		Gambia		Pakistan Zambia
	Exchange Rate, Other		Rwanda		

Source: IMF Desk Survey (2012)

Accordingly, monetary policy frameworks in developing countries are dominated by variants of monetary targeting and exchange rate targeting frameworks. See for example the Table 2. IMF Desk Survey of monetary policy regimes in LICs and LMICs.

Figure 6. De Jure Monetary Policy Regimes in Developing Countries.



Source: IMF desk survey (2012)

Of the 57 LICs and LMICs surveyed, 39 (68%) adopt either exchange rate anchor or monetary aggregate targeting.

2.5.3.1 Monetary Aggregate Targeting in Developing Countries.

Innovations in money supply (or its growth rate) and monetary targeting are generally the dominant policy tools and frameworks in developing countries (Mehrota and Sanchez-Fung, 2006). In small open developing country economies therefore, monetary policy (tools and frameworks) are broadly based on monetary base targeting (money supply and liquidity of the banking system), with the formal banking sector as the main platform of implementing monetary policy and / or the use of exchange rate targeting. For example, Addison, Demery and Page (2001) summarised control tools in developing countries as follows:

Table 3. Targets of Monetary Control in Developing Countries.

	Direct Controls	Indirect Controls
Currency in Circulation (Notes & Coins)	x	
Deposits	x	x
Bank Lending to the non-bank private sector	x	x
Foreign Monetary Impact	x	x

Source: Addison, Demery and Page (2001).

Montiel (1991) opined that money remains an important variable in analysing the dynamics of inflation, and general economic activity in developing countries. Monetary management frameworks in developing countries target the money supply (or its growth rate) as a lever to influence the availability and cost of bank credit. Statutory reserve requirements, with the use of a reserve requirement ratio allows the central banks to directly control the volume of loanable funds available to the commercial banks, to achieve policy objectives. The CB sets statutory reserve requirement for commercial banks, limiting the volume of commercial bank loanable funds. Since the beginning of the mid-1980s, structural and institutional developments in banking systems and the financial sector broadly, and structural shifts towards market based economic systems, motivated a shift to indirect monetary control in most developing countries. This effectively motivate more market based approach to monetary control. A Prominent indirect tool of monetary management in developing countries, in addition to the direct tools such as reserve requirements, include the use of Open Market Operations (OMOs) where the central bank purchases (sells) securities from (to) commercial banks as a mechanism for managing liquidity conditions. In developing countries, the market for central bank securities are generally limited to the primary market, in which the central banks are the primary market participants. An open market sales of central bank securities is associated with a reduction in the monetary base, while an open markets purchases increases the monetary base. Others include the use of Discount Windows (DW).

2.5.3.2 Exchange Rate Targeting in Developing Countries.

For trade dependent, small open developing countries, exchange rates movements are generally significant both export growth and import price inflation (Montiel and Jonathan, 1991; Frankel, 2011, Razafimahefa, 2012). For small open economies with flexible exchange rate regimes, the PPP effects (relationship between domestic and foreign inflation rate and the exchange rate) becomes a significant factor in attempts to stabilise macroeconomic dynamics. From a monetary policy view point, Bofinger (2001) opined that for small open economies, monetary policy frameworks are more complex. This is because while on the one hand their economies are influenced by closed economy transmission process, they also have the complication of exchange rate effects, which are generally too significant to neglect. For small open developing countries therefore exchange rate targeting generally become an is important component of the broader monetary policy framework. The objective of exchange rate targeting in developing countries is thus to cushion the domestic economy from the effects of external shocks. Due to the structural idiosyncrasies with respect to the financial system described above, exchange rate targeting in developing countries generally involves using the exchange rate as an 'operating targeting' rather than an intermediate target. The operating target regime involves the central bank 'directly' intervening (by buying or selling the foreign currency) in the domestic foreign exchange market to keep exchange rate at or within a certain band. Thus exchange rate targeting in developing countries takes the form of an Open Market Operation, which traditionally targets the price of the domestic currency in the FOREX market. In the broader scheme of monetary management, adopting exchange rate as an operating target provides a mechanism for controlling the monetary base within developing countries. A policy of FOREX purchase is associated with an increase in the monetary base, while a policy induced FOREX sale is associated with a decrease in the monetary base. Due to the institutional limitations of developing country financial systems and money markets, intermediate exchange rate targeting is not broadly used in

developing countries. Intermediate targeting involves using domestic interest rates to indirectly targeting the exchange rates.

2.6. Institutional and Structural Change Implications of the Key Theoretical Frameworks.

The broad implication drawn from the conceptual theoretical frameworks in the institutional and structural changes in the key systematic components of the monetary transmission mechanism can have significant long run implications. These includes structural changes in the aggregate financial system or its micro-sectors such as the banking sector, money market or securities markets, would have implications for the long run dynamics of the MTM. With respect to banking micro-sector, permanent structural changes in the size, concentration, activity and well as key balance sheet variables, would have implications for the systemic role of the sector in the MTM. With respect to the permanent changes in the money markets, permanent changes financial development affecting instrument depth, liquidity, information structure of risk pricing, efficiency, technology could change in role in the MTM. Another implication of the literature review is that permanent structural changes in the openness of the economy, especially from a closed to open, could fundamentally change the nature of transmission of international shocks into the domestic economy. For example, changes exchange rates regime from fixed to flexible regime, and liberalisation of international financial and trade flows, would have implications for a potential exchange rate transmission mechanism. Hence, permanent changes in the dynamics of key balance of payment account variables such as exports of goods and services, imports of goods and services, foreign direct investments (inflows) etc. could serve as indicators of changes in openness of an economy. Monetary policy regime shift has been argued in the monetary economics literature as a source of change in the monetary transmission mechanism and in the structural dynamics of inflation and output. Monetary policy regime shift is implied to have occurred when there are changes in the conduct of monetary policy, be it by way of switching from one monetary policy instruments or policy rule to another and / or systemic changes to the monetary policy framework. This included for example, changes in operating, intermediating

and / or final targets of monetary policy. Monetary policy regime switches are argued to influence the effect of monetary policy and / or the structure of the monetary transmission mechanism. These include permanent changes in the term structure of interest rates and hence, the nature of the interest rate transmission mechanism and changes in the long run dynamics of money supply.

CHAPTER 3: INSITUTIONAL AND STRUCTURAL CHANGES IN THE MONETARY TRANSMISSION MECHANISM IN GHANA: THE CONTEXT OF THE REFORMS.

3.1. Introduction.

A key implication drawn from the review of the theoretical framework (chapter two), is that the 'nature' of the monetary transmission mechanism and the choice of a Central bank's monetary policy (frameworks and tools) are functions of a number of institutional and structural determinants. These have been broadly identified as, the dynamics of the money supply, the financial structure, extent of external openness. Within the domestic context, the nature of the institutional determination interest rates and credit supply are also significant. Together, these structural determinants influence the existence and significance of the channels of monetary transmissions, through which the effects of policy induced monetary shocks are transmitted to the real economy. Consequentially, long run changes in these institutional and structural determinants have significant effects on the long run dynamics of the monetary transmission mechanism, and the evolution of a Central bank's choice of monetary policy (frameworks and tools). For example, changes in financial structure (money market, banking sector and securities) can have implications for changes in the significance and strength of the interest rates, asset prices and bank credit channels of monetary transmissions. Changes in external openness, leading to the adoption of capital account convertibility policies (from a regime of capital account restrictions) and adoption of flexible exchange rate regimes (from a regime of fixed (pegged) exchange rates), can have fundamental effects on the transmission of external shocks, and the significance of the exchange rate transmissions channel. The country underwent Structural Adjustment Reforms (SARs) in mid-1980s, which was arguably the most significant institutional and structural change implications for the monetary transmission mechanism, and the evolution of the Bank of Ghana's monetary policy regimes. Key element reforms programme include financial structure reforms, financial sector liberalisation, and regime shift to an open economy. This institutional chapter provides an analysis of the associated institutional and structural changes which

have theoretical implications, and hence provide explanatory significance for the observed evolution of the monetary transmission mechanism, and the Bank of Ghana's monetary policy (frameworks and tools).

The chapter is organised into four main sections. Section 3.2 discusses the Bank of Ghana broad view of the institutional and structural features of the monetary transmission mechanism in Ghana. The analysis looks at the roles of the financial system, external openness and money supply. Section 3.2.1 discusses the significance financial (banking sector) system in the monetary transmission mechanism and monetary policy in Ghana and discusses some measures of financial structure. Section 3.2.2 discusses the external openness in the BOG's view of the monetary transmission mechanism, and discusses some indicators. Section 3.3.3 of the chapter discusses the importance of money supply in the BOG's view of the MTM, its relevance in monetary policy and some relevant measures of money supply. Section 3.3 briefly outlines the Structural Adjustment Reform in Ghana, as the motivating event in the structural change in the monetary transmission mechanism, and the evolution in the BOG's monetary policy frameworks and tools. Key focus of the outline is the relevance of financial sector reforms, external openness reforms and monetary policy reforms, as relating to the key systemic components of the MTM in Ghana. Section 3.4 provides an analysis of the key institutional and structural changes following the reforms. The analysis in this section is divided into an analysis of four key institutional and structural factors. Section 3.4.1 analyses the indicators of broader macroeconomic change, focusing on analysing changes in the long run dynamics of inflation and GDP growth dynamics. Section 3.4.2 examines indicators of long run changes in the financial systems. Key issues analysed include long run changes in aggregate financial structure, structure of the Banking sub-sector, credit market condition relating to changes in the structure of bank lending rates and credit supply to the private sector. Section 3.5 provides an analysis of changes in post reform external openness, as evidenced in changes in the long run dynamics of the GHS/US$ official exchange rate. Section 3.6 provides an of regime shifts in the Bank of Ghana's monetary policy

frameworks and tools. This section provides a brief chronicle of the regime transitions from direct monetary targeting, indirect monetary targeting and inflation targeting. 3.7 discusses the potential implications of the monetary transmission mechanism and monetary policy in Ghana.

3.2 Monetary Transmission Mechanism and Monetary Policy in Ghana: Institutional and Structural Perspectives.

Historically, the Bank of Ghana has been tasked with promoting macroeconomic stability in Ghana. This institutional function evolved overtime, largely in line with the institutional and macroeconomic changes in Ghana. As the authority for motivating macroeconomic stability, the operational mechanism of the Bank of Ghana, in this respect, provided prima facie evidence that bank saw the monetary transmission mechanism, as a structural linkage between monetary policy and the macroeconomy. Monetary policy has been seen as a tool for macroeconomic stability. Specifically, the Bank of Ghana's operational monetary policy frameworks and tools supported the view that the monetary transmission mechanism is perceived as the mechanism by / through which policy induced effects of monetary policy is transmitted to influence inflation and GDP growth dynamics. This assumes that there are establish, stable and understood institutional and structural linkages between monetary policy and the macroeconomy. The evolution of the Bank of Ghana's monetary policy as a tool of macroeconomic stability, and hence the evolution in its perspective of changes in the institutional and structural dimensions of the monetary transmission mechanism, can be partitioned into two distinctive periods. This first period, by all indications, was underscored by an institutional perception that money supply was an active determinant of macroeconomic dynamics, including both inflation and GDP growth. Hence, money supply was key institutional component of the Bank of Ghana perspective of both monetary transmissions and monetary policy. The adoption of money supply growth, was as a key tool of deficit financing, and thus the main institutional tool kit for the Bank of Ghana in influencing economic growth, which was the bank's main policy objective. Thus, the Bank of Ghana's perspective of the monetary transmission mechanism and monetary policy in the 1960s and 1970s was typified by the postulations of the classical monetarist paradigm. This meant that the monetary transmission mechanism has always been perceived as the influence of Bank of

Ghana controlled supply of fiat money (notes and coins) in circulation on inflation and nominal GDP growth.

3.2.1 Indicators of the Financial Structure (Banking Sector).

Institutional and structural developments, particularly in the banking sector, motivated the evolution in the Bank of Ghana's perspective on the monetary transmission mechanism and its monetary policy (frameworks, objectives and tools). A significant point in this evolution is the recognition of the role of the commercial banking sector in the money supply process, and as a key institutional component of the monetary transmission mechanism in Ghana. This marked a shift in the recognition of commercial bank deposits as endogenously determined money, and thus a key part of the money supply process. The implication was that the Bank of Ghana recognised the potential significance of bank credit supply and lending rates a key channels through which monetary policy shocks could be transmitted to the real economy. The implication for the evolution in the Bank of Ghana's monetary policy framework was a shift to direct monetary targeting (up to 1992), using reserve requirements as the main policy tool for influence commercial bank credit supply capacities. Further developments in the institutional structure of the banking system, motivated further evolutions in the bank's perspective of the monetary transmission mechanism and monetary policy. This period provided evidence of the influence of the Post Keynesian Accomodationists, marked by the development of the Bank of Ghana reserves market, as a key mechanism for influencing the supply of reserves to the commercial banks. This further indicates recognition of the development of the money market, as a source of reserves for commercial banks in Ghana. This marked a major shift in the Bank of Ghana's perspective on the monetary transmission mechanism and the dynamics of the financial system in this institutional dispensation.

As a bank based formal financial system, the indicators of the banking sector structure can thus be adopted as proxy for the indicators of the broader formal financial structure. Key banking sector balance sheet variables can be adopted as measures of structure activity, structure size and structure efficiency. For example, bank credit ratio, measured as Total Credit to Private Sector / GDP as an indicator of a bank based financial structure activity and size. Overhead cost ratio, measured as Overhead Cost to Total Assets as a structural measure of structure-efficiency. Following Huang (2005), the following banking balance sheet variables can be used as indicators / measures of financial structure in Ghana.

Table 4. Selected Measures of Financial Structure (Banking Sector) in Ghana.

FINANCIAL STRUCTURE	INDICATOR	MEASUREMENT
Overall Financial Development	Liquid Liabilities	Liquid Liabilities of Banks and Non-Bank Financial Institutions / GDP.
	Private Credit	Private Sector Credit/ GDP
	Commercial-Central Bank Assets	Commercial Bank Assets / Commercial Bank + Central Bank Assets
	Overhead Cost	Overhead Costs / Total Assets
	Net Interest Margin	Interest Income Minus Interest Expenses / Total Assets.

Indicators of financial Structure: Adapted from Huang (2005).

Measures such as Bank Deposits / GDP, banking sector Liquid Liabilities, Total Bank Assets / GDP, Broad Money / Total Required Reserves, Private Sector Credit from Banks/ GDP, Gross Domestic Savings etc., are key indicators / measures of financial (banking sector) structure in Ghana. The dynamics of these bank balance sheet variables have implications for both the volume of bank credit supply and the dynamics of bank lending rates. Long run changes in these bank balance sheet

variables can thus be indicators of change in financial structure in Ghana. These as intermediate targets of monetary policy. Change in the long run dynamics of banking sector structure and balance sheet fundamental can motivate structural change in the monetary transmission mechanism in Ghana.

3.2.2 Indicators of External Openness in Monetary Transmission Mechanism.

Ghana is a small developing country. As such, evolution in its external openness to international trade and capital flows, have been significant for the evolution of the Bank of Ghana's perspective of the monetary transmission mechanism, and of its monetary policy framework. This evolution has largely been influenced by the country's transition, as part of the structural adjustment reforms, from a closed economy to an open economy. During the pre-reform period, successive governments pursued import substitution industrial development strategy. This was largely characterised by inward looking policies leading to restrictions on openness to international trade and financial flows, restrictions on the foreign exchange rate, and the institution of a fixed exchange rate system. The implication was that the capacity of exchange rates to absorb shock was restricted, and as such the exchange rate transmission mechanism was not significant, and not a focus of the Bank of Ghana's monetary policy tool kit. The transition to an externally open economy was underscored by policies, including; transition from a pegged to a flexible exchange rate regime; transition from capital account restrictions to capital account convertibility; and transition trade (high tariffs) restriction to trade liberalisation (tariffs). The implication was that the Bank viewed exchange rates, and the exchange rate transmission as significant. This motivated to the incorporation of exchange rate targeting, as a key dimension of the Bank of Ghana's monetary policy tool kit. As a small, trade dependent country, the developments in the Balance of Payment (BOP) account and exchange rates therefore became important dimension of the post reform economy. The BOP account variables and exchange rates, are therefore important indicators / measures of changes in the external openness in Ghana. Indicators / measures such measure as changes Net Foreign Assets, Foreign Direct Investment flows, Short

Term Capital Flows, Interest Payments on External Debt, Gross Fixed Capital Formation etc. Indicators of changes in Trade account openness factors exports of goods and services and imports of goods and services. Huang (2011) constructed macroeconomic openness indicators using a policy index, comprising of 5 economic volatility indicators and 3 trade openness indicator. These include (1) Output Volatility, Inflation Volatility, Black Market Premium Volatility, Volatility of Terms of Trade, Trading Partners' Output Volatility, Trade Openness and Natural Openness Index.

3.2.3 Measures of Money Supply.

The Bank of Ghana always perceived the monetary transmissions, as the mechanism by which the policy induced shocks in monetary policy are transmitted to the macroeconomy to influence inflation and GDP growth. Monetary policy has therefore been seen as a tool of macroeconomic stability, deployed to stabilise inflation and GDP. There has been a fundamental evolution in what the Bank of Ghana determines as monetary policy, and the policy tools are used. This evolution has centred on transition from direct money supply, to indirect money supply based policy tools. Further transition included the use of short term interest rate based tools. The money supply based policy tool, has centred around what constitutes money supply and how the Bank of Ghana can control it as part of its monetary policy tool kit. The Bank of Ghana's determination of money supply, for the purpose and measure of monetary policy, has mainly centred around the quantity of fiat money (notes and coins in circulation). This includes money supply directly determined and supplied by the of the Bank of Ghana. The constitution of, and measure of money supply, for the purpose of monetary policy has traditionally involved denomination of M1 and M2 monetary aggregates shown in Table 5 below.

Table 5. Key Measures of Money Supply in Ghana.

Money Supply Aggregate	Indicators / Measures
M1 (Narrow Money)	Currency in circulation (Notes and Coins) plus bar current account /demand deposits.
M2	M1 plus deposits with maturities of up to 2 years a deposits redeemable at notice of up to 3 months.
M3 (Broad Money)	M2 + repurchase agreements, money market fund shares + debt securities up to 2 years

Authors Tabulation of conventional monetary aggregates in Ghana.

The evolution in the Bank of Ghana's money supply based policy frameworks, have supported the traditionally significance of money supply in the banks perspective of the monetary transmission mechanism. Up to the 2002, the Bank of Ghana's monetary policy framework has been based on controlling M1 monetary aggregates. This period can be demarcated into two distinct periods; the period of direct monetary control (up 1992), which relied of direct tools such as reserve requirements to control money supply. This was followed by the bank's shift to the period of indirect monetary targeting around 1992. This involved a transition to a market based institutionalisation of monetary policy, using indirect monetary policy tools. The Bank of Ghana thus shifted to using tools such as Open Market Operations and Reserve Discount Windows. This marked a shift from the explicit reliance on reserve requirements. The use of these indirect policy tools reflects a recognition of not only the changes in the financial system, but also changes in the structure of commercial bank balance sheets.

Further developments in the financial system included development in the money markets, the banking sector (with the liberalisation of commercial bank lending rates and credit supply) and the establishment of the Ghana Stock Exchange. These changes set the platform for further evolutions in the Bank of Ghana's perspective of the monetary transmission mechanism and monetary policy. The structure of the post reform financial sector seemed to have motivated a new perspective of the monetary transmission mechanism and monetary policy, in the context of the Post Keynesian Structuralist view and the New Consensus Macroeconomics (NCM) prescriptions of monetary policy. This was evidenced in the transition from monetary targeting to inflation targeting in 2002. This transition involved a shift to the use of the Bank of Ghana Monetary Policy Rate (MPR), as the explicit tool of monetary policy, and price stability of the explicit objective of monetary policy. This assumes a perspective of the post reform financial system that has a multi-interest rates channels, with the money markets and the banking systems as key institutional features of the monetary transmission mechanism.

3.3 The Structural Adjustment Reforms Programme: The Context of Structural Change.

Ghana undertook Structural Adjustment Reform (SARs) in the mid-1980s, as part of the IMF and World Bank supported Structural Adjustment Programme in developing countries. The SARs was arguably the most significant institutional and structural macroeconomic change event in post independent Ghana. This is signified by the fact that the objective of the SARs was to engender a fundamental structural macroeconomic change, from state directed, import substitution macroeconomy, to a markets led, liberalised economy. In other words, the SARs was implemented with the objective of transitioning from a largely closed economy to an open, liberalised economy. By any account this involved a fundamental structural macroeconomic change, underscored by institutional and structural changes in key sectors of Ghana's post reform economy. Ghana was identified as one of the 'good compliers', to fully implement the tenets of reforms programme.

Table 6. Relevant Elements of the Structural Adjustment Reforms Programme.

Primary Objectives	Policies
Private Sector Development	• Financial Sector Reforms • Trade Policy Reforms • Pricing Policies and Incentives Reforms.
Macroeconomic Stabilisation	• Reduction of Fiscal Deficits • Reduction of Public Expenditure • Monetary Policy Effectiveness • Exchange Rate Adjustment

- *Financial structure reforms and sector liberalisation, exchange rate liberalisation and monetary policy reforms were key policy component of Ghana's Structural Adjustment Reforms.*

3.3.1. The financial Sector Reforms Programme.

The objective of the financial sector reforms under the SARs, was to diversify, promote competition and strengthen the balance sheets of the distressed banking sector. This was against the backdrop of a pre-reform formal financial systems that was totally bank based, that was experiencing financial disintermediation and distress. The financial sector reforms comprised of two key dimensions; (1) Financial Structure Reforms Programme (FSRP), (2) Financial Sector Liberalisation. The objective of Ghana's Financial Sector Adjustment Reforms (FSARs) was to improve financial system diversity and competition, recapitalise and strengthen the capital base of the distressed banking sector, improve efficiency of banking operations and strength prudential regulation and supervision.

Table 7. Selected Financial Sector Reforms (1988 -2008).

Financial Sector Reforms Programme (FSRP) (1988-2000)	Financial Sector Strategic Plan (FSSP) (2000-2008)
Interest Rates Liberalisation and Credit supply decontrol.	Universal Banking
Restructuring of financially distressed banks (N-PART)	Bank of Ghana Act (2002)
Promotion of non-bank financial institutions	Payment Systems Act 2003
Liberalisation of Foreign Exchange Market	Abolition of Secondary Reserve Requirements
Establishment of Ghana Stock Exchange (GSE)	Venture Capital Trust Fund Act (2004)
Banking Act (1989)	Long Term Savings Act (2004)
Bank of Ghana Law (1992)	Rural Banking Reforms
Securities Industry Law (1993)	Payments and Settlements Systems Reform
	Non-Bank Financial Institutions Act 2008

Authors: Tabulation of Key Financial Sector Reforms.

3.3.1.1 Programme to Restructure and Recapitalise the Banking System.

To restructure and recapitalise the distressed banking system, the Bank of Ghana set up, and operated a Non-Performing Assets Recovery Trust (N-PART). The N-PART programme included the replacing the non-performing loans on bank balance sheets with BOG bonds. Initially, the programme focused on replacing all non-performing claims on public enterprises with Bank of Ghana bonds. By 1990, the non-performing claims of financially distressed banks on the private sector were also replaced with Bank of Ghana bonds.

3.3.1.2 Programme to Diversify and Promote Competition in the Financial Sector.

To promote the diversification of the financial sector there was a privatisation programme of the state-owned supported by the Banking Act of 1989. The act set the platform for the entry of private banks into the banking sector and the privatisation of the state-owned banks, beginning with the Ghana commercial bank in 1992. The Issuance of banking licenses to private sector bodies paved the way for new private entrants in the banking sector (Meridien (BIAO) Trust Bank, CAL Merchant Bank, Allied and Metropolitan Bank and the Ecobank). This was complimented by programmes to support the development of an effective and functional formal money markets and the establishment of a stock market. The policies to encourage the development of money market included amongst others, the introduction of and availability to banks, of a 90-day treasury bill (1988), the introduction of Bank of Ghana bonds (1989) further strengthened money market activity. The launching of the Ghana Stock Exchange (GSE) in 1991 added a market based dimension to Ghana's financial system. The Ghana Stock Exchange was set up with a key objective of providing the facilities and framework to the public for the purchase and sales of bonds, shares and other securities. Further, the Financial Institution (Non-Banking) Law 1993, allowed for the licensing of non-banking financial institutions (discount companies, finance houses, building societies, or leasing and hire-purchase companies) to provide financial services. The post reform financial structure was therefore transformed from a totally bank based system to a mixture of bank, non-bank financial institutions and a market based

system. This had fundamental implications for the size of Ghana's financial sector (including banking sector capital, strength of balance sheets), activity levels (credit supply and lending to the private sector). Antwi-Asari and Addison (2000) postulated that these reforms have largely been successful in motivating financial development and in expanding the size and diversity of the financial sector. The authors further pointed out that rebuilding bank balance sheets through removing non-performing assets to a Non-Performing Assets Recovery Trust were instrumental in enhancing banking sector performance.

3.3.1.3 Financial Sector Liberalisation.

The objective of the financial sector liberalisation programme was to remove institutional restrictions on the business of the banking sector. Before the liberalisation, commercial bank loan pricing and supply decisions were controlled and restricted by the Bank of Ghana. These restrictions took the forms of mainly determinants controls on both bank lending and savings rates, as well as the imposition of restrictions on the volume of, and allocative distribution of commercial bank credit supply. The modus operandi of these restriction were closely aligned with government industrial development and macroeconomic growth objectives. The objective of the liberalisation was to transition to a markets based determination of both lending and savings rates, as well as bank credit supply. The liberalisation of interest rates in Ghana began in 1987, as part of the Financial Sector Adjustment Programme. This policy meant the authorities (Bank of Ghana) lifted administrative/direct controls on retail levels interest rates and allow them to be market determined. Interest rates on bank deposit were liberalised in 1987, while those on savings rates were liberalised in 1988. Further, restrictive controls on commercial bank credit (loan) supply was in 1988. As well as loosening the use of restrictive reserve requirement on bank deposits, the imposition of sectoral allocative directive was also ceased. The agricultural sector credit directive was however, only lifted in 1990. Control of bank charges and fees were lifted in 1990. The implication of the decontrol of the bank credit supply meant that commercial banks became free to determine their credit policies

and allocative decisions. This became largely dependent of bank assessments of risk and market conditions.

3.3.2 External Openness Reforms.

A key plank of Ghana's structural adjustment reforms programme was macroeconomic liberalisation. Broadly, this involved institutions of reforms policy that engender a shift from closed economy to an open economy. The macroeconomic liberalisation policies with respect to openness included; exchange rate market decontrol (lifting administrative restrictions on domestic exchange rate market), transitioning from a fixed to a flexible exchange rate regime, capital account convertibility and lowering / removal of trade restrictions on imports and exports (tariffs). The exchange rate liberalisation involved a shift from the fixed exchange rate regime to a flexible exchange rate regime. The exchange rate market liberalisation policies involved amongst others, the removal of entry restriction on non-bank foreign exchange bureaus allowing for a more competitive domestic FOREX market.

3.3.3 Monetary Policy Reforms Programme.

In Ghana, like many developing countries, limitations in the diversity and competition in the financial system, relatively low level of financial sector development, means that the Bank of Ghana's choices of monetary policy (frameworks and tools), at least within the barometers of the conventional theories, are both constrained and limited. The financial system is largely dominated by the banking system, with weak formal money and securities markets, and a sizable informal money market. This broadly created a dearth of financial instruments in the money and securities markets. The banking sector is therefore the main platform for the implementation of monetary policy.

Monetary policy is Ghana before the structural adjustment reforms, was largely focused on supporting the governments growth and industrial development objective. Money supply growth was the key tool to achieve this objective. Money supply growth (monetary policy), rather than following

an institutionalised growth rule, was largely haphazard. The objective of monetary policy reform was institute a more institutionalised, independent monetary policy regime, where the objective of monetary policy focuses on 'macroeconomic stability'. This involved transitions in the Bank of Ghana monetary policy frameworks, objectives and tools. The regime shifts in the Bank of Ghana's monetary policy (frameworks, objectives and tools) are chronicled in Table 16 below.

Table 8. Monetary Policy Regime Transitions in Ghana.

Macroeconomic Frameworks	Time Period	Policy Regime	Main Policy Objectives	Policy Tools
Import Substitution Industrial Development	Up to 1992	Direct Monetary Targeting	Promoting Growth	Statutory Reserve Requirement Ratio
Liberalised, Open Economy	1992-2002	Indirect Monetary Targeting	Macroeconomic Stability: Inflation GDP growth	Open Market Operations Discount Windows Reserve Requirements
	2002 on wards	Inflation Targeting	Price Stability	BOG Policy Rate Reserve Requirements Open Market Operations

Authors Tabulation of monetary policy regime shift in Ghana.

- *Ghana underwent monetary policy regime shift involving change in policy frameworks, policy objectives and policy tools, as part of a shift from the import substitution policy framework to liberalised market based framework.*

3.4. Analysis of Institutional and Structural Changes.

By all intents and purposes, the broad objective of the structural adjustment reforms in Ghana, was to engender a macroeconomic structural shift, from a closed economy import substitution macroeconomy, to a liberalised, open economy. Effectively, the policy elements of reforms were designed to motivate a fundamental institutional and structural changes, which potentially will have implications for the institutional and structural features of the monetary transmission mechanism and the evolution of monetary policy. Not least because the institutional and structural determinants of the monetary transmission mechanism and monetary policy are the subjects of the reform. The evolution in the institutional structures and perspectives of the monetary transmission mechanism in Ghana, are closely tied to the Structural Adjustment Reforms (SARs) that the country undertook in the mid-1980s. The SARs was followed by fundamental institutional and structural macroeconomic changes in Ghana, which could provide explanatory significance for the observed changes in the monetary transmission mechanism and the evolution of the Bank of Ghana's monetary policy. In the next section, and their significance for the monetary transmission mechanism and monetary policy. The analysis first looks at indicators of post reform changes in the long run dynamics of inflation and GDP growth, of the financial structure and the banking sector micro-structure, and external openness.

3.4.1 Structural Change: Changes in Inflation and GDP Growth Dynamics.

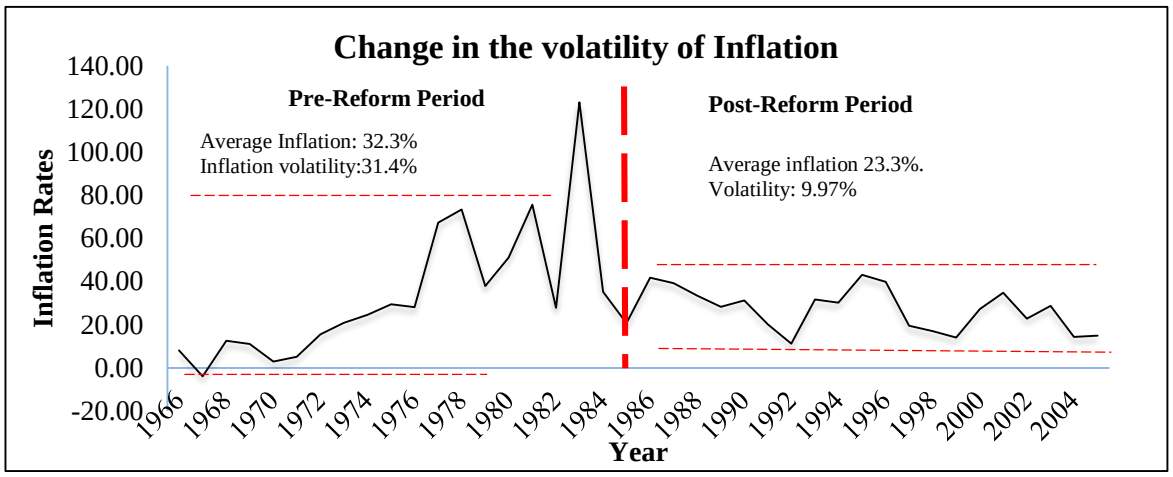
Changes in the long run dynamics of inflation and GDP growth have variously used in the empirical literature, as indicators of changes in the monetary transmission mechanism (see Boivin and Giannoni, 2005 and Boivin, Kiley and Mishkin, 2010 for example used changes in the inflation and GDP growth dynamics during the pre and post Volcker periods (before and after the 1980S) in the US, as indicators of changes in the monetary transmission mechanism. In light of the structural adjustment reforms in Ghana, we analyse changes the long run dynamics of inflation and GDP growth, as indicators of structural changes in the monetary transmission mechanism. This is done by comparing the structure of both inflation and GDP growth for pre-reform (1966-1985) and the post

reform period (1986-2005). Fundamental variations in the structure of inflation and GDP growth provides indications of post reform changes in the structure of the monetary transmission mechanism and / a reflection of post reform changes in effects / effectiveness of the Bank of Ghana's monetary policy.

3.4.1.1 Changes in Inflation Dynamics

High and volatile inflation levels was a significant feature the pre-reform period in Ghana. The average inflation rate before the reforms was 32.3%, with average volatility, as measured by standard deviation estimated to be 31.4%. A key objective of the SARs was to achieve macroeconomic stability, including stability in the rate of inflation, with specific focus on controlling the growth of money supply. Figure 23 shows the changes in inflation dynamics for the periods before and after the reforms.

Figure 7. Structural Change in Inflation Dynamics.



Source: Global Financial Development Database.

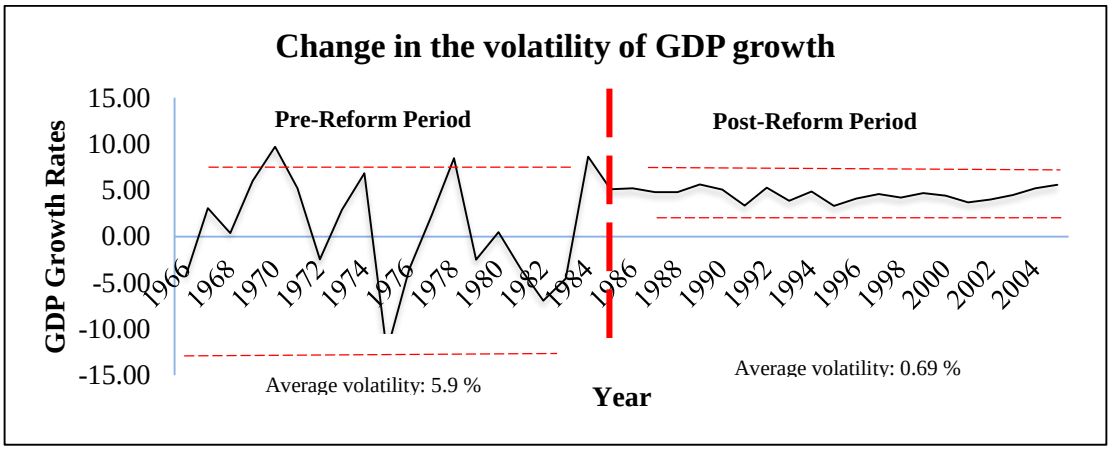
- *Average inflation fell from 32.3% between 1966 – 1985, to 23.3% between 1986-2015. Over the same periods inflation volatility fell from 31.4 % to 9.97%.*
- *The change in the long run dynamics of inflation, provides significant indication of fundamental structural changes in Ghana's post reform economy, with relevance for the monetary transmission mechanism and monetary policy.*

The data supports a view that there was a fundamental change in the structure of the post reform inflation dynamics in Ghana. While the pre-reform period was characterised by high and volatile inflation, average inflation significantly fell, and became less volatile. The changes in the long run dynamics of inflation thus provides significant indication of a post reform changes in the monetary transmission mechanism.

3.4.1.2. Changes in GDP Growth Dynamics.

As was the case with inflation before the reforms, GDP growth in Ghana was characterised by high volatility. The average pre-reform GDP growth volatility between 1966-1985 was 5.9%. This was characterised by high GDP growth rate of around 10% in 1970 to a recession in 1972 where growth rate was approximately -4%. Rising again to a rate of approximately 7% in 1978 to a recession of -3% in 1980. Given that the government was pursuing an import substitution macroeconomic development, this volatility was largely endogenous. The objective of the structural adjustment reforms was thus to address this structural malaise, and ensure stability in GDP growth. Figure 24 provides an analysis of changes in the long run dynamics of GDP growth, in the context of the structural adjustment reforms.

Figure 8. Structural Change in GDP Growth Dynamics.



Source: Global Financial Development Database.

- *The volatility of GDP growth fell from an average of 5.9% between 1966-1985, to an average of 0.69% between 1986-2005.*

- *The change in the volatility of GDP growth, indicates fundamental structural changes in Ghana's post reform economy, with relevance for the monetary transmission mechanism and monetary policy.*

Figures 8 compares the structural dynamics of output growth for the pre and post-reform periods in Ghana. The data shows significantly reduced variability in output growth in the post reform period, compared to the pre-reform period. The data indicated that the standard deviation of output growth rate fell from 5.9% in the pre-reform period to 0.69% in the post reform period. This indicates a 12 % fall in the volatility of GDP growth following the structural reforms. The post reform structural changes in the dynamics of inflation and output growth rates in Ghana, suggests changes in the monetary transmission mechanism or the effect of monetary policy regime shifts.

3.4.2 Structural Changes in the Financial System.

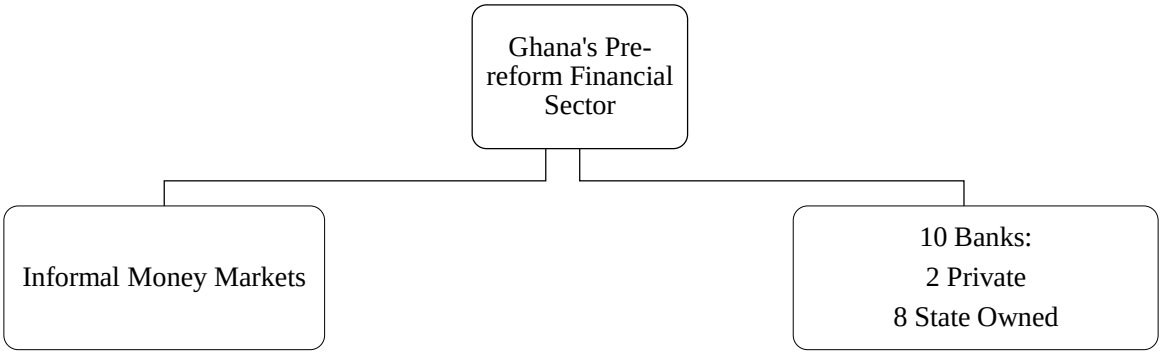
Ghana's financial system, and specifically the banking sector, has been the most important institutional/structural component of the monetary transmission mechanism and the implementation of monetary policy. Developments in the sector has also played an important role in the evolution of the Bank of Ghana's monetary policy frameworks and tools. The banking sector has been the main platform for the implementation of the Bank of Ghana's monetary policy. The up to 2002, of the Bank of Ghana's monetary policy framework was underscored by targeting the liquidity of the banking system, as the platform for controlling bank credit supply and the cost of bank loans. The implication is that institutional and/or structural changes in the commercial banking sector, could have fundamental implications for both the long run dynamics of the monetary transmission mechanism and evolution or transitions in the BOG monetary policy. Following the structural reforms and more specifically the financial structure reforms, the aggregate financial sector, fundamentally changed from a pre-reform sector comprising of a formal banking sector and an informal money markets, to a much diversified and competitive. At the sectoral level, there were fundamental changes in the banking sector structure, size, activity levels and balance sheet strength. The financial sector liberalisation also motivated change in both the long run dynamics of bank lending rates and credit supply dynamics. This section provides an analysis of this long run changes in financial sector reforms, and banking credit market conditions, which, in theory, motivated both fundamental changes in the monetary transmission mechanism and the evolution of the Bank of Ghana's monetary policy framework and tools. The analysis examines to three aspects of structural changes in the financial sector. Section 3.4.2.1 assess changes in aggregate financial structure. Section 3.4.2.2 analyses structural changes in the banking sub-sector, focusing on changes in size, structure and activity of the banking sector. Section 3.4.2.3 analysis structural changes in retail credit market conditions, examining structural changes in commercial bank lending rates and credit supply

dynamics. Section 3.4.2.4 provides a discussion of the implication for the monetary transmission mechanism and monetary policy in Ghana.

3.4.2.1 Changes in Aggregate Financial Structure

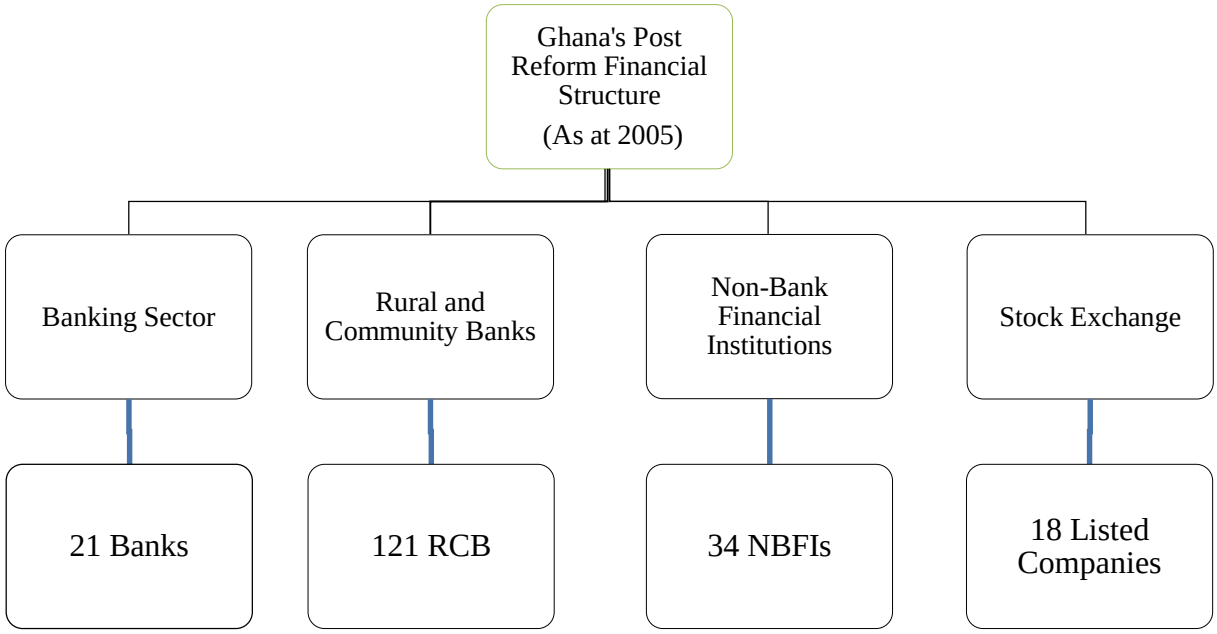
The financial structure / system is a key structural component / determinant of the monetary transmission mechanism, and a Central bank's choice of monetary policy frameworks and tools. The implication is that changes in a country's financial structure, can have fundamental, long run implications for the country's monetary transmission mechanism, and the evolution of monetary policy. In light of the structural adjustment reforms, in which financial structure reforms was a key component, there was profound structural changes in Ghana's aggregate financial structure. The country's pre-reform financial structure, as is typical in all developing countries, was purely bank based. Hence, the banking sector was an important structural component of the monetary transmission mechanism, and the implementation of monetary policy. While there was an informal financial sector, this wasn't important for monetary policy programming. The pre-reform banking sector comprised of 10 banks, of which 2 were majority privately owned commercial banks, and 8 were state-owned development banks. All the development banks were 100 percent state-owned, meaning an 80% stake-holdership. Of the 2 privately owned commercial banks, state had a 25 % controlling stakes. In addition to the largely state-ownership of the banking sector, the development banks operated as quasi-financing institutions largely catering for the government's economic development priorities, with credit directives and restrictions on interest rates. This was very significant as the banking sector was the only institutional provider of formal credit. The implication for the monetary transmission mechanism was that only bank credit and loan interest rate provided any feasible channel for the transmissions of monetary policy shocks. This was supported by the fact that the banking system was the only platform for the implementation of monetary policy by the Bank of Ghana.

Figure 9. Ghana's Pre-Reform (1960-1985) Financial Structure.



- *Ghana's pre-reform financial structure exhibited classic financial dualism, comprising of only a formal banking sector and an informal money market.*
- *The implication was that bank credit and bank loan interest rate channels were the only channel of monetary transmission mechanism.*
- *The banking sector was, in fact, the only platform for the implementation of monetary policy.*

Figure 10. Ghana's Post Reform (1986-2015) Financial Structure.



- *Ghana's financial structure changed from a purely bank based formal structure to a post reform structure comprising of privately owned commercial banks, rural community banks, non-bank financial institutions and a stock exchange.*

Figure 10 above shows the Ghana's post reform financial structure, covering the period 1986 to 2005. The objective of the financial structure reforms was to motivate a more diversified and competitive financial system. Antwi-Asari and Addison (2000) postulated that these reforms have largely been successful in motivating financial development and in expanding the size and diversity of the financial sector. The authors further pointed out that rebuilding bank balance sheets through removing non-performing assets to a Non-Performing Assets Recovery Trust were instrumental in enhancing banking sector performance. As a direct result of the reform policies and programmes, there was fundamental change in the post reform financial structure, exhibiting a much diversified and competitive sector. Structurally thus, the post reform financial structure evolved from a dual to a structurally diverse and complex financial system. The post reform financial structure was therefore transformed from a totally bank based system to a mixture of bank, securities market (Ghana Stock Exchange) and other non-bank financial institutions. The post reform financial structure comprised credit granting private commercial banks, Rural Communities Banks (RCB), Non- Bank Financial Institutions. In addition, the Ghana Stock Exchange (GSE) was established as a key part of a diversified post reform financial system. The privatisation of state-owned banks and the issuances of private banking licenses to private entities, meant that the number of privately owned commercial banks increased from 2 in 1983 to 21 as at 2005.

3.4.2.1.1 Emergence of Non-Bank Financial Institutions.

An important feature of the post reform financial system in Ghana was the entry of formal non-bank, credit granting financial institutions into the financial sector. Before the reforms, these financial institutions were non-existent. The liberalisation of the financial sector meant that, these institutions added a different dimension to the financial system, providing the much sought after diversity. Their credit granting ability also meant that the sector became relatively more competitive, compared to the pre-reform period. Table 10 provides evidence of the almost exponential growth of the non-bank financial institutions in post reform Ghana.

Table 9. The Non-Bank Financial Sector, as at 1997, and 2012.

Type of Institution	Number as at 1997	Number as at 2012
Finance House	13	25
Savings and Loan	7	19
Leasing Companies	6	16
Discount Houses	3	17
Building Societies	2	8
Venture Capital	1	7
Mortgage Financing	1	6
Total	33	98

Source: Bank of Ghana.

- *Before the structural reforms, the formal financial sector comprised only of commercial and state-owned development banks. There were no non-bank financial institutions*
- *The reforms motivated the emergence of non-bank institutions, rising from 0 before the reforms, to 33 in 1997, and 98 by 2005 following the structural reforms.*

3.4.2.1.2 Establishment of Ghana Stock Exchange (GSE).

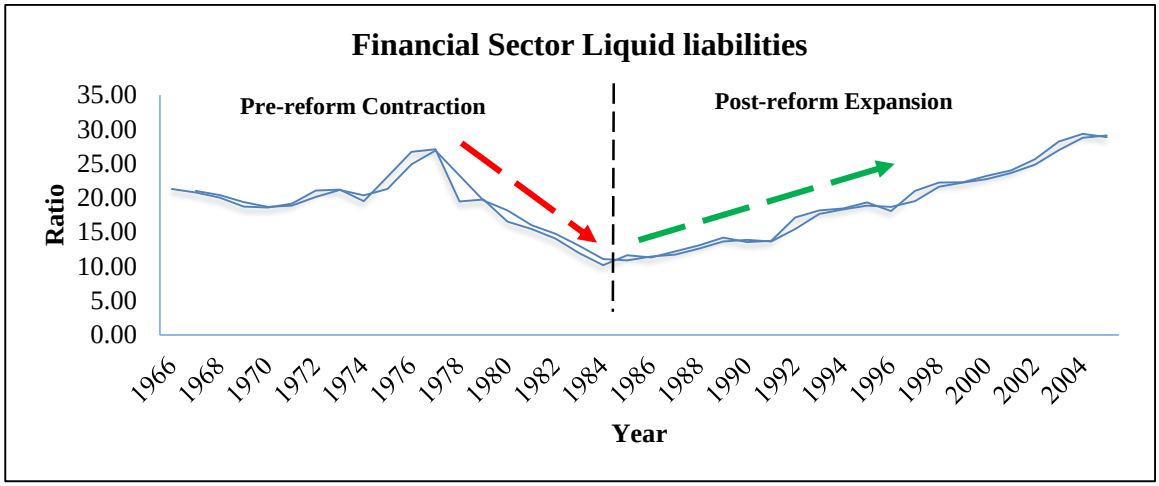
The was no stock exchange market in Ghana before the SARs programme. As part of the financial sector diversification programmes, the Ghana Stock Exchange was established and began operations in November 1990, with twelve companies considered to be the best performers in the country. Although there were stringent minimum investment criteria for registration on the exchange, the government hoped that share ownership would encourage the formation of new companies and would increase savings and investment. After only one month in operation, however, the exchange lost a major French affiliate, which reduced the starting market capitalization to about US$92.5 million. By the end of 1990, the aggregate effect of price and volume movements had resulted in a further 10.8 percent decrease in market capitalization. Trading steadily increased, however, and by mid July 1992, 2.8 million shares were being traded with a value of ¢233 million, up from 1.7 million shares

with a value of ¢145 million in November 1991. The market continued to be small, listing only thirteen companies, more than half in retailing and brewing. In June 1993, Accra removed exchange control restrictions and gave permission to non-resident Ghanaians and foreigners to invest on the exchange without prior approval from the Bank of Ghana. In April 1994, the exchange received a considerable boost after the government sold part of its holdings in Ashanti Goldfields Corporation. Since the Ghana Stock Exchange was established during the reform period, there is no pre-reform data for comparison. However, the establishment of a stock exchange would, in theory, open up new avenue (s) for monetary transmission mechanism. This includes a potential asset channel through stock prices and to the extent that listed companies use the money markets, the interest rate effects could be of added importance.

3.4.2.1.3 Growth in Size of the Financial Sector.

The structural transition set the trajectory for a long run expansion in the size of Ghana's financial sector. Measure of long term change in financial sector Liquid Liabilities (LL) is used as measure of changes in the size of the financial sector, allowing for analysis of changes between the pre and post reform periods. Liquid liabilities is the aggregate measure of the combined liquid liabilities of the financial sector, measures as the sum of the values of currency plus demand and interest bearing liabilities as a ratio of Gross Domestic Product (Huang (2005). This is the aggregate or combined liquid liabilities of all the financial institutions including the central bank, commercial banks and non-bank financial institutions. Following Levine (2002) and Huang's (2005, 2011), we use long run dynamics of Ghana financial sector Liquid Liabilities as indicator of change in the size of Ghana's post reform financial sector. Below, we analyse the changes in the long run dynamics of financial sector liquid liabilities for the pre- reform period (1960-1985), relative to the post reform period (1986-2015). The dotted line demarcates the pre and post reform periods

Figure 11. Structural Change: Financial Sector Size.



Source: International Financial Statistics; Global Financial Development Database.

- *By measure of financial sector Liquid Liabilities, Ghana's financial sector pre-reform contracted by 62.5%, falling from GHS 27 billion in 1977, to GHS 11 billion 1984.*
- *Following the reforms, the financial sector expanded by 61.5 %, with aggregate financial sector Liquid Liabilities expanding from GHS 12 billion in 1986 to GHS 29 billion by 2004.*

Figure 11 shows changes in the size of Ghana's financial sector, by measure of changes in the long run dynamics of financial sector Liquid Liabilities over the period 1966-2005. The dotted vertical line marks the point of the beginning of the financial sector reforms. The blue line is the moving average line showing long run direction of the pre and post reform long run dynamics of financial sector Liquid Liabilities. The figure shows that against the back drop of repressive control of the banking sector and systemic bank sector distress, the size of Ghana financial sector was on a long term trajectory of contraction. By measure of financial sector liquid liabilities, the period from 1976 to1984 saw Ghana's financial sector contract by 62.5%, from a peak of GHS 27 billion in 1977 to Cedi 11 billion in1984. Given Ghana pre-reform formal financial sector comprised of only the banking sector, this long run contraction was indicative of systematic financial disintermediation and weakened bank balance sheet. Following the structural reforms, the post reform financial sector expanded by 61.5 % from 1986 to 2004. In value terms, this included an expansion from GHS 12 billion in 1986 to a high of Ghanaian GHS 29 billion by 2005.

3.4.2.2 Structural Change in Commercial Banking Sector.

The banking sector has been the dominant sector of Ghana's financial system both before, and after the reforms. It has also been viewed as a key structural component of the monetary transmission mechanism by the Bank of Ghana. Not least because the implementation of monetary policy, has for the most part, involved targeting the liquidity of the banking sector, as the formal private sector credit provider in Ghana's economy. As part of the broader structural change in the post reform financial structure, the changes in the banking sector were fundamental and potentially significant. This section provides an analysis a number of structural changes including; (1) changes in the structure of the banking sector, (2) changes in banking sector competitiveness, (3) changes in financial intermediation, (4) changes in banking sector size, (5) changes in credit market conditions, with focus on changes in bank lending rates and credit.

3.4.2.2.1 Changes in Banking Sector Aggregate Structure.

Changes in the size of the banking sector, has been used a measure of financial structure (Levine, 2005; Huang 2010). Structural changes in banking sector size could involve changes in numbers and denomination of banks, which changes the long run dynamics of the banking sector. Structural change in size can have fundamental implications for changes in competitiveness, changes in the levels of financial intermediations, changes in interest rates and bank credit supply dynamics. All these changes could have fundamental implications for the structure of the monetary transmission mechanism, and the evolution of monetary policy. Ghana's post reform banking sector underwent fundamental structure-size changes, relative to before the reforms. Ghana's pre-reform formal financial sector was purely a bank based system. This was complimented by an informal money market, that played to significant part in monetary policy programming. There were two main changes in the structure of the banking sector; (1) changes in the number and compositions of the banking sector, and (2) increases in the number of privately owned commercial banks. The pre-reform banking sector comprised on only 10 banks, of which only 2 were majority privately

commercial banks. This meant that 80% of the commercial banks in the pre-reform landscape were state-owned development banks. A key objective of the reforms was to diversify and privatise the banking sector. In addition to the privatisation of the state-owned banks, banking licences were also issued to private entities. The implication was a fundamental change in the size and composition of the post reform commercial banking sector

Table 10. Changes in Aggregate Banking Sector Structure.

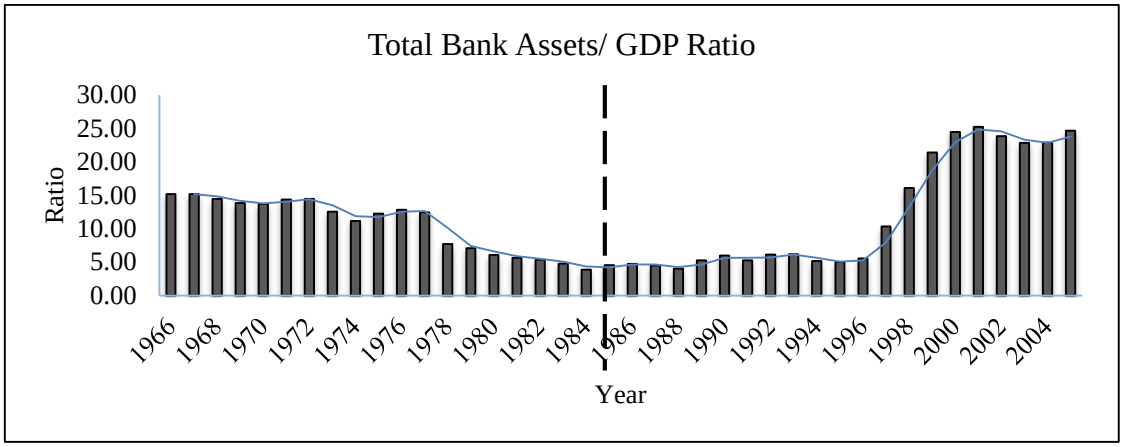
Pre-Reform Banking Sector (as at 1985)	Post Reform Banking Sector (as at 2005)
8 State Owned Development Banks 1 Commercial Bank (with 25 % state-ownership)	8 Universal Banks 7 Commercial Banks 2 Merchant Banks 3 Development Banks

Source: Bank of Ghana Archives.

- *Ghana's commercial banking sector grew from the pre-reform number of 10 (with 80% state ownership) in 1985, to 21 banks by the end of 2005 with 75% private sector ownership*.

The changes in the structure of the banking sector, as a direct result of the financial sector reforms, had a number of important structural implications. The changes in the post reform banking sector was also reflected in the growth in the value of total banking sector assets. Using the measure of Total Bank Assets / GDP ratio, there was evidence of a fundamental long term increase in the size of the banking sector. This fundamental changes in shown in figure 13 below.

Figure 12. Structural Change: Banking Sector Size.



Source: Global Financial Development Database.

- *Using Total Bank Assets to GDP ratio as a measure of size, the graph indicates a fundamental post reform increase in size of the banking sector.*
- *From a contraction of 27% from 1976- 1985, the post reform size of the banking sector increase by 25% from 1986-2005.*

The measure of TBA/ GDP ratio, the size of the banking sector shrank from Cedi 12 billion in 1977 to Cedi 3.8 billion in 1984. Following the banking sector reforms, TBA / GDP as a measure of the size of the banking sector grew from Cedi 4.7 billion in 1986 to Cedi 25 billion in 2005. Increases in the size of the banking sector that sees an increase in both total deposits and total assets of the banking sector means that balance sheet of these banks strengthened following the reforms. The changes in the structure and composition of Ghana's post reform banking sector had a number of important implications, with significance for the monetary transmission mechanism and monetary policy. These include changes in competitiveness of the sector and changes in the levels financial intermediation. These factors are analysed in the sub-sections below.

3.4.2.2.2 Changes in Banking Sector Competitive (Structure Concentration).

Ghana's pre-reform banking sector was highly concentrated (Brownbridge and Gockel, 1996). Two key pre-reform policies contributed to this weakness; Private sector entry restrictions into the banking sector and the state-ownership of the banking system. These restrictions directly contributed to lack of diversification and competitions. This view is alluded to in Aryeetey and Kambur (2005), who opined by citing repressive regulations and weak institutional frameworks of Ghana's financial sector (see also Antwi-Asari and Addison (2000)). Additionally, Brownbridge and Gockel (1996) attributed the shallowness of Ghana's pre-reform banking sector to the repressive financial sector policies and the state control of the banking system. Against the backdrop Ghana's pre-reform banking sector was highly concentrated. The 4-bank concentration ratio for the period 1980-1985 showed that 4 banks dominated banking sector accounting to a period average of 85.5% of total assets, 89.9 % of total banking sector deposits and 79.5 % of total banking sector loan advances. A key objective of the reform was to lower the concentration (improve competitions). Table 12 provides an analysis of changes in post reform concentration

Table 11. Changes in Banking Sector Concentration (Competiveness).

	1980-1986			1990-1996		
	Assets	Deposits	Loan Advance	Assets	Deposits	Loan Advance
	83.7	89.8	79.1	80.2	82.0	68.1
	82.9	88.0	78.9	77.4	79.5	63.7
	84.8	89.9	80.0	71.9	74.3	62.9
	78.8	85.7	74.4	73.7	78.6	56.5
	88.2	92.5	84.6	72.4	75.4	54.2
	86.3	93.2	80.1	66.7	69.0	50.5
Period Average	**84.1**	**89.9**	**79.5**	**73.7**	**76.5**	**59.3**

Source: Calculated from Bank Annual Reports and Bank of Ghana.

- *By measure of the 4-Bank Concentration, the post reform banking sector became more competitive.*

Following the banking sector reforms, Ghana's post reform banking sector became more less concentrated, and by implication, more competitive. Using the period averages for 1980-1985 (pre-reform) and 1990-1996 (post reform), three measures of 4-bank concentration ratio fell. Total banking sector assets attributable to the big- 4 bank fell from 85.5% to 73.7%; deposits fell from 89.9% to 76.5% and Loan Advances from 79.5 % to 59.3% for periods 1980-1985 and 1990-1996 respectively. This indicates that the competitive dynamics of Ghana's banking sector changed following the structural reforms, with possible implications for the loan pricing and credit supply behaviours of the post reform banking sector.

3.4.2.2.3 Changes in the Banking Sector: Growth in Financial Intermediation.

A key consequence of the repressive pre-reform banking sector policies, and the banking sector distress was long term financial disintermediation in banking. Against the backdrop of the repressive banking sector policies (interest rates and credit supply controls), systematic bank distress and macroeconomic instability (high inflation and output volatility) Ghana's pre-form banking sector experienced long run financial disintermediation and financial sector contraction. For example, by measure of M2/ GDP actually falling from 19% in 1970 to 13 % in 1983, with a rapid rise in currency holdings outside of the banking sector seeing currency in circulation rising from 49 % in 1970 to 55 % in 1983. Using banking sector Liquid Liabilities (LL) as percentage of GDP and Total Bank Assets (TBA) as percentage of GDP AS measures of banking sector size, we show that Ghana's banking sector contracted. Equally measure of Bank deposit as a percentage of GDP indicates a financial disintermediation. The value of Liquid Liabilities of the banking sector contracted by 40% between 1977 and 1983, from Cedi 27 billion to Cedi 11 billion. With wide spread banking sector distress, Ghana's pre-reform financial sector experienced financial disintermediation and severe financial shallowing (Brownbridge and Gockel, 1996; Antwi-Asari and Addison, 2000). Evidence of financial disintermediation was reflected in the rise in currency / M2 ratio (Antwi-Asari and Addison, 2000). Broad money / GDP, as a measure of financial depth, collapsed from 29% in 1976 to 12.5 % in 1983.

Brownbridge and Gockel (1996) argued that decline in financial depth was driven by the sharply negative real deposit rates, which drove the scale of financial disintermediation alluded to in Antwi-Asari and Addison (2000).

Table 12. Pre-reform Contraction in Banking Sector Size.

Liquid Liabilities (% of GDP)			Total Bank Assets (% of GDP)		
1966-1972	1973-1979	1980-1986	1966-1972	1973-1979	1980-1986
21.80	21.21	16.55	15.20	12.52	6.07
20.76	19.51	15.46	15.18	11.18	5.67
20.05	23.08	14.04	14.47	12.25	5.34
18.73	26.69	11.92	13.83	12.83	4.77
18.30	27.07	10.16	13.70	12.46	3.89
19.16	19.46	11.63	14.35	7.70	4.52
21.06	19.77	11.30	14.45	7.10	4.70
19.98	**22.39**	**13.00**	**14.45**	**10.86**	**4.99**

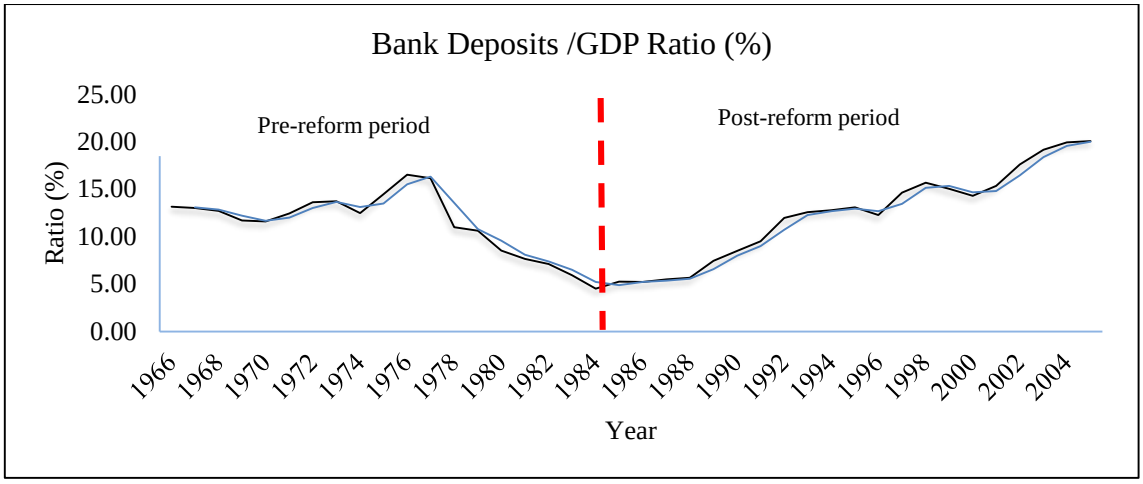
Sources: World Bank Global Financial Development Database.

- *There was long term pre-reform contraction in Ghana's pre-reform banking sector. Using period averages, total banking sector Liquid Liabilities (LL) / % of GDP contracted by approximately 42%, falling from a period average of 22.39% to 13%. By measure of Total Bank Assets / % of GDP, it contracted by 65% from 1966 to 1986.*

The average of the value of Liquid Liabilities / GDP for the period 1973-1979 fell from 22.39 % (1973-1979) to 13% (1980-1986). This was a contraction by 42%. Equally, the measure of banking sector by the Total Bank Assets / GDP also indicate a long term decline in the size of the banking sector. The average value for TBA/GDP fell from 14.45 % (1966-1972) to 4.99% (1980-1986). The shallowing of the banking system was also evident in the fall in the Total Bank Deposits (TBD) / GDP. The contractions in TBA/GDP are all indicative of financial disintermediation (also alluded to by Antwi-Asari and Addison, 2000). Together, the measures of LL, TBA and TBD as percentages of GDP, are all indicative measures of bank balance sheet strength. Bank balance sheet dynamics is

postulated to have important implications for the volume of credit supply and interest rates on bank loans (Bernanke and Gertler, 1995, Kashyap and Stein, 1995) and hence, the dynamics of inflation and output growth. Ghana pre-reform period data broadly indicates strong positive correlations between development in key bank balance sheet variables (LL/GDP, TBA/GDP) and the level of bank credit to the private sector. This indicates that despite the credit controls by the BOG, banking sector balance sheet dynamics is potentially a significant determinant of bank lending dynamics, and hence, an indication of the significance of the bank lending channel in the MTM and monetary policy. The pre-reform data also indicates broadly weak correlations between banking sector balance sheet strength and the lending rates. In light of the interest rates controls on bank lending rates, the weakening of banking sector balance sheets and the contraction in the volume of lending from around 1977, saw interest rates broadly rise. This indicates that the relationship between banking sector balance sheet dynamics and lending rates only broadly conformed to the theoretical prediction during the macroeconomic crisis in the early 1970s to the period to the SARs.

Figure 13. Long Run Changes in the Levels of Financial Intermediation.



Source: Global Financial Development Database (GFDD).

- *Change in the long run dynamics of Bank Deposits to GDP ratio provide evidence of relative increase in post reform financial intermediation.*

Figures 12 and 13 above show relative changes in the size of the Ghana's banking sector between the pre-reform (1966-1985) and the post-reform (1986-2005) periods. Following Levine (2002) and Huang (2005), we use measures of changes in TBD / GDP and TBA / GDP as indicators of changes in the size of the banking sector for the periods under consideration. It is observed that using the TBD / GDP ratio, the size of the banking sector shrank from Cedi 16 billion in 1977 to Cedi 4.5 billion in 1983. Following the reforms, the size of the banking sector grew from Cedi 5.2 billion in 1986 to over Cedi 20 billion by 2005.

Pre-reform financial disintermediation and shallowing in Ghana (Brownbridge and Gockel, 1996; Antwi-Asari and Addison, 2000) is reflected in the long-term decline in financial depth, as measured by the bank deposits to GDP ratio. The data shows financial depth fell from a high of 16.5 % in 1976 to 4.5 % in 1984. The post reform data indicates a structural change in banking sector financial depth strengthened growing from 5.2 % in 1986 to 20.1 % in 2005. The shift in financial depth from a pre-reform decline of 27% to a post reform growth of 25% can be interpreted as a structural shift in banking sector dynamics. Long run changes in financial depth and financial intermediation, should in theory, have structural effects for the monetary transmissions. In addition to the structural significance strengthened bank balance sheets and improved capacity to supply credit, this should have much more significance for the dynamics of retail level interest rates behaviour, particularly in reaction to shocks and changes in market conditions. In theory, the strengthening of bank balance sheets (growing financial depth) should have implications for changes in the monetary transmissions mechanism or the effectiveness of monetary transmission.

3.4.2.2.4 Changes in Banking Sector Balance Sheet Structure.

A key feature of Ghana's post reform banking sector is a change in the bank balance sheet structure of commercial banks. In section 3.3.1 of this chapter, it was shown that Ghana's formal financial sector constituted the only the banking sector. The pre-reform business of banking was pre-dominantly based on the intermediation and maturity transformation. These were reflected in the structure of pre-reform bank balance sheets which constituted mainly the following denominations; Assets: Loan Advances, Cash and Short Term Funds, other non-financial asset investment and securities. Liabilities: Deposits and Shareholder funds. There were no holdings of Treasury Bills and Bank of Ghana Bonds as there were not in existence. Following the reforms, there was a shift in post reform balance sheets structure and balances sheet assets distribution. The changes in post reform bank balance sheet structure also indicated an emergence of formal post reform money market activity. This section provides an analysis of changes in the post reform banking sector balance sheet structure, asset distributions and the emergent formal money markets activity.

Table 13. Changes in Banking Sector Balance Sheet Structure.

Instruments	1980-1986	1990-1996	
Assets	Average	Average	% Change
Loan Advances	31.58	16.44	-48.0
Cash & Short Term Funds	33.53	36.49	+ 9.0
Other Investments	21.44	33.72	+36.4
Treasury Bills	00.00	0.84	+8.4
Bank of Ghana Bonds	00.00	3.61	+36.1
Other Securities	2.20	11.96	+81.6
Liabilities	Average	Average	% Change
Deposits	81.06	65.20	-20.0
Shareholder Funds	4.87	13.06	+62.7

Source: Antwi-Asari and Addison (2000).

- *The incorporation of Treasury bills and Bank of Ghana bonds on post reform bank balance sheets indicates a change in balance sheet structure as well as emergence of a primary money market activity.*
- *While there has been a post reform fall in the proportion of bank assets committed to loan advances, there was an increase in banks holdings of 'cash and other short term funds'.*
- *The post reform 'deposit' component of banks liabilities fell by 20%, while 'shareholder funds' component increased by 62.7%.*

Using period averages for 1980-1986 (pre-reform) and 1990-1996 (post reform), table 13 shows changes in the structure of Ghana's post reform banking sector balance sheets. A significant shift is in the asset side of banking sector balance sheet. The pre-reform average (1980-1986) showed that key assets variables included loan advances, cash & short term funds, other securities and investment. Following the financial sector reforms, the post reform asset denominations included Treasury bills and Bank of Ghana Bonds, in addition to the pre-reform asset denomination. The data also showed a shift in the weight of the individual assets in the banking sector assets portfolio. The weight of Treasury bills increased by 8.4%, from a period average of 0 for 1980-1986 to a period average of 0.84 for 1990-1996. Over the sample periods, holding of BOG bonds increased by 36.1% from a period average of 0 for 1980-1986 to a period average of 3.61 for 1990-1996. The data also showed a shift in the weight of loan advances in banking sector asset portfolio, falling by 48% from a period average of 31.58 for 1980-1986 to 16.44 for 1990-1996. This indicates changes in assets options vis-à-vis, Treasury bills and BOG bonds. The weight of Cash and Short Term funds saw a post reform increase by 9%, from period average of 33.53 for 1980-1986 to an average of 36.49 for 1990-1986. On the liability side, there was a shift in the liability structure of the banking sector. Customer deposit constituent of the banking sector liabilities fell by 20%, from a period average 81.06 of total liabilities for 1980-1986 to an average of 65.20 for 1990-1996. This perhaps indicates an increased reliance on BOG discount window funds. Shareholder fund constituent of banking sector capital increased by 62.7%, from an average of 4.87% (1980-1986) to 13.06% (1990-1996).

The emergence of Treasury bills and BOG Bonds on bank asset portfolios, as well as the fall in customer deposit composition of banking sector liabilities, indicates the emergence of a post reform money market in Ghana. Before the reforms, there was no formal money market. The financial sector reform motivated the emergence of a formal money market (Antwi-Asari and Addison, 2000). The early money market structure comprised of mainly of an interbank market and an interbank foreign currency market. The introduction of and availability to banks, of a 90-day treasury bill (1988), the introduction of Bank of Ghana bonds (1989) further strengthened money market activity. By 1998, Ghana's money market saw the emergence of further instruments such as Commercial Papers, Bankers Acceptances, Promissory Notes and Money Market Funds (first licensed in Ghana in 2004, by DATABANK). Clearly, the emergence of a money market created a new avenue for funding for both banks. Nissanke (1993) for example observed that financial liberalisation in Ghana led to the concentration of banking activity in the market for government debt, thereby starving the private sector of credit.

3.4.2.3. Financial Sector Liberalisation: Interest Rates and Credit Supply Decontrol.

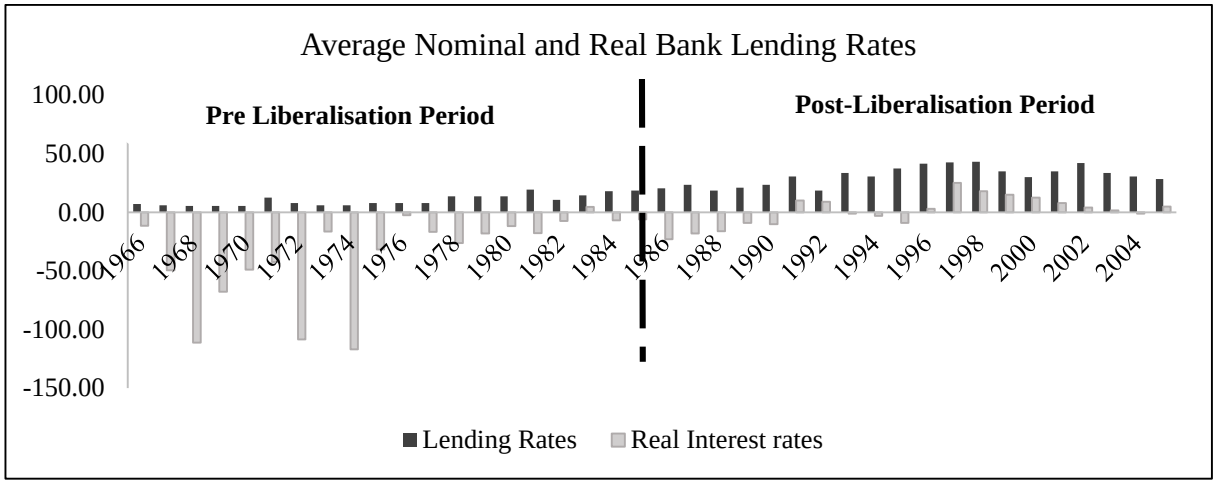
Financial sector liberalisation is broadly used to describe the policy of removing restrictive controls on the financial sector by a policy authority, to an institutionalised markets based system. Financial sector liberalisation traditionally involves policies of removing restrictive controls on interest rates and bank credit supply. McKinnon-Shaw (1973), Stiglitz (1984) and Cecchetti (1999) posited a post liberalisation change in the structure of interest rates. Additionally, McKinnon-Shaw (1973) and Stiglitz (1985) predict not only an increase in credit, but also a redistributive allocation to the private sector by banks. Two key policies under the pre-reform repressive control regime, were quantitative restrictions on bank interest rates (deposits and lending), and restriction on the volume and allocative distribution of bank credit supply to the private sector. According to Daumont, Le Gall and Leroux (2004), the BOG's rationale for repressing interest rate was to lower the cost of credit in order to promote investments and support borrowers and to mitigate against perceived failures of privately owned commercial banks to adequately finance private sector investment. A policy of repressing bank lending rates means that bank lending rates are restricted from adequately discounting such factors. In the case of Ghana, Brownbridge and Gockel (1996) for example, opined that Ghana's pre-reform administrated rates were not systematic risk weighted. In other words, the administered lending rates were not fully reflective to costs, systematic risk, maturity or default risk. Against the backdrop of prolonged pre-reform periods high and volatile inflation rates and low GDP growth, a key implication of the nominal interest rates repression, was prolonged periods of negative real interest rates. This was particularly the case from 1975 to the early 1981, when inflation was high and volatile. A key implication of the pre-reform interest rates repression is the prolonged periods of negative real interest rates. This resulted from the BOG's quantitative restrictions on nominal bank lending rates, in light of high inflation rates.

Credit markets controls, was a key part of the broader pre-reform banking sector regulation. Controls and directives were therefore imposed by the Bank of Ghana on both the volume of bank lending and the allocative / sectoral distribution of bank credit, based on an annual credit plan. These took the form of permissible percentage increases over each bank's outstanding credit to any sector at the end of the previous year. The aggregation of these sectoral ceilings resulted in a 'global credit ceiling' for each bank. Sectoral ceilings were altered periodically to coincide with the government's macroeconomic aspirations and needs. Credit allocation by banks therefore conformed to the directed priority sectors (Aryeetey, 1996; Antwi-Asari and Addison, 2000), thus effectively making state owned banks in Ghana as quasi-fiscal institutions. A key implication of the credit controls and directives is that lending is not driven by credit market conditions but rather by the development objectives and directives of the government.

3.4.2.3.1 Liberalisation and its Effects on Nominal Bank Lending Rates

A key empirical prediction in McKinnon-Shaw (1973), Stiglitz (1984) and Cecchetti (1999) is that liberalisation changes the long term structure of interest rates. McKinnon-Shaw (1973), further posited that post liberalisation interest rates generally embark of an upward trajectory, having factored in credit and systematic risks. Thus given that Ghana's pre-reform nominal bank lending rates were set and repressed at artificially low levels, and thus not effectively risk weighted, the prediction is that liberalisation will motivate an upward long term increase in the nominal rates. We analyse change in the post liberalisation nominal lending rates in the context this prediction. The liberalisation of bank lending rates in Ghana began in 1988. This effectively involved a transition from repressed interest rates to a market determined. The theoretical prediction also provides that to the extent that nominal interest rates fully discount market and other systematic risk factors, then real interest rates will generally be positive. As shown in the figure 15 below, there was indeed a post reform structural shift in both nominal and real bank lending rates.

Figure 14. Long Run Changes in the Levels of Nominal Bank Lending Rates.



Source: International Financial Statistics, Global Financial Development Database, Bank of Ghana Database. Real interest rates are derived from the author computation.

- *Nominal bank lending rates rose from an average of 10% before liberalisation, to an average of 32% following liberalisation.*
- *Real interest rates changed from negative in the pre-reform period, to positive following liberalisation.*

The post liberalisation nominal and real bank lending interest rates in Ghana generally conformed to the predictions of McKinnon and Shaw (1973), that liberalised interest rates will generally rise over the time, relative to the average levels of the restricted rates. Following liberalisation, there was indications of a change in the post-reform structure of the nominal bank lending rates, and real rates. The nominal bank lending rates over the pre-reform period (1966-1985), averaged 10.3%. Following the liberalisation of interest rates, there was a long term change in the structure of nominal bank lending rates, averaging 31% in between 1986 to 2005. Additionally, real interest rates changed from a period average of – 57% between 1966 – 1985, to a post reform average of +26% between 1986 - 2005. The data, fundamentally supports a structural change in both the nominal bank lending rates, and real interest rates, following the financial sector liberalisation in Ghana.

3.4.2.3.2 Liberalisation and its Effects on Bank Credit Supply.

An empirical prediction of McKinnon and Shaw (1973) and Stiglitz (1985) is that post-liberalisation, there is generally a long run changes in both the volume of commercial bank credit supply to the private sector and allocative distribution of credit supply. The is attributed to improved role of systemic risk-weighting is credit assessment decisions of banks. This means banks are able to lend to households and firms based on their assessment of risk and other credit market conditions. As part of the financial sector liberalisation programme, Ghana decontrolled its credit markets in 1988. The agricultural sector credit directive was however, only lifted in 1990. Control of bank charges and fees were lifted in 1990. The evidence on post credit liberalisation in Ghana however does not conform to the increase in credit supply prediction. There was however evidence of change in the allocative distribution of credit, which could be significant for the post reform dynamics of the MTM in Ghana, for three reasons; (1) the optimisation, consumption and investment behaviour of households and firms (who became main beneficiaries of credit market allocative redistribution) is fundamental in the monetary transmission process, (2) capacity of banks to fully risk assess lending proposals will have fundamental implications for banks balance sheets strength, as the proportion of non-performing assets in likely to be lower, thus improving the stability and capacity of banks to supply credit and (3) the supply of credit is likely to be more sensitive to macroeconomic and monetary shocks, thus enhancing the monetary transmissions process. In the next sections, we analyse the effects of credit market decontrol on the volume and allocative distribution of commercial bank credit supply to the private sector.

3.4.2.3.2.1 Effects on the Volume of Credit Supply to Private Sector.

The data shows that there is no definitive post reform structural break in the volume of commercial bank credit supply to the private sector. Average value of credit supply to the private sector as a ratio of GDP was 27.5% and 26.3% between 1966 to 1975, and 1975-1985 respectively. In fact, the volume of credit supply in the immediate post liberalisation actually fell, compared to the pre-reform periods, to an average of 21.17% between 1986 – 1995. The value however rapidly increased to surpass the pre-liberalisation averages, averaging 28. 72% between 1996 – 2005.

Table 14. Changes in Volume of Bank Credit Supply.

1966-1975	1976-1985	1986-1995	1996-2005
20.66	30.24	23.50	18.90
26.74	37.21	24.00	18.40
31.99	34.50	28.20	25.50
31.57	30.75	20.60	24.60
28.07	26.58	21.20	32.50
26.29	22.55	17.50	39.30
29.31	21.49	16.40	35.10
29.01	21.93	20.60	34.60
24.07	18.46	21.30	26.90
26.90	18.87	18.40	31.40
Average: **27.5**	**26.30**	**21.17**	**28.72**

Source: World Bank Global Financial Development Database.

- *No definitive evidence of a post liberalisation changes in the volume of bank credit supply to the private sector in Ghana.*

Brownbridge and Gockel (1996) attributed the constrained post reform credit expansion to the private sector to, amongst other factors, macroeconomic instability (high fiscal deficits, high and variable inflation rates, high nominal interest rates).

3.4.2.3.2.2 Effects on the Allocative Distribution of Credit Supply to the Private Sector.

A key prediction of the removal of restrictive sectoral directives on commercial bank credit supply to the private sector, is a fundamental reallocation in sectoral distribution. This traditionally involves reallocation from high risk, informal sectors such as the agricultural sector. There was evidence of the post liberalisation allocative distribution of commercial bank credit supply to the private sector, as shown in table 15 below.

Table 15. Changes in Distributive Allocation Bank Credit to the Private Sector.

Sector	Percentage of Total Loan Advances	
	1980-1986	1990-1996
Agriculture, Fishing and Forestry	25.01	11.5
Mining	4.7	1.89
Manufacturing	23.21	28.27
Construction	11.56	14.44
Electricity, Gas and Water	1.18	1.84
Import Trade	2.9	6.37
Export Trade	5.86	6.75
Other Commerce	10.76	14.06
Transport and Communication	7.05	3.36
Other Services	5.05	7.72
Miscellaneous	2.74	4.16

Data Source: Antwi-Asari and Addison (2000).

- *Under the pre-reform credit supply directives, a high value of commercial bank credit supply was allocated to priority sectors such as the agricultural and manufacturing sectors, each attracting 25% and 23% respectively, of average value to total credit supply to the private sector.*

- *Following liberalisation, there was evidence of allocative redistribution, especially away from the agricultural sector, which fell by more than 50% from 25.01% to 11.5%.*

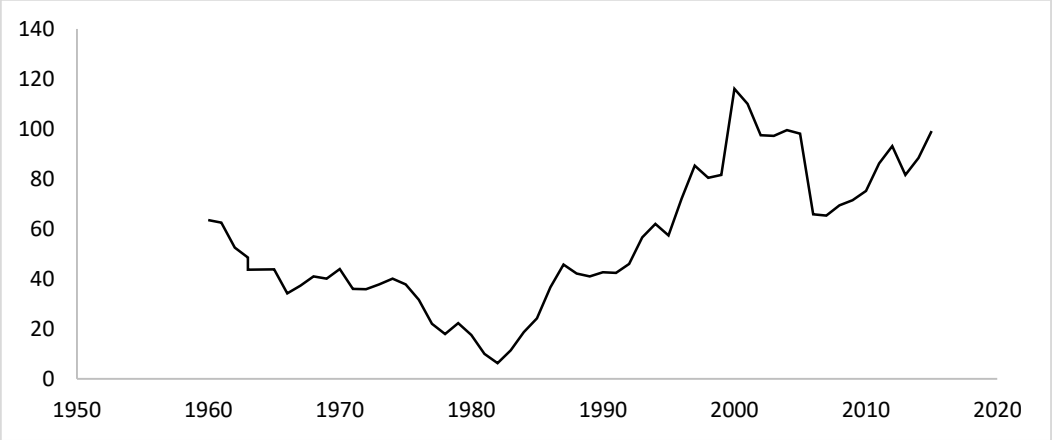
- *There was a large increase in the post liberalisation credit supply to cash generative sectors such as import trade, which attracted credit, rising 2.9% in the pre-liberalisation period to 6.37% following the reforms. Export trade, also attracted increased lending rising from 5.86% to 6.75%.*

3.5 External Openness Reforms: Change in Exchange Rate Dynamics.

A key policy within Ghana's pre-reform import-substitution development policy framework, was the institution of a fixed exchange rate regime and restrictions on domestic foreign exchange market. The Ghanaian Cedi was pegged against the British Pound sterling and as such, the Cedi / Sterling rate was set by the BOG to maintain it within a +/ - 2 % band. A key structural macroeconomic implication of the institution of the fixed exchange rate regime, was that the dynamics of the Ghanaian Cedi in the FOREX market during this period was largely reflective of the macroeconomic dynamics of the British Pound Sterling rather than domestic macroeconomic developments. The implication was that developments in domestic inflation, money supply and GDP growth do not necessarily drive the value of the Cedi in the FOREX market. Restrictions on the domestic currency market were imposed through entry and licencing restrictions. Additionally, restrictions were imposed on international capital and trade flows. Trade flows were restricted through high export and import tariffs on trade in goods and services. Theoretically, all the factors that are instrumental in driving the dynamics of the Ghanaian Cedi in the FOREX market, including the exchange rate regime, competitiveness of the domestic FOREX market, international capital mobility and international trade flows, were all restricted, thus fundamentally distorting pricing and value of the Cedi in the FOREX market. In light of the macroeconomic challenges including high / low and volatile inflation and GDP growth and volatile money supply growth, the Cedi was overvalued in the FOREX market (Brownbridge and Gockel, 1996, Antwi-Asari and Addison, 2000). From a monetary transmissions perspective, the fixed exchange rate regime, the restrictions on the domestic FOREX market, capital and trade account restriction, meant that the significance of the exchange rate transmission channel would have been restricted to the macroeconomic effects of associated with the dynamics of the British Pound Sterling. The theoretical prediction is that a shift from a closed economy to an open economy is that exchange rates dynamics become more significant in the MTM. Accordingly, the shift from a fixed exchange rate regime to a flexible exchange rate regime and the

lifting restrictions on domestic exchange rate market should have significant structural implications for the role of exchange rates in macroeconomic dynamics, for two main reasons; (a) it will motivate a revaluation of the GHS in the FOREX market. In the case of Ghana, the prediction is that the GHS will experience long run depreciation; (b) the dynamics of the GHS in the FOREX market would be correlated to domestic macroeconomic factors such as inflation and GDP growth as well as international capital and trade flows. This section provides an analysis changes in the long run exchange rate dynamics and changes in its relationship between official exchange rates The analysis of changes in the long run dynamics of official exchange rates looks at whether the exchange rates, revaluated by way of depreciation, following a shift to a flexible exchange rate regime. Post liberalisation changes in long run exchange rates dynamics could serve as an indicator of the significance of exchange rate dynamics in the MTM.

Figure 15: Changes in Ghana's Openness Index (1960-2015)

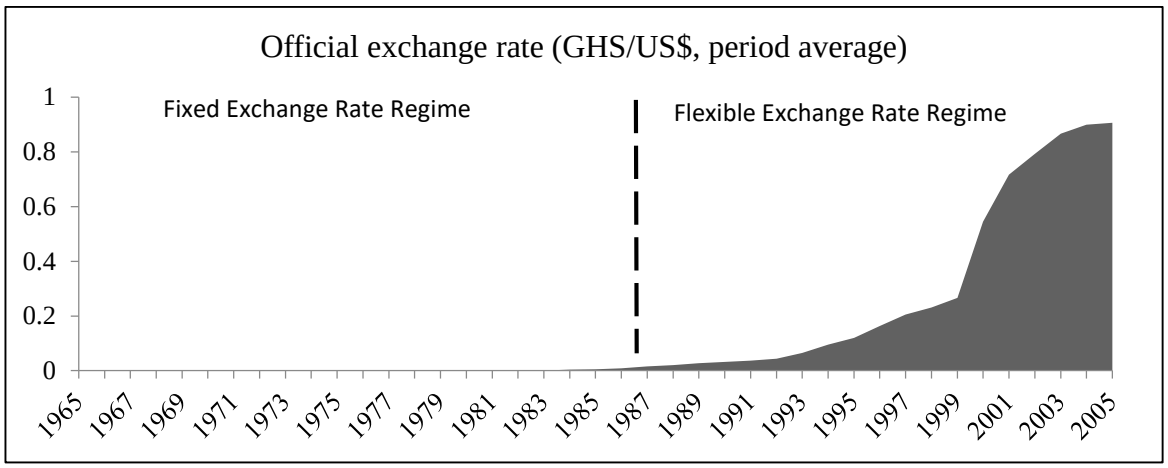


- *Ghana became increasingly protectionist following independence, with the index of openness falling from 63.6 in 1960 to 6.61 in 1982.*
- *Following the beginning of the structural reforms in 1983, the country became much more open, with the index rising from 11.5 in 1983 to a high of 116.04 in 2005.*

3.5.1 Effects of External Openness on the GHS /$US Official Rate.

The period of fixed exchange rate meant that there were asymmetries between the official exchange rates, and inflation and GDP growth rates. The pre-reform official exchange rates pegged to the dynamics of the British Pound Sterling, rather than allowed to adjust to reflect macroeconomic developments. As such the GHS was adjudged to have been overvalued for prolonged periods (Antwi-Asari and Addison, 2000). The implication of the transition to a flexible exchange rate regime, as part of the transition to an open economy, was that exchange rate adjustment reflected domestic and external macroeconomic developments. A key theoretical prediction on the effect of exchange rate liberalisation, is that the exchange rate will depreciate to reflect its market value. This adjustment can lead to fundamental changes in the long run dynamics of exchange rate, and potentially its significance in the transmission of external shocks into the domestic economy. Figure 16 provides an analysis of the long run dynamics of the official exchange rate vis-à-vis the U.S dollar.

Figure 16. Long Run Changes in the Levels of Official GHS/US$ Exchange Rate.



*Source: World Bank Global Financial Development Database***.**

- *The shift to a flexible exchange rate regime was followed by long run depreciation of the GHS / $US.*

Figure 16 shows structural change in the long run exchange rate dynamics of the Ghana Cedi against the USD. The pre-reform data shows the effect of the fixed exchange rate regime on the exchange rate, which was literally flat throughout the pre-reform period sample period (1966-1985). Following

the exchange rate liberalisation, the Cedi depreciated by approximately 80% compared to the average 1984 value. A key implication of the shift to a flexible exchange rate regime is that exchange rate will broadly mirror changes in key macroeconomic variables, such as money supply, interest rates, BOP account dynamics, the inflation rate and output growth rate. Given that the pre-reform state of fixed exchange rate regime restricted the exchange rate from freely reflecting the dynamics of these variables, we interpret change in the dynamics of the post reform exchange rate as an indicator of structural change in the post SARs.

3.6: Bank of Ghana's Monetary Policy Reforms.

Monetary policy regime shift has been identified as changes in monetary policy framework, policy objectives and /or policy tools. Foerster (2013) for example, identified monetary policy regime shift with changes in operating targets, intermediate targets or even final targets. Schorfheide (2005) identified changes to the inflation target in an inflation targeting framework as a policy regime switch. (see also Davig and Doh (2008), Bianchi (2013), and Chib et al. (2011) identified changes in the inflation response (active or passive) as constituting monetary regime switch. Monetary policy regime switches are argued to influence the effect of monetary policy and / or the structure of the monetary transmission mechanism (Knetter and Mosser, 2003, Boivin, Kiley and Mishkin, 2010). For example, Foerster (2013) argued that monetary policy regime switches cause changes in the term structure of interest rates and hence, the nature of the interest rate transmission mechanism. Ghana underwent a number of changes to its monetary policy frameworks, objectives and tools, which are identified as monetary policy regime shifts / switches. Ghana's monetary policy regime history can be divided into three distinct periods and associated changes in monetary policy framework, tools, objectives.

3.6.1 Direct Monetary Management (up to 1992).

Monetary policy under the import substitution industrial development strategy was direct monetary management. The functional framework of the direct monetary management focused on directly managing liquidity, specifically of the banking system. Rather than macroeconomic stabilisation, the underlying objective of monetary policy during this period was to actively support the growth priorities and objectives of import substitution development and hence, monetary policy was design to direct banking sector liquidity to meet government growth objectives. The combination of the objective of monetary policy (support government growth objectives) and the structural limitations of the formal financial system, which was bank base only, meant that choices of monetary policy tools were limited. With no formal money markets or securities market, the banking sector was the

only platform for implementing monetary policy, and statutory reserve requirements for commercial banks the only plausible tool. The use of reserve requirements was supplemented by direct controls on bank deposit and lending rates. Monetary policy therefore targeted the with a policy objective of macroeconomic growth and development and a policy tool of statutory reserve requirements. For the sample period in this thesis, the period of direct monetary management covers 1966 to 1992.

3.6.2 Indirect Monetary Management (1992-2002).

As part of the monetary policy reforms under the SARs, Bank of Ghana's monetary policy changed from direct monetary controls, to an institutionalised, market based monetary management. In consequence to the broader SARs, a number of significant structural changes supported a market based monetary management. These include; (1) the liberalisation of interest rates and credit supply, (2) the development of money market instruments such as Treasury bills and the Bank of Ghana Bonds, (3) the change to a flexible exchange rate regime and the liberalisation of the domestic foreign exchange market which supported the development of a liquid interbank market for foreign exchange. The structural changes in money market structure and instrument seemed to support the conditions, for a regime shift from direct monetary management, to indirect monetary management regime in 1992. However, the change to indirect monetary management meant that post reform monetary policy framework in Ghana (1992-2002) continued to be underscored by a monetarist view. This means that money supply (liquidity of the banking sector) management, remained the key framework of monetary policy. As such, the banking sector remained the main platform for the implementation of monetary policy.

The objective of monetary policy changed from supporting growth priorities to macroeconomic stability capacity, to stabilising inflation and growth. The main monetary policy tools also changed from statutory reserve requirements to the use of Open Market Operations (OMO) and the use of Discount Windows (DW). Open market operations enable the BOG to influence the banking sector

balance sheets and though their holdings of Treasury bills. A monetary policy expansion is supported by the buying of banks T-Bill holdings of commercial banks in exchange for liquidity assets (money), while a monetary policy contraction involves selling T-Bills to banks to mop-up liquidity. The use of discount windows the use of a discount window facility allowed the Bank of Ghana to influence the monetary based indirectly through supporting access to short term liquidity. This not only influences short term liquidity of banks but the discount rate (rates on discount window facility (ies)) becomes an important component of the monetary policy framework. This meant that BOG liquidity supply formed a key part of the post reform banking sector balance sheets.

3.6.3 Inflation Targeting (2002-Onwards).

The Bank of Ghana transitionally change its monetary policy from monetary targeting to inflation targeting in 2002. This became official and explicit in 2007. This regime transition marked a fundamental regime shift in both policy framework, policy objective and policy tool. Under the inflation targeting regime, the primary objective of monetary policy is price stability, defined as a medium term target of inflation target of 8 %, with a symmetric band of ± 2. The inflation target is assumed to be optimal for full potential economic growth. The inflation targeting framework involves the use of the Monetary Policy Rate (MPR) to set the bank's monetary policy stance, as an anchor of inflation expectations. The mechanism of the bank's inflation targeting framework involves positioning the MPR to neutralise any differentials between the inflation target and actual inflation. Monetary policy positioning is thus guided expected developments in actual inflation. While focus of monetary targeting is monetary aggregates (especially associated with the liquidity of the banking sector) as intermediate target variables, inflation targeting involved the targeting of short and long interest rates, as intermediate variables to influence money demand (bank loans).

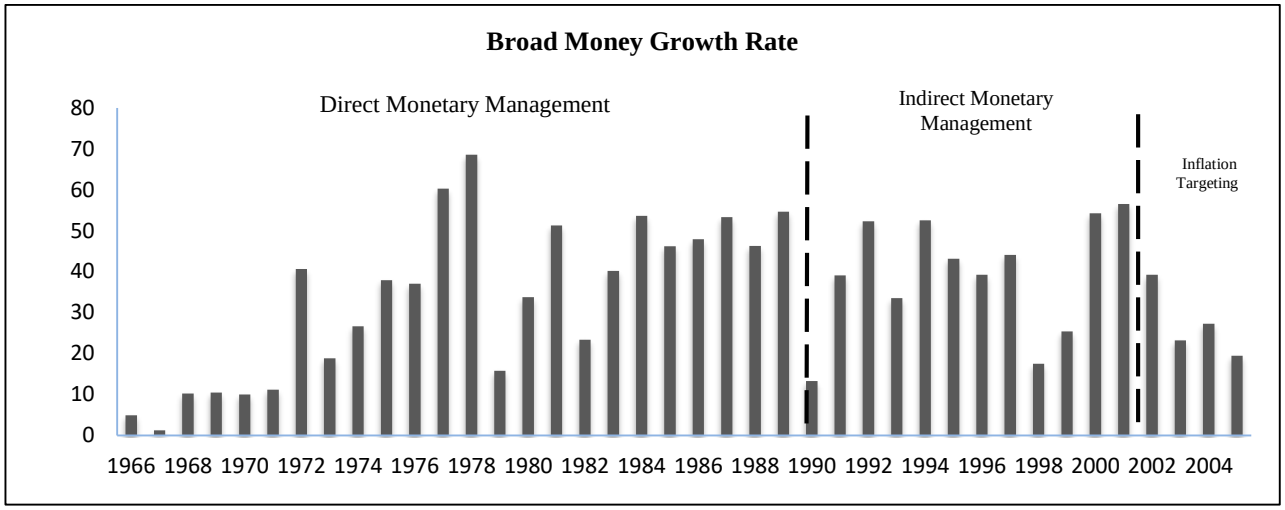
The objective of monetary policy also changed, from macroeconomic stability (inflation and output) to explicit price stability. The regime change, from a monetary targeting to inflation targeting in

Ghana suggests a change in the BOG's view of the structure of the MTM. This indicates a recognition of sufficient development in the financial sector, including the money market and banking sector, to support an interest rate based policy tool. The inflation targeting framework therefore, meant that the basis of monetary policy changed from liquidity management to demand and expectations management on the future trajectory of important indicators and the broader economy. This is signified by the shift to the adoption and use of the BOG policy rate as the official tool of monetary policy. Short term interest rates, generally overnight rates, rates for one month, three-month money, become the targets of the BOG policy rate. In this next sections, I analyse the implications of monetary policy regime shifts for the long run dynamics of money supply and changes in the long run dynamics of inflation and output growth in Ghana.

3.6.4 Monetary Policy Regime Shifts and Change in Money Supply Dynamics.

As a key component of monetary policy, the changes in the Bank of Ghana's monetary policy regime, had implications for the long-run dynamics of money supply. Using the measure of money and quasi-money as indicator of money supply, this section provides an analysis changes in the long run structural dynamics of money supply growth and the role of money supply in macroeconomic (inflation and output growth) dynamics. The section interprets a post reform change in the long run dynamics of money supply and changes in effect of money supply on inflation and GDP growth as indicators of change in the monetary transmission mechanism in Ghana.

Figure 17. Long Run Changes in Levels of Monetary Growth.



Source: Global Financial Development Database.

- *Volatility of money supply in Ghana fell from 19.3% under the direct monetary management regime to 12% under the indirect monetary management regime.*

The volatility of money supply is significantly reduced, following the shift from a direct monetary regime to an indirect monetary regime. The overall volatility of money supply fell from 19.3% in the pre-reform period to 12.0% in the post structural adjustment reform period. This is indicative of change in the long run structural dynamics of money supply following monetary policy regime shift.

3.7 Potential Implications the Changes for the Monetary Transmission Mechanism.

Ghana's pre-reform formal financial structure was entirely comprised of the banking sector. Ghana's pre-reform financial structure and restrictive controls had significant limitations and implications for the monetary transmission mechanism and the potential effect of monetary policy on the economy. This includes the limitations on the platforms for monetary policy implementation, the choice of monetary policy tools and frameworks. Developments in, and the dynamics of the informal money market did not form a part of the BOG's broader monetary policy framework. There was no formal money market, and no securities market. As such, indirect monetary targeting framework was not supported by the pre-reform financial structure. This means the pre-reform monetary policy

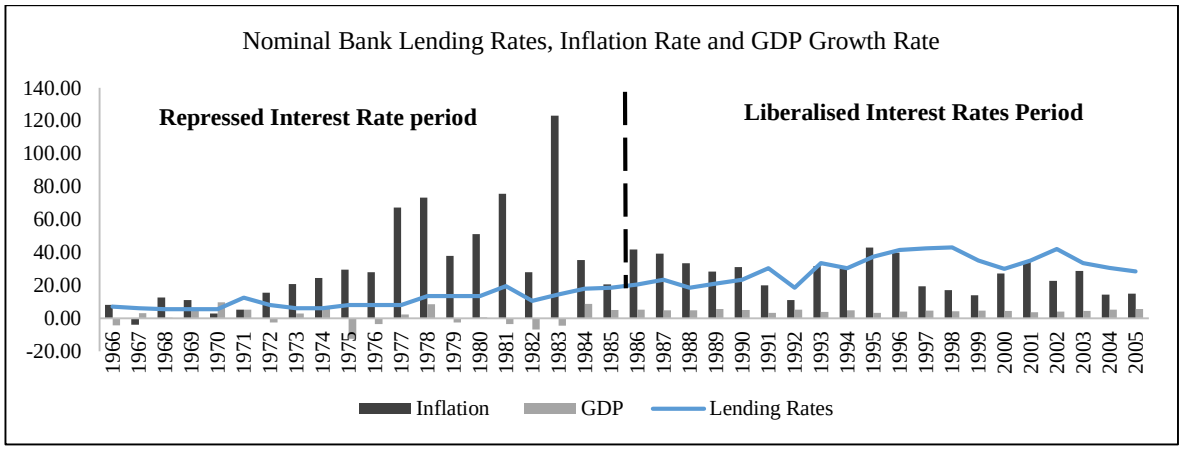
framework was therefore restricted to 'direct monetary targeting' with the main lever being the adjustment of the reserve requirement ratios. Through the use of reserve requirements, the banking sector was the only platform for the implementation of monetary policy. Monetary policy was based on monetary management through controlling money supply, by controlling the liquidity of the banking sector. Reserve requirements were used to target bank credit supply and bank lending (interest) rates, as intermediate targets of monetary policy. By default, pre reform monetary transmission mechanism constituted the bank lending channel and bank lending rates (interest rates). By virtue of the direct monetary targeting framework and the use of reserve requirements as the main policy tool, the implication was that the BOG viewed of the monetary transmission mechanism was based on the monetarist framework, treating money supply (which was narrowly defined as credit supply from commercial banks) as an active determinant of bank deposits demand, inflation and nominal GDP growth. This is evidence by their view that controlling interest rates and credit supply by bank is a lever to achieving growth objectives.

3.7.1 Potential Implications for Bank Interest Rates Channel.

The theoretical foundation of the bank lending channel is that bank loan rates provide a key link between monetary policy, and inflation and output. The theory provides that, within a market setting, bank loan rates has a negative relationship with both the inflation rate and output growth rate. The long run relationship between bank lending rates, and inflation and output growth rate should 'normally conform' to this theoretical provision. A key anomaly in the case of Ghana, was that while the use of reserve requirements was aimed at controlling influencing bank lending rates, the further quantitative determination of lending meant that its relationship with inflation and GDP growth would have been distorted, thus raising a fundamental question on the effectiveness of the bank lending rates channel. In order word, the systematic link between bank lending rates, and inflation and output growth would have been weakened by the restrictions, which meant that bank loan rates were not market determined. The correlations between bank lending rates, and inflation and GDP

growth data seems to support this. Figure 8 indicate that, against the backdrop interest rate controls, there were no theoretically discernible long term correlations between bank lending rates, and inflation and GDP growth rate during the pre-reform period. This indicates that the use of reserve requirements to target bank lending rates as a potential channels of monetary transmissions might have not been effective. This further supports the view that the interest rates (bank lending rates) transmission mechanism was weak and probably ineffective is transmitting monetary policy shocks.

Figure 18. Long Run Changes: Correlations between Nominal Bank Lending Rates, Inflation and GDP Growth.



Source: The inflation and GDP data are extracted from the World Bank Global Financial Development Database. Nominal bank lending rates are extracted from International Financial Statistics and Bank of Ghana databases.

- *Indicator of post liberalisation change in the long run correlation between nominal bank lending rates, inflation rate and GDP growth rate. This probably indicates a strengthening of the bank lending channel in the broader monetary transmission mechanism in post reform Ghana.*

The long run relationship between the nominal bank lending rates, inflation rate and nominal GDP growth rate indicates a post liberalisation structural shift. Figure 16 shows that during the pre-reform years (1966-1985), there was to be no theoretically discernible correlations between nominal bank lending rates, and the inflation rate and GDP growth rate. This could be explained by the combination of the restriction on the bank lending rates by the BOG and the high/low and volatile inflation and GDP growth rates respectively. The post reform (1986-2005) correlations between the nominal bank

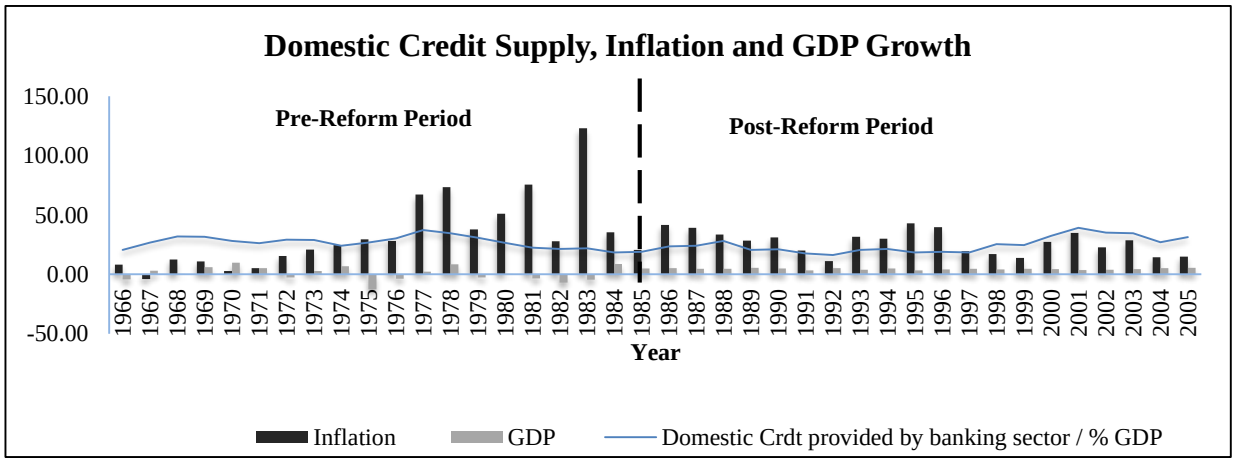
lending rate, and inflation and GDP growth rate in Ghana indicates a much closer correlation between the variables. The post liberalisation nominal bank lending rate appear lead to developments in both inflation and GDP growth compared to the pre-liberalisation period. This is indicative of a change in influence of bank lending rates in the macroeconomics dynamics, and potentially the monetary policy transmission mechanism. The change in the structural relationship between discount rate and the inflation over the sample period could reasonably be indicative of a structural change in Ghana's economy. Given the structural significance of interest rates in the monetary transmission mechanism, we argue that there probably was a post reform change in the structure of the monetary transmission mechanism in Ghana.

3.7.2 Potential Bank Credit and Lending Channel of Monetary Transmissions.

The theoretical framework on the bank lending channel, provides that changes in the volume of bank lending is a key channel linking monetary policy and the real economy. The theory provides that volume of bank lending, has a positive effect on both inflation and GDP growth. In the BOG's pre-reform monetary policy framework, bank credit supply was a key intermediate target. The use of reserve requirements as the principal monetary policy tools was designed to influence banks' balance sheets, and more specifically their loanable funds balances. This meant that the bank lending channel formed a key part of the BOG assessment of the MTM. However, in addition to the use of statutory reserves requirements as a tool to control overall banking sector liquidity, the BOG also used allocative and volume directives on banking sector credit supply. Provided bank credit supply formed a key part of aggregate household and business investment financing, bank credit should have a strong effect on inflation and output growth. But in light of pre-reform banking sector structural idiosyncrasies of low coverage and high credit rationing (Brownbridge and Gockel, 1996), fundamental question may have lingered on the overall effects of bank credit supply on the dynamics of inflation and output. From a monetary transmission view point, this raises questions on the effectiveness of a potential bank lending channels of monetary transmission. Figure 18 provides an

analysis of the correlations between bank credit supply to the private sector, and inflation and GDP growth rates.

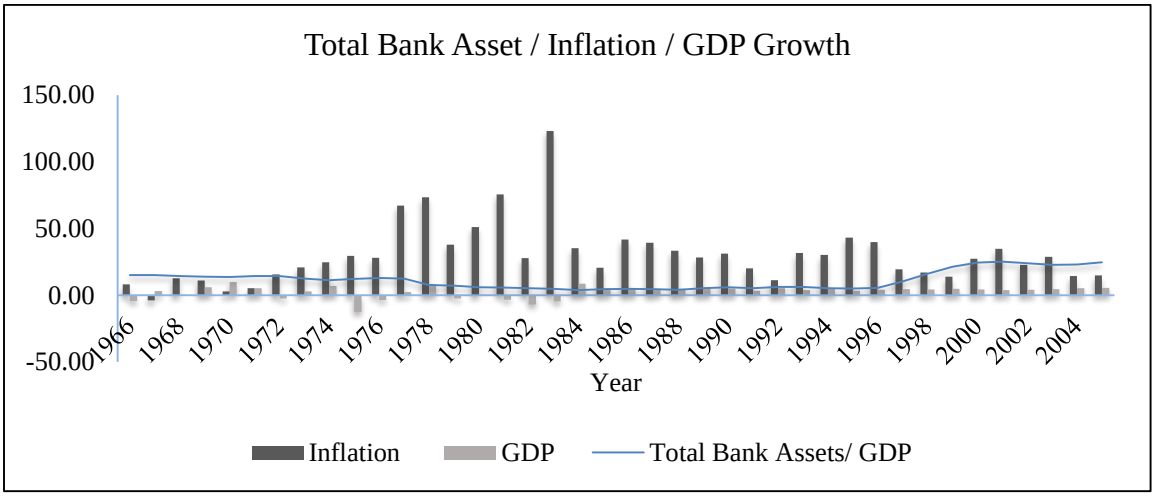
Figure 19. Long Run Changes: Correlations Between Bank Credit Supply to the Private Sector, Inflation and GDP Growth.



Source: Global Financial Development Database.

Figure 19 is a graph showing how the long run relationship between credit supply to the private sector from bank, inflation and GDP growth changed between the pre-reform and post reform periods. The data for the pre-reform period shows no theoretically discernible relationship between the either of credit supply and inflation or credit supply and GDP growth. The post credit market liberalisation data indicates a reasonable degree of correlation between the variables, providing an indication of change in the post reform MTM. This support the view that potentially, the bank lending channel became much more significant in the broader MTM following the credit market liberalisation. The differences in correlations between the pre and post reform period, can thus be indicative of change in the importance of the bank lending channels and hence the structure of the broader post reform MTM in Ghana.

Figure 20. Long Run Changes: Total Bank Assets, Inflation and GDP Growth.



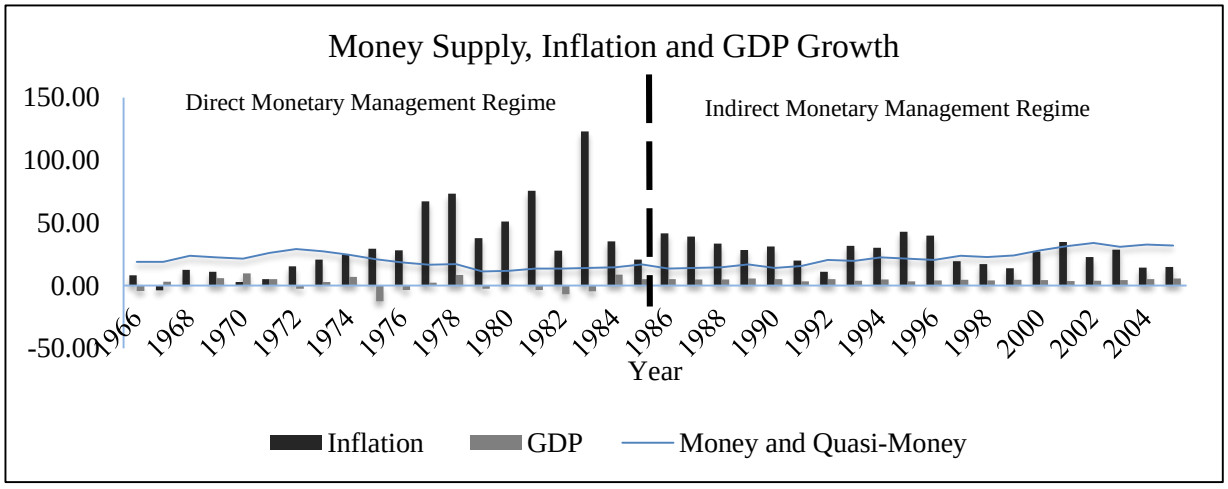
Source: Global Financial Development Database.

Figure 20 above shows the role of Ghana's banking sector activity in macroeconomic dynamics. The data indicates no clearly discernible relationship between aggregate banking activity, as measures by the dynamics of total bank assets, and inflation and output. The pre-reform data indicates no discernible correlations between banking sector balance sheet dynamics and inflation and output. However, the very high and volatile inflation rate, and low and volatile GDP growth rate in the periods between the mid-1970s up to 1984 was correlated with the sustained contraction of the banking sector balance sheet strength. The incidence of long periods of negative interest rates, may have contributed to the sustained decline in banking sector balance sheet strength. Following the banking sector reforms, including liberalisation and balance sheet restructuring, there appeared to be much closer relationships between total bank assets and inflation and output dynamics. This particularly hold around the mid-1990, when much of the reform programme was implemented.

3.7.3 Potential Implications for Role of Money Supply in Macroeconomic Dynamics.

Ghana's monetary policy frameworks of direct monetary management in the pre-reform period and indirect monetary management in the post reform period, and the employment of policy tools such as statutory reserve requirements, open market operations and discount windows were directed towards liquidity management (of the banking sector). This suggest that money supply was perceived as an active determinant of macroeconomic (inflation and output) dynamics. In light of changes in long run money supply dynamics, it is plausible that the long run relationship between money supply, and inflation and output growth changed following monetary policy regime shifts.

Figure 21. Long Run Changes: Correlations between Money Supply, Inflation and GDP Growth.



Source: Global Financial Development Database.

- *Long run dynamics of money supply, and inflation and GDP growth changed following monetary policy regime shift.*

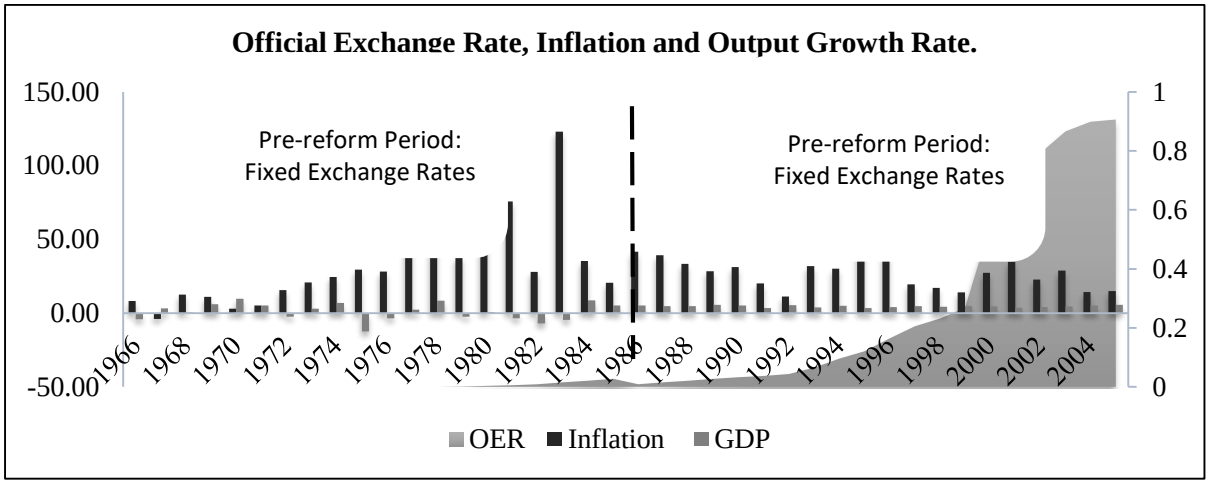
Figure 21 shows changes in the long run relationship between money and quasi money growth, inflation and output growth over the sample period. The line in the graph is the demarcation between the pre-reform (1966-1985) and post reform (1986) period. For the pre-reform period 1965-1975, there appeared to have been a degree of, even if weak, correlation between money supply and inflation. This relationship seemed to have broken down for the period from around 1975 to 1985). Over this period, there was no apparent causal relationship between money supply growth and either

of inflation and output. The volatility of inflation was much higher in this period without a discernible growth or volatility in money supply. For the post reform period, the volatility of both inflation and output seemed to be much closely related to money supply growth. From the data for both periods, this is reasonable evidence indicating that the long run relationships between money supply growth on the one hand, and inflation and output growth on the other changed following the structural adjustment reforms. The transitions in the data shows there is theoretical evidence that the long run dynamics of the monetary transmission mechanism in Ghana changed following the structural adjustment reform.

3.7.4 Potential Implications for an Exchange Rates Transmission Channel.

Additionally, the theoretical exchange rate transmission channel is underscored by the effect of exchange rate movements on the inflation and output growth rate. The broad framework of the exchange rate transmission mechanism postulates that monetary policy influences inflation and output through exchange rate adjustments. The postulation is that therefore is a correlation between exchange rates movements, within a framework of a flexible or freely floating exchange rate regime, and the inflation and output growth rate. A flexible exchange rate is postulates to respond to macroeconomic developments such as a changes in money supply or the relative interest on domestic financial assets. Equally foreign monetary developments are reflected into domestic inflation and output growth rate via the exchange rate adjustments. Figure 22 below provides an analysis of changes in the dynamics between the official exchange rates, inflation and output growth rate.

Figure 22. Correlations between Official GHS/US$ rate, Inflation and GDP Growth.



Source: Global Financial Development Database.

- *There was a change in the correlations between exchanges rates, inflation and GDP growth dynamics in Ghana following the exchange rate liberalisation.*

Figures 22 shows how the changes in the correlations between the official exchange rate, the inflation rate and output growth rate change over the sample period (1966-2005). The dotted vertical red line market the beginning of the SARs and more specifically the period of shift from a fixed exchange rate regime to a flexible exchange rate regime. In the period under the fixed exchange rate regime, when the official exchange rate wasn't freely adjusting to macroeconomic conditions, there was no discernible correlations between the OER, inflation and GDP. During this period, the exchange rate was kept artificially overvalued, in light of the high and volatile inflation, worsening BOP account and low GDP. A key development in the post exchange rate liberalisation period was the long run depreciation if the Ghanaian Cedi. Accordingly, post exchange rate liberalisation data, given the depreciation could indicate a degree of correlations between official exchange rate on the one hand, and inflation and output on the other. This provides indication that the exchange rate transmission mechanism may have become a significant part of the broader MTM in Ghana. Additionally, it could provide an additional platform for monetary policy through exchange rate targeting by the BOG.

CHAPTER 4. THE MODEL SPECIFICATIONS AND RESEARCH METHODOLOGIES.

4.1 Introduction

The institutional chapter (chapter 3) provided a structured analysis of institutional and structural changes motivated by the structural adjustments reforms in Ghana. Hypothetically, these changes would explain the post reform changes in the long run dynamics (structural change) of the monetary transmission mechanism in Ghana, and the evolution of the Bank of Ghana's monetary policy frameworks and tools. The thesis therefore, aims to empirically test the broad hypothesis that the structural adjustment reforms, and the associated institutional and structural changes were significant in explaining the structural change in the MTM in Ghana, and the effects of the post reform evolution of the Bank of Ghana's monetary policy (frameworks and tools). This broad hypothesis is divided into two sub-hypotheses; Hypothesis One and Hypothesis Two. #Hypothesis One# assesses the significance of the role of changes in financial structure and external openness in explaining the structural change in the MTM in Ghana. A benchmark model with GDP growth, inflation and broad money supply is estimated, against an augmented model with GDP growth, inflation, broad money supply, financial structure index and external openness index. From the estimated model, changes in the long run causality, significance of changes in coefficients, significance of structural change and impulse responses to shocks in financial structure and external openness indices are analysed. Hypothesis Two assesses the effects of post reform indirect monetary policy frameworks and tools in achieving macroeconomic and price stability. In light of the institutionalised, market based reforms of the financial sector, the effects of the post reform monetary policy, under the Bank of Ghana's indirect monetary targeting and inflation targeting framework are assessed.

This chapter explains the estimation methodologies used to test Hypotheses One and Two. The chapter is organised into three main sections. Section 4.2 explains the empirical model and estimation methodologies for testing Hypothesis One, which assesses the roles of financial structure and external openness in the MTM in Ghana. Section 4.2 is organised into 5 main sub-sections. Section 4.2.1 sets the research hypothesis. 4.2.2 explains the empirical benchmark model (without financial structure and external openness indices) and the augmented model (with financial structure and external openness indices), as alternative structural representation of the MTM in Ghana. Further, the section also explains the rationale for using the augmented model. Section 4.2.3 explains the methodologies for estimating the augmented model. This section explains the selection of the financial structure and external openness indicators, and the step in the construction of the indices, including the explanation of the Kaiser-Meyer-Ohlin (KMO) Measure of Sampling Adequacy and correlations testing. Further, the section also explains Principal Factor Analysis, as a Dynamic Factor Modelling technique. Section 4.2.4 explains the specification and estimation of the augmented model. This section explains the methodologies for assessing the time series properties of the admissible variables, including explanation of the Augmented Dicky Fuller Units Roots test and the Johansen Cointegration Testing. The section also explains the model diagnostic tests used, covering the Residual Autocorrelations Test, and Residual Heteroskedasticity Test. Section 4.2.5 explains the methodologies for assessing the structural dynamics of the MTM in Ghana, discussing the structural breaks test (Likelihood Ratio (LR) Test and Impulse Response Function Analysis.

Section 4.3 explains the empirical models and estimation methodologies for examining Hypothesis Two, which assesses the effectiveness of the post reform indirect monetary policy tools in Ghana. The section is divided into five sub-sections; section 4.3.1 sets out the research hypothesis. 4.3.2 explains the specified models of BOG's inflation targeting and monetary targeting frameworks. Section 4.3.3 explains the recursive identification used for identifying monetary policy shocks. Section 4.3.4 explains the estimation process and methodology of the inflation targeting model and

the monetary targeting model. This includes a brief summary of the methodologies for assessing the time series properties of the variables in both the inflation targeting and monetary targeting frameworks. These include the Augmented Dickey Fuller Unit Roots test of the stationarity the Johansen Cointegration test of cointegration between each model variables. Section 4.5.4 briefly outlines the model diagnostic test, including the Residual Autocorrelations Test, and the Residual Heteroskedasticity Test. 4.3.5 explains the structure of the respective Impulse Response Function (IRF) for the inflation targeting model, and the monetary targeting model.

4.2. The Monetary Transmission Mechanism in Ghana: Role of Financial Structure and External Openness.

4.2.1 The Research Hypothesis.

As explained in the introduction to this chapter, Hypothesis One test the hypothesis that the structural adjustment reforms, the more specifically, the changes in financial structure and external openness were significant in explaining the structural change in the MTM in Ghana. Structural change is defined as changes in the long run dynamics of the relationships between the key institutional and structural components of the MTM. The structural dynamics of the MTM in Ghana is assumed to be explained by the relationship between GDP growth, inflation, financial system, broad money supply and external openness. The hypothesis thus argues that the structural adjustment reforms motivated fundamental long run changes in these relationships, which then has fundamental significance for the evolution of monetary policy in Ghana. Thus, the hypothesis assumes that 1985/1986 marked a period of significant structural change for the MTM in Ghana. Functionally, the hypothesis can be stated as:

$$Pre - Reform\ Period\ (1960 - 1985): H_0 = \sum_{l=1}^{L} \emptyset_{l,t} = 0 \qquad (4.1)$$

$$Post\ Reform\ Period\ (1986 - 2015): \ H_1 = \sum_{l=1}^{L} \emptyset_{l,t} \neq 0 \qquad (4.2)$$

The null hypothesis (H_0) argues no parameter changes, and hence no structural change. The alternative hypothesis (H_1) on the other hand infers parameter change, and hence structural change. A number of econometrics techniques are used to test this hypothesis. This include assessment of changes in long run and short run causalities running from monetary policy to GDP growth and inflation; analysis of significance of coefficients between an estimated benchmark model (GDP growth, inflation, broad money supply) and an augmented model (GDP growth, inflation, broad

money supply, financial structure index and external openness index), structural breaks test (likelihood ratio test) and analysis of impulse response of GDP growth, inflation and broad money supply to shocks in financial structure and external openness indices. Such structural change will potentially explain or influence the effectiveness of the post reform transitions to indirect monetary policy frameworks and tools by the Bank of Ghana.

4.2.2. The Models.

The Bank of Ghana's conduct of monetary policy frameworks, objectives and tools, have consistently indicated that the authority perceives the MTM as the causative effects of policy induced changes in monetary policy, on inflation and GDP growth. The banking sector, as the main platform for the implementation of monetary policy, is seen as the main institutional linkage between monetary policy, and inflation and GDP growth. Monetary policy largely operates by targeting the liquidity and balance sheet of commercial banks. Additionally, a key component of the BOG's monetary policy frameworks involved mitigating the effects of external shocks on domestic inflation and GDP growth. The model for estimating structural change therefore, captures the unique structural features of the MTM in Ghana. The model assumes the MTM is described by the dynamic relationships between; (1) money supply (M) representative of liquidity management based monetary policy, (2) financial (banking) system, to capture the bank loan rate (interest rates) and credit supply channels of monetary transmission channels (3) macroeconomic openness, to capture the significance of the exchange rates transmission channel, (4) inflation and (5) GDP growth, as target of macroeconomic stability. Together, these variables represent the core systematic components of the MTM in Ghana.

4.2.2.1. The Benchmark Model.

The benchmark model assumes a monetary transmission mechanism in which the financial system and external openness have important systematic roles. The MTM is therefore assumed to be fully described by the dynamic relationships between GDP growth, inflation and the supply of fiat money by the Bank of Ghana (BOG). The MTM is thus perceived as the causative effects of BOG controlled fiat money supply on GDP growth and inflation. This reflects the pre-reform view of the MTM and the practice of monetary policy in Ghana. Structurally, the benchmark model can be represented as follows:

$$A[Y_t, M_t] = B(L)\left(y_{t-p} + \pi_{t-p}\right) + M_t + \varepsilon_t \qquad (4.3)$$

Where Y represents a $M \times 1$ vector of observable macroeconomic variables. $Y = \{y, \pi\}$, where π_t is inflation rate. FI_t is the factor 1, as a proxy for financial structure index. EI_t is factor 1, as a proxy for the external openness index. M_t broad money supply, as the key tool in the Bank of Ghana monetary targeting policy framework. $B(L)$ represents the p^{th} order matrix polynomial. A represents the matrix of coefficients determining the contemporaneous relationships between the system's variables. $\varepsilon_t \sim N(O, \Omega)$ represents a vector of structural shocks, assumed to be is uncorrelated.

4.2.2.2. The Augmented Model.

The augmented model, unlike the benchmark model, recognises the systematic role of, and thus incorporates financial structure and external openness as key systematic components of the monetary transmission mechanism. However, a key econometric issue with the measurement of 'financial system' and 'external openness' is that rather than be described by a single variable, both can be described by a number of variables. The augmented model is thus designed to capture the influence of all the variables (that can describe financial structure and external openness) in a single representative index, using Dynamic Factor Modelling (DFM). DFM is a data dimension reduction technique allowing for the dimension of a set of representative 'financial structure' and 'external

openness' indicators to be reduced into a single representative factors, such that $N > F$, where N is the number of indicators, and F is the representative number of extracted latent factors. This allows for the construction of the augmented model as a Factor Augmented Vector Autoregression (FAVAR) model, by which the dynamic relationships between GDP growth, inflation, broad money supply, financial structure index and external openness index are estimated. The augmented model is effectively a Vector Autoregressive (VAR) model, nettled with estimated factors as the financial structure and external openness indices. The FAVAR model thus comprises of two equations; the observation equation and the transition equation. The model can be functionally represented as:

$$X_t = \wedge^F F_t + v_t \tag{4.4}$$

$$A\left[Y_{t,}F_t, M_t\right] = B(L)\left\{Y_{t-p}, Fi_{t-p}, Ei_{t-p}\right) + M_t + \varepsilon_t \tag{4.5}$$

Equation (4.4) is the observation equation, and its estimation underscores the construction of the financial structure and external openness index, using dynamic factor modelling techniques. Thus, X_t are unobserved sets of representative financial structure and external openness indicators set. Thus equations of X_t are estimated:

$$X^{Fi} = \wedge^{Fi} F_t + v_t \tag{4.6}$$

$$X^{Ei} = \wedge^{Ei} F_t + v_t \tag{4.7}$$

Where X_t^{Fi} represent a $N \times 1$ vector of financial structure indicators and X_t^{Ei} represent a $N \times 1$ vector of external openness indicators. In both equations (4.5 and 4.6), F_t is a $K \times 1$ vector of common dynamic factors (CDF) such that $K < N$. F_t is assumed to drive the common dynamics of the variables in X_t. $\wedge^{Fi}$ and $\wedge^{Ei}$ are the estimated factor loadings, signifying the significance of a given factor in driving the common dynamics of the financial structure and macroeconomic openness indicators (X_t). v_t represents the respective error terms for each equation. Equation (4.5) is the

transition equation, describing the specified FAVAR model, which incorporates all the systematic components of the MTM in Ghana. The specification of the model is conditional upon the estimated and retained factors (F), representing the financial structure and external openness indices. Where Y_{t-p} is a $M \times 1$ vector of observed variables by the BOG, where $Y_t = \{GDP, \pi\}$, such that GDP represents GDP growth and π represents the inflation rate. (π_t). Fi_{t-p} represents the estimated $K \times 1$ vector of financial structure factors and Ei_{t-p} represents the estimated $K \times 1$ vector of external openness factors. M represents Bank of Ghana determined money supply, indicating its monetary policy stance. $B(L)$ represents the p^{th} order matrix polynomial. A represents the matrix of coefficients determining the contemporaneous relationships. $\varepsilon_t \sim N(O, \Omega)$ represents a vector of structural shocks, assumed to be is uncorrelated. The reduced form of the transition equation (equation 4.4) estimable with data is thus:

$$\left[Y_{t,} F_t, M_t\right] = C(L)\ [gdp_{t-p}, \pi_{t-p}, Fi_{t-p}, Ei_{t-p}] + m_t + u_t \qquad (4.8)$$

Where $u_t \equiv A^{-1}\varepsilon_t \sim (0, \Sigma)$ represents the vector of reduced form residuals, and more readily interpretable and focused on of identification.

4.2.2.3 Measurement Rationale of Using a FAVAR model.

Principal Factor Analysis, is a data dimension reduction technique, using Dynamic Factor Modelling (DFM). Fabrigar, Wegener, MacCallum, & Strahan, (1999) described the DFM as a multivariate statistical method for data reduction by determining the number and nature of common factors needed to account for the patterns of observed correlations. Bernanke et al (2005) described it as a nonparametric way of estimating the common space spanned by the unobservable factors. DFM, which has traditionally been attributed to the seminal work of Geweke (1977) and Sargent and Sims (1977), uses time domain methods to estimate the number of factors (Stock and Watson, 2001). The authors identified three generations of time-domain estimation of DFMs; (1) generation low-dimensional (small N) parametric models estimated in the time domain using Gaussian maximum

likelihood estimation (MLE) and the Kalman Filter (this generation however suffers from dimensionality problems), (2) generation entailing non-parametric estimation with large numbers of variables (large N), using cross-sectional averaging methods (principal components and principal factors), and (3) generation that use nonparametric estimates of the factors to estimate parameters of the state space model used in first generation models.

A FAVAR model for monetary transmissions and monetary policy analysis was first developed in Bernanke, Boivin and Elliasz (2005) (Henceforth BBE). Following BB (2003) and BBE (2005), FAVARs have been increasingly used in MTM and monetary policy analysis. For example, Mumtaz and Surico (2006) and Boivin and Giannoni (2006), amongst others, extended the use of FAVAR to international monetary transmissions studies. As a developing country, Ghana financial (banking) sector, and the openness of the economy are important features of the monetary transmission mechanism. The banking sector is the main platform for the implementation. Given that both the dynamics of the financial system and macroeconomic openness are driven by a relatively large number of variables. However, empirical regularities on the MTM in Ghana have traditionally focused on a handful of financial system and external openness variables, with the potential sparse information problems. Additionally, individually incorporating all financial structure and external openness variables motivates the over-parameterisation problems inherent with standard monetary VARs. The FAVAR model mitigates against the both the sparse information and over-parameterisation problems, thus allowing the alignment of empirical estimations with the monetary policy practice of the Bank of Ghana, which considers dozens of macroeconomic and financial sector variables in the course of monetary policy decision making. The FAVAR model therefore, enables a larger number of potentially information rich financial sector and macroeconomic variables to be incorporated. In aggregate, the FAVAR model allows for the incorporation a larger, richer set of potentially significant macroeconomic information, than is reasonably practical with standard VARs. From a monetary policy programming view point, understanding the significance and dynamics of

these financial structure and external openness indicators allows for a much robust understanding of the MTM.

4.2.3 Methodologies for Estimating the FAVAR model.

The identified FAVAR model of the MTM in Ghana comprises of two equations (4.3 and 4.4). The estimation therefore involves a two-step estimation process, involving the estimation of the observation and transition equations respectively. The estimation of the observation equation underscores the construction of the financial structure and external openness indices, using Dynamic Factor Modelling (DFM) techniques, and more specifically, using Principal Factor Analysis (PFA). Conditional upon the constructed and retained financial structure and external openness indices, the augmented model (FAVAR model) is specified and estimated using standard VAR techniques. The estimation methodologies involved are explained in the next sub-sections.

4.2.3.1. Selection of the Financial structure and External Openness Indicators.

As stated, both 'financial structure' and 'external openness' are described by a range of structural indicators. The technique used here is to collectively capture all these range of variables in a single representative financial structure index. A confirmatory, rather than exploratory, Principal Factor Analysis. This means that the selection of the 'financial structure' and 'external openness' indicators are motivated by the broad theoretical frameworks of the MTM. The selection of the financial structure indicators draws on the conceptual framework of the Post Keynesian Endogenous Money theories, and the institutional role of the financial system in determining the cost of, and supply of endogenous money. Financial structure factors that influence the supply and cost of endogenous money become important components of the financial structure. Financial structure, a range of banking sector balance sheet variables, as the formal financial structure is not only predominantly bank based, but is also the main platform for the implementation of monetary policy.

Table 16. The Selected N Financial Structure Indicators.

Deposit Money Bank Assets to (Deposit Money + Central Bank Assets (%)
Bank Deposits (BD) (% GDP)
Central Bank Assets (% GDP)
Banking sector Liquid Liabilities (BLL) (% GDP)
Deposit Money Bank Assets (DMBA) (% GDP)
Broad Money / Total Reserve Requirement.
Broad Money Growth.
Broad Money Supply (% GDP)
Gross Domestic Savings (GDS)
Credit provided by Financial Sector.
Claims of Central Government
Private Sector Credit from Banks (PSCB) (% GDP)
Claims on Private Sector /Broad Money(CPSBM)
Bank Credit to Bank Deposits (%)
Total Bank Reserves (% GDP)

The selection of the external openness indicators is influenced by the Open Macroeconomic Theory of exchange rate transmission, and the structural role of balance of payment (BOP) factors. These include the structural determinants of the Uncovered Interest Parity (UIP) and Purchasing Power Parity (PPP) theories. Since Ghana's international trade relations are largely driven by trade in goods, the selection of the indicators of macroeconomic openness and drivers of exchange rate dynamics draws on Balance of Payment (BOP) account variables.

Table 17: The Selected N External Openness Indicators.

INDICATOR
Exports of Goods and Services
Imports of Goods and Services
Official Exchange Rate (GHS/USD)
Net Foreign Assets (LCU)
Foreign Direct Investment, Net Inflows (% GDP)
External Debt Stock (Short Term)
External Debt Stock (Long Term)
Total Interest Payments on External Debt (% GDP)
Current Account Balance (% GDP)
Net Financial Account (% GDP)

4.2.3.2 Construction of the Financial Structure and External Openness Indices.

The construction of the financial structure and external openness indicators (factors) involves statistically reducing the dimensions of X_t^{Fi} and X_t^{Ei}. This involves a number of estimation steps. First, we measure the sampling adequacy of X_t^{Fi} and X_t^{Ei} for dynamic factor modelling. The Kaiser-Meyer-Ohlin (KMO) methodology is used to assess whether both data sizes of X_t^{Fi} and X_t^{Ei} are sufficient for their dimensions to be reduced using PFA. Second, we assess the degree to which the dynamics of the indicators in X_t^{Fi} and X_t^{Ei} are related, and driven by common factors. Indicators correlations test is used to assess these relationships. Next, conditional upon the results of the sampling adequacy and correlations tests, we construct the financial structure index and external openness index using DFM. The PFA is the DFM methodology used. In the next section, each of these steps are explained and their application to the empirically methodology discussed.

4.2.3.2.1. Measures of Sampling Adequacy: Kaiser-Meyer-Ohlin Methodology.

An important step before subjecting the financial structure indicators set (X^{Fi}) and macroeconomic openness indicators set (X^{Ei}) to PFA process, is to test the adequacy of their respective sample sizes. In other word, the sample sizes of each set is examine to be satisfied that they are sufficient for their respective dimensions to be reduced, using DFM. To test the adequacy of the respective samples sizes, Kaiser-Meyer-Ohlin of Measure of Sampling Adequacy (KMO) is used. The KMO methodology measures the proportion of variance amongst the variables in (X_t^{Fi}) and (X_t^{Ei}) that might be common variance. The methodology uses the following formula:

$$KMO_j = \frac{\sum_{i \neq j} r_{ij}^2}{\sum_{i \neq j} r_{ij}^2 + \sum_{i \neq j} u} \tag{4.9}$$

Where r_{ij} represents the correlations matrix, and u_{ij} is the partial covariance matrix. The methodology generates KMO scores for the set of variables. A sample size is deemed to be adequate for DFM if the KMO Score is > 0.50. The KMO scores of X_t^{Fi} and X_t^{Ei} are estimated to test the adequacy of their respective sample sizes. Both X_t^{Fi} and X_t^{Ei} indicator set must pass, with a minimum KMO score of > 0.50, for to be adequate for DFM. Conditional upon the adequacy of the respective sample sizes, the next step is to test for unit roots in each indicator, and the level of correlations between the indicators.

4.2.3.2.2. Correlations (Matrix) Tests: Financial Structure Indicators and External Openness Indicators.

A key statistical assumption for the conduct of dynamic factor modelling is that the variables either co-vary or are correlated. This underlies the assumption that the financial structure and external openness indicators respectively selected for DFM are driven by common dynamic factors. We test this assumption by analysing the level of correlations between the variables in the financial structure (X^{Fi}) and macroeconomic openness (X^{Ei}). It is thus important that there is a significant level of correlations between the selected financial structure and macroeconomic openness indicators, as this

will form the basis of extracting the factors driving the correlations dynamics. I thus estimate the correlations between the variables sets; financial structure variables set and external openness variables set. The estimated correlations matrix shows the extent to which the variables in each set are driven by common factors. The objective is thus to estimate and extract these common factors, using Principal Factor Analysis (PFA).

4.2.3.2.3 Construction of the Indices Using Principal Factor Analysis (PFA).

Subject to the adequacy of the sample sizes of X^{Fi} and X^{Ei} for DFM, and the existence of a significant level of correlations between the indicators in each sample, the next step in PFA process is the estimation of the common dynamic factors, using Principal Factor Analysis, as the statistical methodology for DFM. PFA is a data reduction methodology, allowing the N indicators in X^{Fi} and X^{Ei} to be reduced to their respective factors (F) such that $N > F$. Statistically, PFA summarises the collective dynamics of the $N \times 1$ indicators in X^{Fi} and X^{Ei} into a $K \times 1$ factors (F). In explaining the conceptual framework of PFA, Stock and Watson (2010) constructed as weighted average of X_t, a $N \times 1$ vector of variables, using non-random $N \times r$ matrix of weights, W, where W is normalised so that $W'W/N = I_r$:

$$\hat{F}_t(N^{-1}W) = N^{-1}WX_t \qquad (4.10)$$

The principal components estimator of the factors (F_t) is the weighted average estimator, with $W = \hat{\wedge}$, where $\hat{\wedge}$ is the matrix of the eigenvectors of the sample variance matrix of X_t, $\hat{\Sigma}_X = T^{-1}\sum_{t=1}^{T} X_t X_t'$. Stock and Watson (2010) therefore provided that the principal factors estimator is derived as a solution to the least squares problem;

$$min_{F_1,\ldots\ldots F_T,\wedge} V_r(\wedge, F), \text{ where } V_r(\wedge, F) = \frac{1}{NT}\left(\sum_{t=1}^{T}(X_t - \wedge F_t)'\,(X_t - \wedge F_t)\right) \qquad (4.11)$$

PFA is thus used to estimate the common dynamic factors for the financial structure indicators (X_t^{Fi}) and the external openness indicators X_t^{Ei}). The process reduces the N −dimensions of each set to a $K \times 1$ vector of common dynamic factors, such that $> K$. For a given estimated factor, higher factor loadings ($\wedge^F$) for each variable indicates the extent to which the common spaces spanned by the variables is explained by the said factor. To test the robustness of the PFA results, and to simplify the structure of the estimated factors, the factor loadings are rotated, using orthogonal varimax rotation. This simplifies the structure of the factor loadings for a more robust estimation of the factors.

In addition to the estimated number of factors, an important output of the PFA is the Factor Loadings for each variable. The factor loading is the estimated coefficient of the strength of the relationship between an estimated factor and an individual indicator / variable. Thus, the factor loadings give an estimate how highly the dynamics of an individual variable is determined by a given estimated factor. The more influential an estimated factor is on an individual indicator, the closer the factor loading is to 1.0. The loadings distribution thus supports the robustness of the estimated number of factors. However, estimated factors and factor loading, may contain measurement errors or noise. Factor rotation allows for such measurement errors or noise to be reduced, allowing for a more robust estimated factors. Factor rotation simply rotates the factors in an F-dimensional space. The rationale for rotating estimated factors and the associated factor loadings can be attributed to amongst, Cattell (1978), who opined that factor rotation simplifies factor structure and makes it easier and more reliable to interpret. There are a number of rotation methodologies; Varimax Rotation, Quartimax Rotation, Orthogonal Rotation and Oblique Rotation. In this chapter, Orthogonal Varimax Rotation is used to rotate and simply the structure of the factor loadings for ease of interpretation. The Orthogonal Rotation preserves the independence of the factors, while the Varimax attempts to simplify the loadings to ones (1.0) and zeros (0.0) in the columns of the component matrix. Generally, following the factor rotation, only a handful of factors are retained and the remaining factors are

assumed to be measurement errors and are discarded. Factor rotation allows for the robust factors to be identified for incorporation into the FAVAR model.

4.2.4. Specification and Estimation of the FAVAR model.

Step two of estimation process is conditional (upon the estimated and retrained factors) specification and estimation of the identified FAVAR model. The specification of the FAVAR model is conditional upon the number of retained $K \times 1$ vector of factors and the definition of the $M \times 1$ vector of the observable variables. Hence, the FAVAR model is a VAR augmented with retained factors. For the FAVAR specification, the M observable variables are augmented with the retained K factors. Effectively, the identified FAVAR model (equation 4.6) become a standard *n*-equation, *n* variable linear model, where $n = 5$. The model is estimated as a multivariate standard recursive VAR model, in which each of the variable is explained by its own lagged values, plus current and past values of the remaining *n*-1 variables. The recursive structure is constructed so that the error terms are uncorrelated. This is achieved by incorporating on some of the system's equations, contemporaneous values of the other variables as regressors. Recursively incorporating the contemporaneous values allows for equations to be individually estimated by OLS given the violation the assumptions of the classical regression model of uncorrelation between the regressors and the error terms. The identified FAVAR model of the MTM in Ghana takes the following recursively structured generic functional form:

$$A[Y_t, F_t, M_t] = B(L)[GDP_{t-p} + \pi_{t-p} + (Fi_{t-1}^1 + \cdots + Fi_{t-p}^K) + (Ei_{t-1}^1 + \cdots + Ei_{t-p}^K)] + M_t + \varepsilon_t \qquad (4.12)$$

Where Y_t is a $M \times 1$ vector of observed macroeconomic variables, for which GDP_t represents output growth, π_t is the inflation rate, M_t is money supply (representative of monetary policy, since the BOG pursued monetary targeting for most of the whole of the pre-reform and most of the post reform periods). $Fi_t^1 \cdots Fi_t^K$ represent the estimated financial structure factors, conditional upon the number of factors retained for estimation of the FAVAR, and $Ei_t^1 \cdots Ei_t^K$ represent the estimated

macroeconomic openness factors. $B(L)$ represents the p^{th} order matrix polynomial. A represents the matrix of coefficients determining the contemporaneous relationships. ε_t is zero mean (serially uncorrelated / independent) error term with variance-covariance matrix $E(\varepsilon_t \varepsilon_t') = \sum_{\varepsilon}$. The model therefore assumes the systematic component of the MTM in Ghana is described by the dynamics relationship between monetary policy (M_t), the financial sector ($Fi_{t-1}^{1} \cdots Fi_{t-p}^{K}$) , macroeconomic openness, as international capital and trade flow dynamics, and exchange rate dynamics ($Ei_{t-1}^{1} \cdots Ei_{t-p}^{K}$), inflation (π_t) and GDP growth (y_t) and other idiosyncratic components (ε_t).

4.2.4.1. Tests of the Time Series Properties of the Augmented Model Variables.

The variables incorporated in the specified FAVAR model are time series variables, covering the full sample period 1966-2015. As such, a number of properties of variables needs to be examined, less the regression results from the specified FAVAR model become spurious, and thus any inferences misleading. Two key properties of the variables are examined. First, admissible variables in the specified augmented model are tested for stationarity, using Augmented Dicky Fuller Unit Roots Test. Second, Johansen Cointegration test is employed to test for cointegration between the admissible variables. In the next two sections, the conceptual frameworks of the Augmented Dickey Fuller Unit Roots Test and Johansen Cointegration Test are explained.

4.2.4.1.1. Augmented Dickey Fuller Unit Roots Tests.

Macroeconomic times series typically contain trends, which means they are often non-stationary. As such, when non-stationery time series in are included into an econometric model, the validity of the resulting t-statistics and / or the estimated coefficients are compromised (Wassell and Saunders). One such issues that may undermine the validity of econometric results using trended time series variable is the problem of spurious regression. Hence, to avoid this problem (spurious regression), the time series trend must be removed before being employed in econometric analysis. Once de-trended, a time series variable is determined to be stationary. Stationarity in a time series variable which means

that the mean and variance are constant over time and that the covariance between two values from the series depends only on the length of time separating the two values and not on the actual time at which the variables are observed (Hill et al, 2008). For a de-trended time-series variable y_t is stationary when the mean is constant;

$$E(y_t) = \mu \tag{4.13}$$

when the variance is constant or independent of time;

$$Var(y_t) = \sigma^2 \tag{4.14}$$

When the Covariance is time dependent;

$$cov(y_t, y_{t-s}) = cov(y_t, y_{t+s}) = \gamma_s \tag{4.15}$$

Ensuring stationarity in the variables avoids potential spurious regression problems. There are a number of time series de-trending methodologies, with the most prominent methods including the Augmented Dickey-Fuller Unit Roots Testing, Phillip-Perron Tests and KPSS tests. In this chapter, Augmented Dickey-Fuller de-trending methodology is used;

$$y_t = \rho y_{t-1} + v_t \tag{4.16}$$

$$\Delta y_t = (1 - \rho) y_{t-1} + v_t \tag{4.17}$$

Random walk:

$$\Delta y_t = \gamma y_{t-1} + v_t \tag{4.18}$$

Random walk with drift (intercept):

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + v_t \tag{4.19}$$

Trend Stationary Process:

$$\Delta y_t = \alpha_0 + \alpha_1 t + \gamma y_{t-1} + v_t \tag{4.20}$$

Augmented Dickey Fuller Test:

$$\Delta y_t = \alpha_0 + \alpha_1 t + \gamma y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta y_{t-1} + v_t \qquad (4.21)$$

The ADF tests for non-stationarity under the Null hypothesis of unit roots. ADF test is conducted to de-trend the following on both the 'unobservable' and observable variables The unobservable variables comprise of the set of 'financial structure' variables (X_t^{Fi}), 'external openness' variables (X_t^{Ei}), while the observable variable (Y_t) is a $M \times 1$.

4.2.4.1.2 Johansen Cointegration Tests.

Generally, time series variables are non-stationary, $I(1)$. The modelling of two more of such variables requires the existence of a combination of variables to be stationary. When two variables are cointegrated, there exists a stationary equilibrium relationship between them. Otherwise, spurious regression problems arise, in which completely unrelated time series variables appear to be related using conventional estimation methods. Cointegration test is used to test the long run equilibrium relationships between two or more of such variables in a model. Given a $M \times 1$ vector, y_t, the component variables are said to be cointegrated of the order d, b, denoted as $y_t \sim CI(d, b)$, if two conditions are satisfied; (1) all the component variables of vector y_t are $I(d)$, meaning they need d differences to induce stationarity, and (2) there exists a vector, $\beta(\neq 0)$, such that $Z_t = \beta' y_t \sim I(d - b)$. The vector β is the cointegrating vector. Consider two $M \times 1$ vector of time series variables, y_t^1 and y_t^2, assumed to be $I(1)$. y_t^1 and y_t^2 will be cointegrated if there exists a vector $\omega = (1, \omega_2)$ such that when y_t^1 and y_t^2 are in equilibrium;

$$[y_t^1, y_t^2] = \omega \equiv y_t^1 - \omega_{2,} y_t^2 = 0 \qquad (4.22)$$

ω is thus the cointegrating vector. Realistically, y_t^1 and y_t^2 are likely to be changing over time systematically as well as stochastically. The cointegrating relationship will thus be;

$$Y\omega = X\beta \qquad (4.23)$$

Where $Y = [y_2^1, y_t^2]$ and X is a non-stochastic matrix. The relationship $[y_t^1, y_t^2]\omega = 0$ cannot be expected to hold exactly for all periods t. Cointegrating variables are 'equilibria', and as such, it is important to test and model these relationships. Testing for Cointegration is a necessary step in modelling empirically meaningful long run relationships. A number of Cointegration testing methodologies exists, including amongst other, the Durbin-Watson Test Statistics, Engle-Grander Approach and the Johansen Cointegration Test.

To test for Cointegration between the variables in identified FAVAR model, Johansen Cointegration Testing, deemed as central to Cointegration testing (Bo Sjo, 2008), is used to test the long run equilibrium relationships between the variables in the FAVAR model. Given an n variables, Johansen test estimates the number of cointegrating vectors. Given n variables, there would be at most $n - 1$ cointegrating relationships. Johansen tests are likelihood ratio tests, of which there are two types; (1) Maximum Eigen Value Test and, (2) Trace Test. For both test types, the initial Johansen test is a test of the null hypothesis of no Cointegration, against the alternative hypothesis of Cointegration between the variables. Thus GDP growth (GDP_t), inflation (π_t) financial structure index ($Fi^1 \ldots . Fi^K$), external openness index ($Ei^1 \ldots . Ei^K$) and broad money supply (M_t) are tested for cointegration, using the Johansen Cointegration test methodology.

4.2.4.2. Methodologies for Model Diagnostics Tests.

The augmented model is estimated as a standard VAR model. The implication is that certain assumptions are made regarding the structure and relationships between the residual (error terms) of the estimated augmented model. A key assumption about the residual is $\varepsilon_t \sim N(O, \Omega)$ representing a vector of structural shocks, assumed to be is uncorrelated. Additionally, the variance of the residuals is assumed to be constant. These assumptions will need to hold before any reliable inferences can be drawn from the estimated augmented model. Two diagnostics tests are employed test these assumptions, and hence the adequacy and robustness of the results of the estimated FAVAR model for inferencing. First, a residual autocorrelations test to test the assumption that the error terms are uncorrelated. Second, residual heteroskedasticity test is used to assess if the variance of the error term is constant. In the next sections, the frameworks of these two diagnostics tests are explained.

4.2.4.2.1 Residual Autocorrelation Test.

The FAVAR model structural assumption that the error terms are serially uncorrelated. For time series data such as those employed in the FAVAR model, the error term for one period can be correlated with the error term in the previous periods. The consequences of such, are that the OLS estimator is still unbiased and the OLS is not BLUE anymore. The usual standard errors and t-statistics are no longer valid. Consider the following model;

$$Y_t = \beta_1 + \beta_2 X_{1t} + \cdots\cdots + \beta_K X_{Kt} + \varepsilon_t, \qquad , t = 1,2 \cdots\cdots T \qquad (4.24)$$

And let the error term be specified by;

$$\varepsilon_t = \emptyset \varepsilon_{t-1} + \epsilon_t \qquad (4.25)$$

The structure of the error term is a linear model with first order autoregressive serial correlation. Assuming that $\emptyset < 1$ and that $E(\epsilon_t) = 0$, $V(\epsilon_t) = \sigma_\epsilon^2$, and $cov(\epsilon_t, \epsilon_s) = 0, t \neq 0$. The error term is linked overtime, implying the presence of correlations. The no autocorrelation assumption is;

$$cov(\varepsilon_t, \varepsilon_s) = 0 \tag{4.26}$$

Newey and West (1987) suggested the following process in correcting autocorrelation;

$$Var = [\hat{\beta}_1/X] = \frac{1}{\{\sum_{t=1}^{N}(X_t - \bar{X})^2\}^2} \times \left\{ \sum_{t=1}^{N} \hat{\varepsilon}_t^2 (X_t - \bar{X})^2 + \sum_{/=1}^{L} \sum_{t=/+1}^{N} W/\hat{\varepsilon}_t \hat{\varepsilon}_{t-1} (X_t - \bar{X})(X_{t-1} - \bar{X} \right\} \tag{4.27}$$

Where;

$$W_/ = 1 - \frac{/}{L+1} \tag{4.28}$$

The correlations between ε_t and ε_{t-1} is approximated with $\left(1 - \frac{/}{L+1}\right)\hat{\varepsilon}_t \hat{\varepsilon}_{t-1}$. We conduct an autocorrelation tests on the estimated FAVAR model. There are a number of autocorrelations tests, including amongst other the Durbin-Watson Test and the Breusch-Pagan Tests. Residual autocorrelations test conducted on the estimated FAVAR model (equation 131), as a diagnostic test.

4.2.4.2.2. Residual Heteroskedasticity Test.

One of the key assumptions of regressions is that the variance of the error terms is constant across observations, i: e the errors terms are homoscedastic. However, where the variance of the error terms differs across observations (non-constant variance), they are Heteroskedastic. With heteroskedasticity of the error terms, standard estimation methods are inefficient estimated model, since the standard errors of the estimates are biased. With biased standard errors, such estimates as the t-statistics, F-statistics and LM-statistics cannot be used for drawing inferences. Assuming a regression model:

$$Q_t = \alpha + \delta_x x_t + \delta_y y_t + \delta_z z_t + \varepsilon_t \tag{4.29}$$

Testing for heteroskedasticity essentially involves testing the variance of the error terms;

$$H_0: Var(\varepsilon/\delta_x x_t, \delta_y y_t, \delta_z z_t) = \sigma^2 \tag{4.30}$$

Which is equivalent to:

$$H_0: E(\varepsilon^2/x_t, y_t, z_t) = E(\varepsilon^2) = \sigma^2 \quad (4.31)$$

Assuming a linear relationship between ε^2 and x_t, y_t, z_t, heteroskedasticity tests for linear restrictions, such that:

$$\varepsilon^2 = \alpha + \delta_x x_t + \delta_y y_t + \delta_z z_t + v \quad (4.32)$$

Thus testing for heteroskedasticity means testing:

$$H_0: \delta_x = \delta_y = \delta_z = 0 \quad (4.33)$$

There are number of heteroskedasticity test, including the White Test and the Breusch-Pagan Test both of which are based on the residuals of the fitted model. We conduct a heteroskedasticity test on the estimated FAVAR model of the MTM in Ghana, as a diagnostic test measure using the Breusch-Pagan Test. The Breusch-Pagan test does not observe the error terms but rather estimates it with the residuals form the OLS regression. Assuming the dependent variables in equation 4.33, the methodology uses the R^2 to form a F or LM test.

4.2.5 Assessment of the Structural Dynamics of the Monetary Transmission Mechanism.

The chapter tests the broad hypothesis that the structural adjustment reforms in Ghana (beginning 1985/1986), motivated change in the long run dynamics (structural change) of the MTM in Ghana, with implications for the evolution of monetary policy (frameworks, objectives and tools). Within this context of this broader hypothesis, two sub-hypotheses are tested. (1) The hypothesis that the SARs motivated a significant structural break point for the FAVAR model, using the Likelihood Ratio (LR) Test. (2) The hypothesis that the institutional and structural changes associated with the SARs motivated a change in the long run dynamics of inflation and GDP growth in Ghana. These approaches to estimating structural change are explained in sections 4.2.4.3.1 and 4.2.4.3.2 respectively.

4.2.5.1 Structural Break Test (Likelihood Ratio (LR)).

To test the hypothesis that the SARs motivated significant structural break in the MTM (FAVAR model) in Ghana, a structural breaks test is conducted using the Likelihood Ratio (LR) approach. Using the LR approach, two versions of the FAVAR model are estimated; restricted FAVAR model, and an unrestricted FAVAR model. Dummy variables $D = 0$ and $D = 1$ are constructed, as proxies for structural break, and incorporated in the unrestricted FAVAR model. Asteriou and Hall (2011) opined that when a regression equation includes multiplicative dummy variables for each of the independent variables, the coefficients are allowed to vary, thus implying different underlying structures for the two conditions (0 and 1) associated with the dummy variable. Traditionally, the conditions estimate two regression equation representing two time or sample period, where it is assumed that structural change occurred in the second period. The authors concluded that using a dummy variable equates to a test of structural stability. The construction and incorporation of the dummy variables in the unrestricted FAVAR model thus assumes, the underlying coefficients changed in 1985/1986 (beginning of the SARs), implying different underlying structure of the

unrestricted FAVAR model, for the pre-reform period ($D = 0$) identified as the period 1960-1985, and post reform period ($D = 1$) identified as 1986-2015. Thus:

$$D = \begin{cases} 0 & \text{for t} = 1 \ldots\ldots, \text{s} \quad (1960 - 1985) \\ 1 & \text{for t} = \text{s} + 1 \ldots\ldots, \text{T} \quad (1986 - 2015) \end{cases} \tag{4.34}$$

The Likelihood Ratio (LR) to estimating the significance of structural breaks means the following full sample period (1966-2005) restricted and unrestricted FAVAR models are estimated.

$$A[Y_t, FSF_t, MOF_t, M_t] = B(L)\left(gdp_{t-p} + \pi_{t-p} + fsf_{t-p} + +mof_{t-p}\right) + M_t + \varepsilon_t \tag{4.35}$$

$$A[Y_t, FSF_t, MOF_t, M_t] = D_{it} + B(L)\left(gdp_{t-p} + \pi_{t-p} + fsf_{t-p} + mof_{t-p}\right) + M_t + \varepsilon_t \tag{4.36}$$

Equation (4.4.3) is the estimated restricted (without dummy variables, and hence no structural change variable) FAVAR model. Equation (4.4.4) is the estimated unrestricted FAVAR with dummy / structural change variables D_t, such that i is defined as $D = 0$ and $D = 1$. The estimation of the significance of structural break (change) is done using the following Likelihood Ratio (LR) equation:

$$LR = (T - m) * (In/\Sigma_r/ - In/\Sigma_u/) * x^2/q \tag{4.37}$$

Where T is the number of observations, m is the number of parameters in each equation of the unrestricted model plus constant, Σ_r is the determinant of the residual covariance matrix of the restricted model, Σ_u is the determinant of the residual covariance matrix of the unrestricted (with dummy variables) model, q is the number of degrees of freedom, calculated as number of dummies multiplied by the number of equations. The values for Σ_r and Σ_u are drawn from the estimated models (4.4.3 and 4.4.4). The interpretation Likelihood Ratio (LR) Test results, is that structural change is significant if the estimated LR is greater than the value for the degrees of freedom (D.F) at the 0.05 percent significance level. Thus the result of the LR test, using 1985/1986 as a potential break point, gives the significance of the beginning of the SARs, as the point of change in the long run dynamics

of the FAVAR model, and hence the MTM in Ghana. After assessing the significance of the structural breaks / change in the MTM, the significance of shocks in the financial structure index and external openness index significance are assessed, using impulse response analysis. This methodology is discussed in the next section.

4.2.5.2 Impulse Response Function Analysis.

The chapter also tests the hypothesis that the institutional and structural changes, associated with the SARs, was significant in the long run dynamics of the MTM in Ghana. This examines the effects of shocks in the financial structure index and external openness index on GDP growth, inflation and broad money supply. Point estimates of IRFs have traditionally use to report empirical findings about the dynamic effects of structural macroeconomic shocks (Moon et al (2009). Ronayne (2011) opined that IRFs are used to track the response of a VAR system's variables to impulses of the system's shocks. (see also Stock and Watson, 2001). Ronayne (2011) further opined that the standard procedure for generating IRF uses estimates from the estimated VAR model, involving a non-linear function of the estimated VAR parameters. For VAR based frameworks, IRF are built on the theoretical assumption that any VAR(p) has a Vector Moving Average (VMA)(∞) representation (Ronayne, 2011). To examine time variant change, using the estimated FAVAR models, the structure of the IRF is as follows:

$$IRF(GDP, \pi, m, d_i) = E\left[y_{GDP+\pi}/u_{GDP+j} = \begin{cases} d_i \; if \; j = 0 \\ 0 \; if \; j \in (1, \pi) \end{cases}; I_t\right] - E\left[y_{GDP+\pi}/u_{GDP+j} = 0 \forall j \in (0, \pi); I_t\right] \quad (4.38)$$

Where the IRF measures the responses of GDP growth (GDP) and inflation rate (π) for $\pi = 0, \cdots, K$ to a shock of the disturbance term d_i. I_t is the set of information available at time t, which is the set of lagged dependent variable vectors up to lag order p. The shocks d_i, $i = 1,2$, corresponding financial structure index and external openness index. The i^{th} structural shock corresponds with the i^{th} column of $\hat{A}^{-1}$ where each row corresponds to the response. Hence, matrix A^{-1} is the 'impact matrix' tht holds the information on $IRF(t, t, d_i)$ for $i = 1,2$.

4.2.5.2.1 Identification of Structural Shocks.

A key issue for the generation of IRFs in monetary policy analysis is the issue of 'identification' of a shock. The shock need to be isolated to identify it from other systems shocks. In other words, the effects of shock in Fi_t and Ei_t needs to be isolated and identified from shocks emanating from GDP growth (GDP), inflation (π) and broad money supply (m).. There are a number of identification scheme traditionally used in monetary policy analysis, including recursive identification (Cholesky Decomposition), Long run schemes sign restrictions. In this paper, a recursive (Cholesky Decomposition) identification scheme is used. Traditionally referred to as Cholesky decomposition / Wold causal chain, recursive identification of reduced form shocks in VARs are attributed to Sims (1980), who described it as 'triangularising' the reduced form shocks. Triangularising achieves Orthogonalisation, but imposes a recursive structure on the contemporaneous relationships between the Fi_t, Ei_t, GDP_t, π_t and m_t. Orthogonalising the FAVAR model's shocks is necessary so that the shocks tracked by the IRF are uncorrelated. For the FAVAR model, the following recursive structure is assumed:

$$[gdp_t, \pi_t, Fi_t, Ei_t, m_t] \tag{4.39}$$

This recursive structure assumes that the relationship between the reduced form errors ($\varepsilon_t^y, \varepsilon_t^\pi, \varepsilon_t^m$) and the structural disturbance (ε_t^{Fi} and ε_t^{Ei}) is given by:

$$\begin{bmatrix} \varepsilon_t^y \\ \varepsilon_t^\pi \\ \varepsilon_t^m \\ \varepsilon_t^{Fi} \\ \varepsilon_t^{Ei} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ f_{21} & 1 & 0 & 0 & 0 \\ f_{31} & f_{32} & 1 & 0 & 0 \\ f_{41} & f_{42} & f_{43} & 1 & 0 \\ f_{51} & f_{52} & f_{53} & f_{54} & 1 \end{bmatrix} \begin{bmatrix} \mu_t^y \\ \mu_t^\pi \\ \mu_t^m \\ \mu_t^{Fi} \\ \mu_t^{Ei} \end{bmatrix} \tag{4.40}$$

Shocks in the Recursive VARS and IRFs have been extensively used in empirical regularities of the effects of monetary policy (BBE, 2005) or changes in the effects of monetary policy in an economy

(Boivin and Giannoni, 2006). Christiano et al (2006) opined that recursive SVARs perform 'remarkably well' by way of the relatively strong sampling properties of the IRF output.

4.3 Assessing the Effectiveness of Post Reform Indirect Monetary Policy Frameworks.

4.3.1 Research Hypothesis.

Against the backdrop of the institutional and structural changes associated with the structural adjustment reforms, the Bank of Ghana's monetary policy transitioned to institutionalised market based indirect policy framework and tools this chapter tests. The two key post reform indirect monetary policy frameworks included indirect monetary targeting and inflation targeting framework. These transitions to market based policy frameworks, are probably not only motivated by the post reform institutional and structural changes in the financial sector, but also reflected the bank's evolving view that the post reform institutional changes in the financial sector were sufficient to support such market based frameworks. In other words, this transitions reflect the bank's view that post reform institutional structure of the post reform financial system, supported the use of Open Market Operations (OMO's) and short term interest rates, as effective tools of macroeconomic and price stability. The Post Keynesian theory postulate that view that institutionalised market based transitions and structural changes in the financial sector will support the effectiveness of such indirect policy frameworks and tools. Given that Ghana's is a developing country, with significant structural limitations of the financial system, are such indirect policy tools effective in motivating macroeconomic stability. This chapter test this hypothesis the link between market based institutional of the financial system and the indirect monetary policy tools in Ghana. This hypothesis is tested by assessing the effectiveness of the BOG's post reform indirect monetary policy tools, against the backdrop of the market based institutional reforms. The thesis thus assesses the effectiveness of the transmission of policy induced shocks of Open Market Operations and Monetary Policy Rate through the banking sector, to inflation and GDP growth. These are examined using Vector Autoregressive (VAR) modelling. In the next sections, the specified structure of each of the inflation targeting and monetary targeting VAR models are outlined.

4.3.2 The Models.

The Bank of Ghana's post reform Inflation targeting and Monetary Targeting frameworks reflect the bank's long standing perspective the MTM is the mechanism by which the effects of policy induced innovations in monetary policy are transmitted to inflation and GDP growth. Monetary policy is used as a tool of macroeconomic stability, with key targets being inflation and GDP growth. Following the structural reforms, and owing largely to the limitations of the financial system, the bank's inflation targeting, was largely complimented by indirect monetary targeting. Under the inflation targeting regime, the Monetary Policy Rate (MPR) is used as the explicit monetary policy tool, and the explicit objective of monetary policy is price stability. Under the monetary targeting, indirect policy tools such as Open Market Operations (OMOs) and discount windows, are used as commercial bank liquidity targeting tools. The broader objective of monetary policy under the monetary targeting regime is macroeconomic stability, including GDP growth. The banking system is viewed as a key systemic link between monetary policy and its final targets (inflation and GDP), as it is the main platform for implementation. Both the inflation targeting and monetary targeting frameworks are operational through mainly the banking system. The inflation targeting framework, with the use of the MPR, targets the cost of bank loans and savings rates, as key determinants of investment spending. The monetary targeting framework, with the use of Open Market Operations, is a framework for achieving macroeconomic stability through targeting and regulating the liquidity of the banking system. The framework assumes that the cost of, and supply of bank loans is a key institutional link between monetary policy and the macroeconomy. Thus, policy induced changes in the MPR and the use of OMO as monetary policy tools, are thus aimed at influencing inflation and GDP through their transitory effects on the cost of, and supply of bank loans and aggregate investment spending. The econometric models employed in this thesis, are constructed to model the structure on the MTM implied by the BOG's inflation and monetary targeting frameworks. Vector Autoregressive (VAR) models are use the capture the dynamic structural relationships between the

variables. In the next sub-sections, the model of the inflation targeting and monetary targeting are set out.

4.3.2.1 The Inflation Targeting Model.

The Bank of Ghana's inflation targeting framework reflects the bank's perception that the MTM is underscored by the transmission of policy induced shocks in the Monetary Policy Rate (MPR) to Inflation (π) and GDP growth (gdp), through its effects on the Bank Loan Rates (BLR) and Bank Savings Rates (BDR). BLR and BDR are positively dependent on the MPR, and is negatively related to both GDP growth and inflation. To model this structural mechanism, we construct a VAR, to capture both the contemporaneous and lag dynamics of the relationships between the key structural variables. The specified VAR model of the MTM under the inflation targeting regime is thus:

$$[Z_t, MPR_t] = A(L)\left[\pi_{t-p} + BDR_t + BLR_{Lt-p}\right] + MPR_t + \varepsilon_t \qquad (4.41)$$

Where Z_t is assumed to be a $M \times 1$ vector of observed final and intermediate targets of monetary policy. Where $Z_t = \{\pi_t, BDR_t, BLR_{Lt},\}$, π_t is inflation rate, BDR_t is the deposit (savings) rates and BLR_t is the bank lending rate. MPR_t is the exogenously determined cost of bank reserves in the money market. $B(L)$ represents the p^{th} order matrix polynomial. A represents the matrix of coefficients determining the relationships. $\varepsilon_t \sim N(O, \Omega)$ represents a vector of structural shocks, assumed to be is uncorrelated. The BOG's inflation targeting framework is thus assumed to operate as follows: (1) A policy induced shock in the monetary policy rate exerts a positive effect on bank loan rates. This assumes a functional money market, of which the market for reserves is a key component. The cost of reserves (MPR_t), which represents the BOG monetary policy rate is a positive determinant of bank loan rates (r_t), $\frac{\partial MPR}{\partial BLR} > 0$. Bank loan rate is assumed to be a key link between the BOG monetary policy rate and the target variables of GDP and inflation. Within the context of Ghana's inflation targeting framework, $\frac{\partial MPR_t}{\partial \pi_t} < 0$ and $\frac{\partial MPR_t}{\partial y_t} < 0$. Thus an expansionary

monetary policy (a decrease in the BOG policy rate (MPR_t), causes a fall in bank loan rates, leading to increased demand for bank loans by businesses and households for investment spending. These in turn put an upward pressure on inflation while the increase in investment spending leads to more economic activity, and an increase in GDP growth (y_t) and an upward pressure on domestic prices levels (π_t). A contractionary monetary policy (increase in the BOG monetary policy rate) has the opposite effect. The reduced form representation of the BOG's inflation targeting framework estimable with data is thus:

$$[Z_{t,}MPR_{t,}] = C(L)\,[(-)\,\pi_{t-p} + bdr_{t-p} + blr_t] + mpr_t + u_t \qquad (4.42)$$

Where $u_t \equiv A^{-1}\varepsilon_t \sim (0, \Sigma)$ represents the vector of reduced form residuals, and more readily interpretable and focused on identification. The model first estimates the dynamic relationships between the BOG monetary policy rate (mpr), bank deposits rates (bdr), bank loan rate (blr), inflation (π_t), as representative of the structural dynamics of the monetary transmission mechanism under the BOG's inflation targeting framework. The model assumed the following recursive ordering of the variables:

$$[Z_t, MPR_t] = [\pi_t, bdr_t, blr_t, mpr_t] \qquad (4.43)$$

The recursive structure allows the causative direction to be from the BOG policy rate, through the retail bank loan rate, to inflation and then to GDP growth. The recursive ordering of the variables has significance for the identification of the effects of shocks to the monetary policy rate by the Bank of Ghana. Accordingly, the recursive structure of the model, assumes a recursive identification of shocks to mpr. This is significant as it allows for the impulse responses of the admissible variables (π, bdr, blr) to a shock in mpr to be effectively identified and analysed.

4.3.2.2 The Estimated Monetary Targeting Model.

Under the BOG's monetary targeting regime, the MTM is postulated as the causative effects of policy induced innovation by way of an open market operation, on credit supply from banks (CBS), inflation rate and GDP growth (GDP). The specified VAR model of the MTM under the monetary targeting regime is thus:

$$[Q_t, MS_t] = A(L)\left[GDP_{t-p} + \pi_{t-p} + CSB_{t-p}\right] + OMO_t + \varepsilon_t \quad (4.44)$$

Where Q_t represents a $M \times 1$ vector of observed monetary policy target variables under the BOG's monetary targeting framework. Similar to the inflation targeting framework, the BOG's monetary targeting framework targets elements of $Z_t = \{GDP_t, \pi_t, CSB_t\}$, where GDP_t is the GDP growth, π_t is inflation rate and CSB_t is the credit supply from the banks. OMO_t represents an open market operation by the Bank of Ghana. We use changes in the exogenously determined Money and Quasi money supply, as a proxy for the open market operation. $B(L)$ represents the p^{th} order matrix polynomial. A represents the matrix of coefficients determining the relationships between the system's variables. $\varepsilon_t \sim N(O, \Omega)$ represents a vector of structural shocks, assumed to be is uncorrelated. Theoretical underpinning of the transmission mechanism under the BOG's monetary targeting framework is thus assumed to be as follows: (1) A policy induced shock in the money supply, has a liquidity effect on bank loan rates. The banking system is the main platform for the implementation of monetary targeting in Ghana. Through the instruments of the statutory reserve requirements, an increase in money supply (lowering of the reserve requirement), increases the volume of loanable funds available to banks. Increases in the volume of loanable funds forces the banks to lower interest rates to attract borrowers. Thus, transmission wise, an inverse relationship exists between money supply and bank loan rates, $\frac{\partial OMO}{\partial BRL} < 0$. Bank loan rate is assumed to be a key link between policy induced changes in money supply and the BOG's target variables of GDP and

inflation. Policy induced increases in money supply, which causes bank loan rate to fall, causes an increase in demand for bank loans for investment spending. Increase investment spending has a positive effect on both inflation and GDP growth. Within the context of the broader exogenous money theory of the MTM, $\frac{\partial OMO_t}{\partial \pi_t} > 0$ and $\frac{\partial OMO_t}{\partial GDP} > 0$. This provides that a positive shock in money supply (increase in banking sector liquidity) leads to a to a rise in in inflation (π_t) and (GDP_t).

The reduced form representation of the BOG's monetary targeting framework estimable with data is thus:

$$[Y_t, MS_t,] = C(L)\,[gdp_{t-p}, -\pi_{t-p}\; csb_t] + tsr_t + u_t \qquad (4.45)$$

Where $u_t \equiv A^{-1}\varepsilon_t \sim (0, \Sigma)$ represents the vector of reduced form residuals, and more readily interpretable and focused on of identification. The model estimates the dynamics relationships between an open market operation by the BOG (tsr_t), credit supply from banks (csb_t), inflation (π_t) and GDP growth (GDP_t), as representative of the structural dynamics of the MTM under the indirect monetary targeting regime. The model assumed the following recursive structure:

$$[Y_t, OMO_t] = [gdp, \pi, csb, tsr] \qquad (4.46)$$

This structure allows the causative direction to be from open market operations to Inflation and GDP growth, via its effects on credit supply from banks. The recursive ordering of the variables has significance for the identification of the effects of shocks through an open market operation by the Bank of Ghana. Accordingly, the recursive structure of the model, assumes a recursive identification of shocks to monetary policy. This is significant as it allows for the impulse responses of the admissible variables (gdp, π, csb) to a shock in tsr to be effectively identified and analysed.

4.3.3 Monetary Policy Shock Identification.

For both the inflation targeting and the monetary targeting models, identifying the respective monetary policy shocks is an important process, in assessing /estimating the effects. Monetary policy shock identification allows for the isolation the effects of shocks in the MRP and OMO, from other systemic shocks (in BLR, GDP, π and u). For both models, structural restrictions are imposed, using a recursive scheme (Cholesky decomposition). This imposes a variable ordering restrictions (Sims, 1980; Bernanke et al, 2005), reflecting the BOG's view of the MTM under both the inflation targeting and monetary targeting frameworks. The inflation targeting framework) system variables are thus recursively ordered as follows:

$$[Z_t, MPR_t] = [\,\pi_t, BDR_t, BLR_t\; MPR_t] \tag{4.47}$$

The recursive structure of the model therefore assumes the relationship between the reduced form errors ($\varepsilon_t^{\pi}, \varepsilon_t^{bdr}, \varepsilon_t^{blr}$) and the structural disturbance (ε_t^{mpr}) is given by:

$$\begin{bmatrix} \varepsilon_t^{\pi} \\ \varepsilon_t^{bdr} \\ \varepsilon_t^{blr} \\ \varepsilon_t^{mpr} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ f_{21} & 1 & 0 & 0 \\ f_{31} & f_{32} & 1 & 0 \\ f_{41} & f_{42} & f_{43} & 1 \end{bmatrix} \begin{bmatrix} \mu_t^{\pi} \\ \mu_t^{bdr} \\ \mu_t^{blr} \\ \mu_t^{mpr} \end{bmatrix} \tag{4.48}$$

The recursive identification and the Cholesky Decomposition assumes identifies the shock is monetary policy (μ_t^{mpr}), by holding shocks in μ_t^{blr}, μ_t^{bdr} and μ_t^{π} constant. The recursive means only the effects of shock in μ_t^{mpr} on the residual of bank deposit rates (bdr_r), bank lending rates (blr_t), and inflation rate (π_t) to be traced. Equally, the variables in the monetary targeting model are thus recursively ordered as follows:

$$[Z_t, MPR_t] = [GDP_t\; \pi_t\;\; CSB_t\; OMO_t] \tag{4.49}$$

The model structure therefore assumes the relationship between the reduced form errors ($\varepsilon_t^{gdp}, \varepsilon_t^{\pi}, \varepsilon_t^{CSB}$) and the structural disturbance (ε_t^{OMO}) is given by:

$$\begin{bmatrix} \varepsilon_t^{gdp} \\ \varepsilon_t^{\pi} \\ \varepsilon_t^{csb} \\ \varepsilon_t^{omo} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ f_{21} & 1 & 0 & 0 \\ f_{31} & f_{32} & 1 & 0 \\ f_{41} & f_{42} & f_{43} & 1 \end{bmatrix} \begin{bmatrix} \mu_t^{gpd} \\ \mu_t^{\pi} \\ \mu_t^{csb} \\ \mu_t^{omo} \end{bmatrix} \quad (4.50)$$

The recursive identification and the Cholesky Decomposition assumes identifies the shock is monetary policy (μ_t^{omo}), by holding shocks in μ_t^{csb}, μ_t^{π} and μ_t^{gdp} constant. This allows for the only the effects of shock in μ_t^{omo} on the residuals of the credit supply from banks (csb_t), inflation rate (π_t) and GDP growth rate (y_t) to be traced.

4.3.4 Model Estimations.

Both the inflation targeting and the monetary targeting frameworks are estimated as recursive standard VARs. The model estimation included a number of steps. The first step is the of the time series properties of the constituent variables in each models, using Augmented Dickey-Fuller unit roots and Johansen cointegration test. Both estimated models are then subjected to diagnostic tests, using Residual Autocorrelations Test and Residual Heteroskedasticity test.

4.3.4.1. Augmented Dickey-Fuller Unit Roots Test.

All the admissible variables in both the inflation targeting and monetary targeting models are tested for stationarity, using the Augmented Dickey Fuller Unit Roots Test methodology. The objective of the ADF is to establish if the individual variables stationarity or if they will require differencing to motivate stationarity. This is important in order avoid potential spurious regression results for both models. For a conceptual intuition of Augmented Dickey Fuller Unit Roots test methodology, see section 4.2.4.1.1.

4.3.4.2. Johansen Cointegration.

Johansen Cointegration Test methodology is used to test for cointegration between the variables in both the inflation targeting and monetary targeting models. Cointegration testing is used to tests for the existence of long run equilibrium relationships between the constituent variables. For the inflation targeting the Johansen cointegration test tests for cointegration between the inflation rate (π), bank deposit rate (bdr), bank loan rates (blr) and the monetary policy rates (mpr). For the monetary targeting model test examines for cointegration between GDP growth, inflation rate (π), credit from banks to private sector (csb) and open market operations (omo). The conceptual intuition of the Johansen Cointegration test methodology is explained in section 4.2.4.1.2.

4.3.4.3 Diagnostics Tests.

The structures of the residuals of both the estimated inflation targeting and monetary targeting models are restricted by assumptions that the residuals are serially uncorrelated, and that the variance of the residual are constant. The diagnostic tests are used to test whether these assumptions hold. The holding of these assumption is significant in determining the robustness and adequacy of the estimated model parameters for reliable inferencing on the effects of policy induced shocks in MPR and OMO. Residual autocorrelations test and residual heteroskedasticity test are used to test the restrictions on the residuals.

4.3.5 Impulse Response Function (IRF) Analysis.

Impulse Response Function (IRF) analysis, is used to draw inferences on the effects of policy induced innovations in the MPR on the admissible variables under the inflation targeting regime, and policy induced open market operations on the admissible variables under the monetary targeting regime. Impulse Response Functions allow for the effects of shocks in both policy tools to be traced on the respective admissible variables.

4.3.5.1 Inflation Targeting Model: Structure of the Impulse Response Function.

For the estimated inflation targeting ($VAR[1]$)model the responses of BLR, Inflation and GDP to a One Standard Deviation (Cholesky Decomposition) shock in the MRP is examined.

$$IRF(\pi, bdr, blr\ d_i) = E\left[y_{\pi+bdr+blr}/u_{GDP+j} = \begin{cases} d_i\ if\ j = 0 \\ 0\ if\ j \in (1, r) \end{cases}; I_t\right] - E\left[y_{\pi+bdr+blr}/u_{\pi+j} = 0 \forall j \in (0, blr); I_t\right] \quad (4.51)$$

Where the IRF measures the responses of the variables inflation (π), bank deposit rates (bdr) and bank loan rate (blr) for $blr = 0, \cdots, K$ to a shock of the disturbance term d_i. I_t is the set of information available at time t, which is the set of lagged dependent variable vectors up to lag order p. The shocks d_i, $i = 1$, corresponding to the MPR. The i^{th} structural shock corresponds with the i^{th} column of $\hat{A}^{-1}$ where each row correspond to the response. Hence, matrix A^{-1} is the 'impact matrix' that holds the information on $IRF(t, t, d_i)$ for $i = 1$.

4.3.5.2 Monetary Targeting Model: Structure of the Impulse Response Function.

For the estimated monetary targeting ($VAR[2]$)model the responses of BLR, Inflation and GDP to a One Standard Deviation (Cholesky Decomposition) shock in the MS is examined. The structure of the IRF is functionally described as:

$$IRF(gdp, \pi, blr\ \theta_i) = E\left[y_{GDP+\pi+blr}/u_{GDP+j} = \begin{cases} d_i\ if\ j = 0 \\ 0\ if\ j \in (1, r) \end{cases}; I_t\right] - E\left[y_{GDP+\pi+blr}/u_{GDP+j} = 0 \forall j \in (0, blr); I_t\right] \quad (4.56)$$

Where the IRF measures the reaction of GDP growth (gdp), inflation rate (π) and credit supply from banks (csb) for $csb = 0, \cdots, K$ to a shock of the disturbance term θ_i. I_t is the set of information available at time t, which is the set of lagged dependent variable vectors up to lag order p. The shocks θ_i, $i = 1$, corresponding to MS. Similarly, the i^{th} structural shock corresponds with the i^{th} column

of $\hat{A}^{-1}$ where each row corresponds to the response. Hence, matrix A^{-1} is the 'impact matrix' that holds the information on $IRF(t, t, d_i)$ for $i = 1$.

CHAPTER 5: THE MONETARY TRANSMISSION MECHANISM: ROLE OF FINANCIAL STRUCTURE AND EXTERNAL OPENNESS (1960-2015).

5.1 Introduction.

The aim of the chapter is to empirically assess the role of financial structure and external openness in the monetary transmission mechanism in Ghana, against the backdrop of the structural adjustment reforms, for the long run dynamics of the monetary transmission mechanism in Ghana. Using time series data for the full sample period covers 1966-2015, a benchmark model and augmented model of the monetary transmission mechanism are estimated is estimated in an identified Factor Augmented Vector Autoregressive (FAVAR) model of the monetary transmission mechanism in Ghana. This chapter presents the estimation results and analysis. The chapter is organised into five main sections. Section 5.2 outlines the identified augmented model, to explain the systematic role of financial system and external openness. Section 5.3 outlines the selection and selected financial structure indicators and external openness indicators, used for the construction of the financial structure index and external openness index. 5.4 presents the estimation results of each stage of the construction of the financial structure and external openness indices. This includes the results of the KMO measure of sampling adequacy, the correlations test results and the principal factors analysis results for the financial structure indicators, and the external openness indicators. Section 5.5 presents the benchmark model and the augmented model. Section 5.6 presents the estimation results of the benchmark and augmented models. These results include the ADF unit roots test result, the Johansen Cointegration test result, Further the diagnostic tests results are presented and analysed for the augmented model, including the residual autocorrelations and residual heteroskedasticity test. Thus, section 5.6.6 presents and analysis results of the structural breaks test 5.6.7 presents the results of impulse responses of shocks in the financial structure index, and external openness index.

5.2 The Identified Augmented model

The identified FAVAR model of the MTM in Ghana takes the following functional form:

$$A[Y_t, M_t] = B(L)\left[GDP_t + \pi_t + \left(FS_t..FS_{t-p}\right) + (EO_t..EO_{t-p}\right] + MP_t + \varepsilon_t \qquad (5.1)$$

Where Y_t is a $M \times 1$ vector of observed systematic components of the MTM, such that Y_t defines GDP growth (GDP_t), inflation rate (π_t), financial structure (FS_t) and external openness (EO_t). MP_t represents monetary policy. $B(L)$ represents the p^{th} order matrix polynomial. A represents the matrix of coefficients determining the contemporaneous relationships. ε_t is zero mean (serially uncorrelated / independent) error term with variance-covariance matrix $E(\varepsilon_t \varepsilon_t') = \sum_{\varepsilon}$. Assuming a recursive structure, the model assumes the monetary transmission mechanism is fully described by the causative effects running from monetary policy, through financial system and external openness to GDP growth and inflation rate. The financial systems and external openness, are therefore key institutional and structural determinants of the MTM. The specification and estimation of the model is a two-step process. Step One involves the construction of financial structure and external openness indices to represents the financial system and external openness respectively. Dynamic Factor Modelling (DFM) is used to construct these indices. Step Two involves the specification and estimation of the FAVAR model. This section presents the estimation results and analysis of these two stages of the estimation process.

5.3 Selected Financial Structure and External Openness Indicators.

The estimation challenge is that financial structure and external openness are traditionally described by a range of potentially informative variables. The aim is to construct financial structure and external openness indices that captures the dynamic effects of all these potentially informative variables, allowing for their effects to be modelled using a single representative financial structure index and external openness index. These indices are constructed using DFM, and specifically confirmatory

Principal Factor Analysis (PFA). Confirmatory PFA approach, allows for the selection and inclusion of the range of variables that collectively describe financial structure and external openness to be informed and motivated by theories on monetary transmission mechanism. Principal Factor Analysis allows for the collective dynamics of these variables (N) to be captured in one representative financial structure index (F) and one external openness index (F), such that $N < F$. Where N is the number of indicators and F is the number of common dynamic factors. For the selected 'financial structure indicators' and 'external openness indicators' see tables 17 and 18 (Chapter 4, page 165 and 166).

5.4 Construction of the Financial Structure and External Openness Indices.

The first is the test of the adequacy of the financial structure and external openness samples variables for dynamic factor modelling. The Kaiser-Meyer-Ohlin (KMO) measure of sampling adequacy is used. Second, we measure the dynamic correlationships between the variables, to ensure that the included variables for financial structure and external openness are driven by common dynamic factors as predicted by the theory. The key foundation of dynamic factor modelling is the assumption that the included variables have common dynamics. Thirdly, we test for unit roots in the variables, using the Augmented Dickey-Fuller test for Unit Roots. Finally, we estimated and construct the financial structure and external openness index, by extracting the common dynamic factors as the representative indices. The estimation results of each step of the construction of the financial structure and external openness indices are discuss in the next sections.

5.4.1 Results of the Kaiser-Meyer-Ohlin (KMO) Measure of Sampling Adequacy.

We use the Kaiser- Meyer-Ohlin (KMO) measure of sampling adequacy to tests if there is a statistically viable scope for reducing the dimensions of the selected 'financial structure' and 'external openness' indicators for DFM. Variables that are have dynamic commonalities will have a high KMO score. The standard interpretation is that a minimum MSA score of > 0.50 indicates that the sample sizes of included variables are adequate for extracting the common factor using DFM. The results of the KMO estimation for the financial structure and external openness sample, are analysed in Tables 18 and 19 respectively.

Table 18. KMO Results: Financial Structure Sample of Variables.

INDICATORS	MSA SCORE
Deposit Money Bank Assets to (Deposit Money + Central Bank Assets (%)	0.783265
Bank Deposits (BD) (% GDP)	0.668756
Central Bank Assets (% GDP)	0.727650
Banking sector Liquid Liabilities (BLL) (% GDP)	0.869076
Deposit Money Bank Assets (DMBA) (% GDP)	0.659872
Broad Money / Total Reserve Requirement.	0.560984
Broad Money Supply (% GDP)	0.939876
Gross Domestic Savings (GDS)	0.480982
Credit provided by Financial Sector.	0.749860
Claims of Central Government	0.440823
Private Sector Credit from Banks (PSCB) (% GDP)	0.885644
Claims on Private Sector /Broad Money(CPSBM)	0.706542
Bank Credit to Bank Deposits (%)	0.640976
Total Bank Reserves (% GDP)	0.839213
KAISERS MSA SCORE	**0.7801834**

Authors Tabulation of the MSA Results.

- *The KMO score of 0.78 indicates that the size of the Financial Structure sample is adequate for dynamic factor modelling.*
- *This concludes that there is a statistically viable scope for dimension of the financial structure sample to be reduced using Dynamic Factor Modelling.*

Table 19. KMO Results: External Openness Sample of variables.

INDICATOR	MSA SCORE
Exports of Goods and Services	0.725651
Imports of Goods and Services	0.631164
Official Exchange Rate (GHS/USD)	0.681436
Net Foreign Assets (LCU)	0.520729
Foreign Direct Investment, Net Inflows (% GDP)	0.649510
External Debt Stock (Short Term)	0.501428
External Debt Stock (Long Term)	0.750332
Total Interest Payments on External Debt (% GDP)	0.852306
Current Account Balance (% GDP)	0.885319
Net Financial Account (% GDP)	0.560318
KAISER'S MSA SCORE	**0.690176**

Authors Tabulation of the MSA Results. LCU means Local Currency Unit.

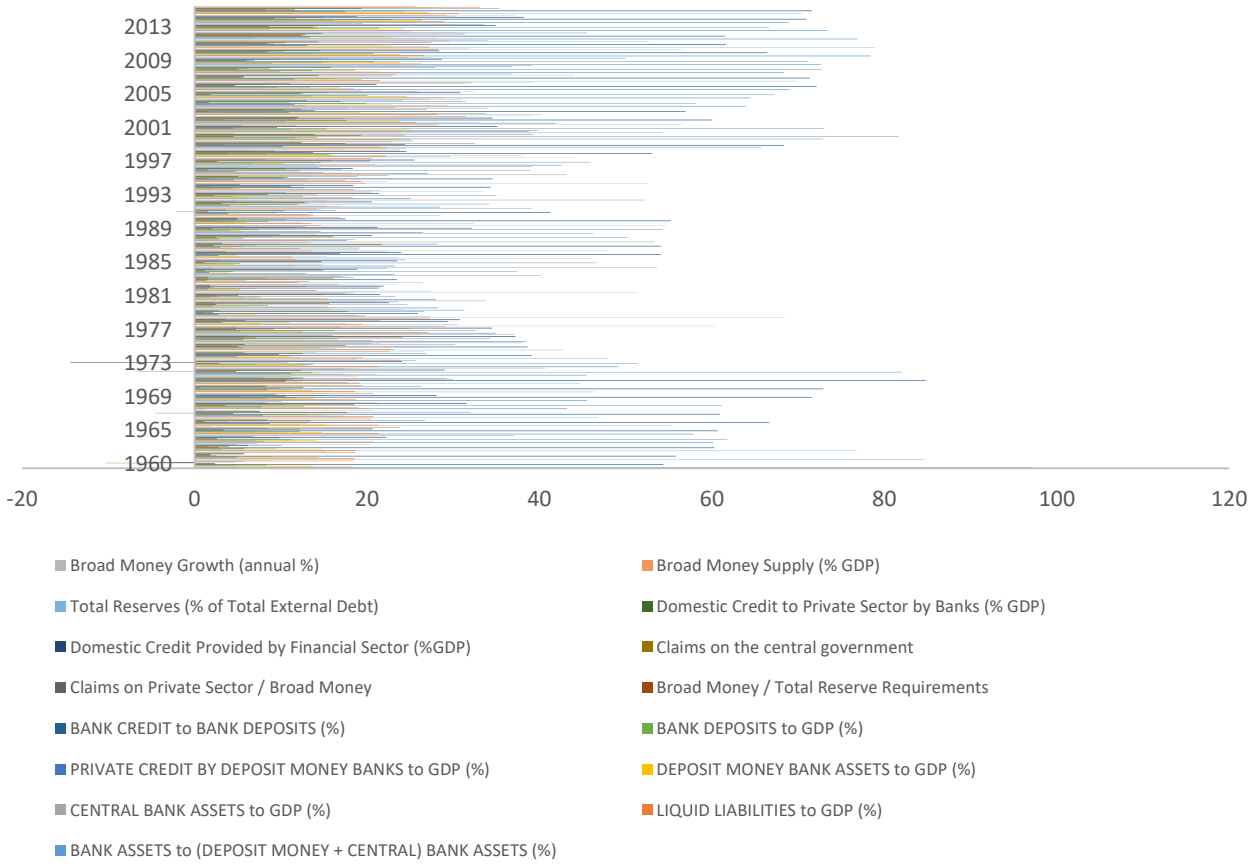
- *The KMO score of 0.69 indicates that the size of the external openness sample is adequate for dynamic factor modelling.*
- *This concludes that there is a statistically viable scope for reducing the dimension of the sample using Dynamic Factor Modelling.*

The results of the KMO measure of sample adequacy has implications for the modelling of the financial structure and external openness indices. The results indicate that there is a statistically viable scope for reducing the dimensions of both sets of indicators into a single representative index The next step in the construction of the financial structure and external openness indices is to test the extent to which the variables in each sample are driven by common dynamic factors, that can be extracted as the representative factor (index). To test this, the correlations between the variables in each (financial structure and external openness) sample is measured. The results of the correlations tests are analysed in the next sections.

5.4.2 Results of Test of Correlations between the selected *N* Indicators.

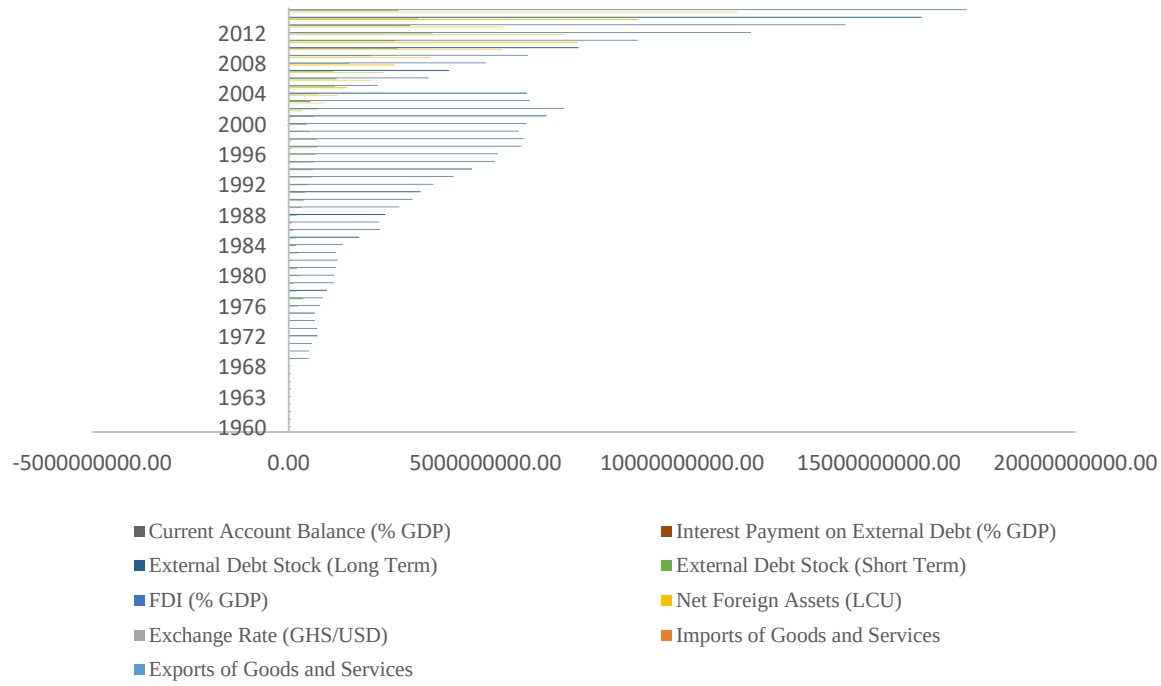
The underlying statistical assumption, which is a statistical prerequisite for efficient Dynamic Factor Modelling, is that the individual dynamics of the selected N financial structure and external openness indicators are driven by common latent factors. The strength of these common latent factors is indicated by the degree correlations or covariance between the indicators. The interpretation, for the purpose of assessing the common dynamics between the N indicators, is that a high degree of covariance or correlations is an indication that the dynamics of the variables are driven common latent factors. Thus, the correlations between both the set of the selected N financial structure and external openness indicators are assessed.

Figure 23: Correlations between the Financial Structure Indicators.



Authors computation of the degree of correlations between the financial structure indicators.

Figure 24: Correlations between the External Openness Indicators.



The correlation test result, as supported by figures 23 and 24 above, indicate a high degree of correlations between; (1) the financial structure indicators, and (2) between the external openness indicators. The implication is that there a statistically significant probability that the dynamics of both the N financial structure indicators, and the N external openness indicators respectively, are driven by common latent factors. These factors can therefore be extracted to represent the collective dynamics of the respective indicators. The factors, by function, is an index of the collective dynamics of the respective indicators. The respective financial structure, and the external openness factors are extracted, and thus the respective indices constructed, using PFA. The results of these estimations are presented, and analysed in the next section.

5.4.3 Principal Factor Analysis.

A key feature of the construction of the financial structure and external openness indices, as part the systematic components of the MTM in Ghana, is the use of DFM, and more specifically Principal Factor Analysis (PFA). Effectively, the extracted common dynamic factors are indices, that represents the common dynamics of a number of financial structure and external openness indicators. The effective features of this approach to building the financial structure and external openness indices is that each index (factors) captures the common dynamics of the most correlated variables. The results of the construction of the financial structure and external openness indices, using PFA are presented and analysed in the next section.

5.4.3.1 The Financial Structure Index.

Table 20 shows the results of the PFA on the selected N financial structure indicators (shown in table 17). The result of the PFA shows that the common dynamics of the selected N financial structure indicators are driven by 5 latent factors (F1, F2, F3, F4 and F5). Together, these 5 latent factors explain 100% of the variance of the N financial structure indicators, as shown by the cumulative variance.

Table 20. Estimated Number of Financial Structure Latent Factors.

Factor	Variance	Cumulative	Difference	Proportion	Cumulative
F1	7.260407	7.260407	4.467655	0.569759	0.569759
F2	2.792752	10.05316	1.469622	0.219161	0.788919
F3	1.323130	11.37629	0.601254	0.103832	0.892752
F4	0.721876	12.09817	0.077093	0.056649	0.949401
F5	0.644783	12.74295	---	0.050599	1.000000
Total	12.74295	12.74295		1.000000	

	Model	Independence	Saturated
Discrepancy	0.044092	25.72735	0.000000
Parameters	80	15	120
Degrees-of-freedom	40	105	---

Authors Tabulation of the number of estimated common latent factor for the financial structure indicators.

- *The PFA estimation on the N-financial structure indicators concluded the presence of 5 common latent factors (F1, F2, F3, F4, F5), each of which represents the common dynamics of a set of the financial structure indicators outlined in table 17.*
- *The F1 is identified as explaining approximately 57% of the total common variance between the variables. F2 explains approx. 22% while F3, F4 and F5 explain 10%, 5% and 5% respectively of the total variance of the N -financial structure indicators.*

The given sub-sets of the N- indicators whose common dynamics are driven by the estimated latent factors are demarcated in table 21. The factor loadings of each indicator is shown, indicating the degree of influence of the latent factor on the associated indicator. Thus, table 21 outlines the distribution of the financial structure indicators to each estimated latent factor.

Table 21: N-Indicators Constitution of each Estimated Factor.

LATENT FACTOR	**CONSTITUENT INDICATORS**	**FACTOR LOADING**
FACTOR 1/ **Financial Structure Index 1**	Bank Deposits to GDP	0.94
	Broad Money to Total Reserves	0.70
	Deposit Money to Bank Assets	0.95
	Bank Assets to Central Bank Assets	0.68
	Domestic Credit Provided by Banks	0.56
	Domestic Credit provided by Financial Sector	0.96
	Banking Sector Liquid Liabilities	0.90
	Private Sector Credit to Bank Deposits	0.97
	Total Bank Reserves to GDP	0.48
	Bank Credit to Bank Deposits	0.68
	Central Bank Assets	0.76
	Claims on the Private Sector	0.47
	Domestic Credit Provided by Banks	0.73
FACTOR 3 / **Financial Structure Index 3**	Total Reserves to GDP	0.50
FACTOR 4 / **Financial Structure Index 4**	Claims on Private Sector	0.47

Author's computation of the common latent factors, common dynamics of indicators each factor explained, and the factor loading distributions.

- *The implication of the results is that 5 financial structure indices (F1, F2, F3, F4 and F5) can be constructed to capture the collective dynamics of the selected N financial structure indicators in table 17.*
- *Factor 1 is a proxy for Financial Structure Index (1), constructed by capturing the collective dynamics of Bank Deposits, Broad Money to Total Reserves, Broad Money Supply, Deposit Money to Bank Assets, Bank Assets to Central Bank Assets, Domestic Credit Provided by Banks, Domestic Credit provided by the Financial Sector, Banking Sector Liquid Liabilities, Private Sector Credit to Bank Deposits, Total Bank Reserves to GDP and Bank Credit to Bank Deposits.*
- *Factor 2 is a proxy for Financial Structure Index (2), constructed by capturing the collective dynamics of Broad Money Growth, Central Bank Assets, Claims of Private Sector and Domestic Credit Provided by Banks.*
- *F3, F4 and F5 are proxies for Financial Structure Index 3, 4 and 5 respectively.*

5.4.3.2 The External Openness Index.

Table 22 shows the results of the PFA on the selected *N* external openness indicators (shown in table 18). The result of the PFA shows that the common dynamics of the selected *N* external openness indicators are driven by 2 latent factors (F1 and F2). Together, these 2 latent factors explain 100% of the variance of the *N* financial structure indicators, as shown by the cumulative variance.

Table 22. Estimated Number of External Openness Latent Factors.

Factor	Variance	Cumulative	Difference	Proportion	Cumulative
F1	6.619646	6.619646	5.361644	0.840307	0.840307
F2	1.258002	7.877649	---	0.159693	1.000000
Total	7.877649	7.877649		1.000000	

	Model	Independence	Saturated
Discrepancy	0.349867	18.94757	0.000000
Parameters	29	10	55
Degrees-of-freedom	26	45	---

Authors Tabulation of the PFA Results.

- *The PFA estimation on the N-external openness indicators concluded the presence of 2 common latent factors (F1, F2), each of which represents the common dynamics of a given sub-set of external openness indicators outlined in table 18.*
- *The F1 is identified as explaining approximately 84% of the total common variance between the variables, while F2 explains approx.15%.*

The given sub-sets of the N- indicators whose common dynamics are driven by the estimated latent factors are demarcated in table 23. The factor loadings of each indicator is shown, indicating the degree of influence of the latent factor on the associated indicator. Thus, table 23 outlines the distribution of the indicators to each latent factor.

Table 23. Rotated Loading Distribution for External Openness Indicators.

LATENT FACTOR	CONSTITUENT INDICATORS	FACTOR LOADING
FACTOR 1/ **External Openness Index 1**	Current Account Balance	0.72
	Official Exchange Rate (GHS/USD)	0.93
	Exports of Goods and Services	0.73
	Imports of Goods and services	0.74
	External Debt Stock (Short Term)	0.95
	External Debt Stock (Long Term)	0.92
	Foreign Direct Investments, Net Inflow (% GDP)	0.88
	Net Foreign Assets	0.89
FACTOR 2 / **External Openness Index 2**	Interest Payment on External Debt	0.66
	Net Financial Account	0.32

Authors Tabulation of the Factor Loading Distribution.

- *The implication of the results is that 2 external openness factors / indices (F1 and F2) capture the collective dynamics of the selected N external openness indicators.*
- *Factor 1 is therefore an external openness Index (1), constructed by capturing the collective dynamics of current account balance, exports of goods and services, imports of goods and services, official exchange rate*

(GHS/USD), external debt stock (short term), external debt stock (long term), foreign direct investment, net inflows and *net foreign assets.*

- *Factor 2, is an external openness index (2), constructed by extracting and capturing the collective dynamics of Interest payment on external debt (% GDP)* and *net financial account.*

5.4.4 Implications of the Results of the Principal Factor Analysis.

The PFA is used to construct the financial structure and external openness indices for incorporation into the augmented model of the MTM in Ghana. The implication of the indicator distributions in tables 21 and 23, is that each latent factor constitutes the collective dynamics of the associated variables. Thus each factor is an index. Thus Factor 1(FS) and Factor 1(EO) for both financial structure and external openness samples respectively, are indices constructed by combining the collective dynamics if the associated indicators (see tables 21 and 23). The observed time series values for each of these factors / indices are extracted using their factor scores. Thus for our specification and estimation of the augmented model, we retained only F1 for the financial structure sample, and F1 for the external openness indicators. Statistically, these factors explain 57% and 84% of the common variance of the financial structure sample and external openness sample respectively. Additionally, only F1s of both sample are retained to avoid potential autocorrelations between the respective financial structure (F1, F2, F3, F4, F5) and external openness (F1 and F2) indices. Thus for the specification of the augmented model, the financial structure index is F1(FS), and the external openness index is F1(EO). The observations of both variables are generated using their respective factor scores.

5.5 Estimations of the Specified Models.

The specification of the augmented model is thus conditional upon the retained F1(FS) and F1(EO). The construction of the financial structure and external openness indices allows for their incorporation into the FAVAR model as key structural / systematic components of the MTM in Ghana. To put the significance of the financial structure and external openness in the MTM in Ghana, two alternative models are estimated. These include a benchmark model constituting only GDP growth, inflation and broad money supply (with the financial structure and external openness indices), and an augmented model constituting the elements of the benchmark model plus the financial structure index and external openness index. These functional structure of these two models are set out in section 5.5.1 and 5.5.2.

5.5.1 The Benchmark Model:

$$A[Y_t, M_t] = B(L)\left(y_{t-p} + \pi_{t-p}\right) + M_t + \varepsilon_t \qquad (5.2)$$

Where Y represents a $M \times 1$ vector of observable macroeconomic variables. $Y = \{y, \pi\}$, where π_t is inflation rate. FI_t is the factor 1, as a proxy for financial structure index. EI_t is factor 1, as a proxy for the external openness index. M_t broad money supply, as the key tool in the Bank of Ghana monetary targeting policy framework. $B(L)$ represents the p^{th} order matrix polynomial. A represents the matrix of coefficients determining the contemporaneous relationships between the system's variables. $\varepsilon_t \sim N(O, \Omega)$ represents a vector of structural shocks, assumed to be is uncorrelated.

5.5.2 The Augmented Model:

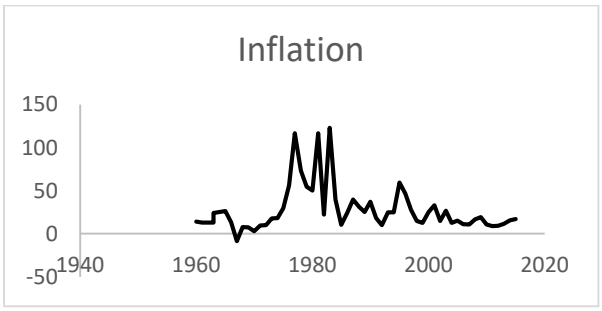
For the purpose of constructing a robust model, we retain factor 1 (financial structure index (1), and factor 1 (external openness index 1) for incorporation in the FAVAR model of the MTM. Financial structure index 1 explains approximately 60% of the common variance of the N-financial structure indicators, while external openness index 1 explains 84% of those of the N-external openness

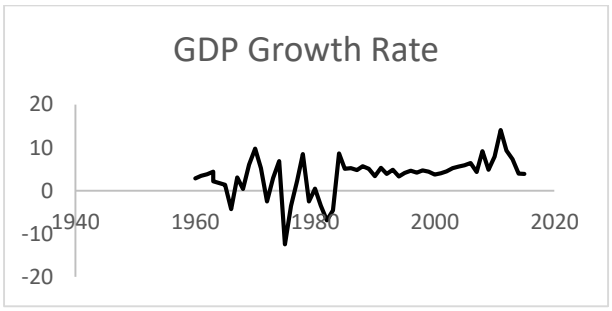
indicators. Thus, the specified and estimated FAVAR model of the MTM in Ghana is functionally represented as follows:

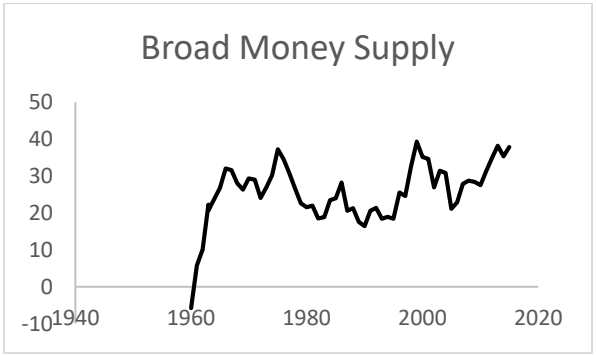
$$A[Y_t, FI_t, EI_t, M_t] = B(L)\left(y_{t-p} + \pi_{t-p} + FI(1)_{t-p} + EI(1)_{t-p}\right) + M_t + \quad (5.3)$$

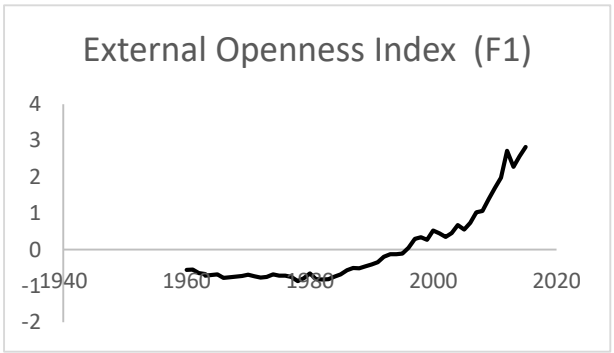
Equation 5.3 is thus a structural model that represents and aims to examine the dynamics relationships between the key institutional and structural features of the MTM in Ghana. Y represents a $M \times 1$ vector of observable macroeconomic variables. $Y = \{y, \pi\}$, where π_t is inflation rate. FI_t is the factor 1, as a proxy for financial structure index. EI_t is factor 1, as a proxy for the external openness index. M_t money supply, as the key tool in the Bank of Ghana monetary targeting policy framework. $B(L)$ represents the p^{th} order matrix polynomial. A represents the matrix of coefficients determining the contemporaneous relationships between the system's variables. $\varepsilon_t \sim N(O, \Omega)$ represents a vector of structural shocks, assumed to be is uncorrelated.

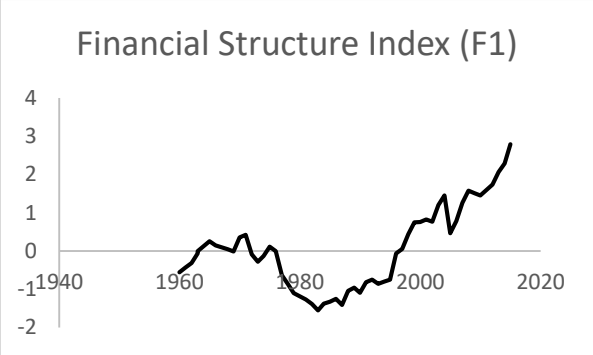
Figure 25: The Plots of the Admissible Variables











5.6 Model Estimation Results: The Benchmark Model and the Augmented Model.

Both the benchmark model and the augmented model are estimated as standard recursive Vector Autoregressive (VAR) models. This estimation involves a number of econometric steps, including assessing the time series properties of the admissible variables using Augmented Dickey-Fuller (ADF) Unit root test and the Johansen Cointegration test. The estimated model is then subject to diagnostic tests using the residual autocorrelations and residual heteroskedasticity tests. The second step involves assessing structural changes in the identified model, using two approaches. First, the significance of structural change around the beginning of the reforms (in 1985/1986) is assessed using structural breaks test (likelihood ratio approach). Second, time variant changes in the effects financial structure and external openness on inflation and GDP growth dynamics are assessed. The results of these estimations are presented and analysed in the rest of this section. In this section of the estimation of the specified FAVAR model, the results of the ADF unit roots test, Johansen Cointegration Test, the model estimates and model diagnostic tests are presented and discussed.

5.6.1 Results of Augmented Dicky-Fuller Unit Roots Test.

All the admissible variables in both the benchmark model and augmented model are tested for stationarity, using Augmented Dickey-Fuller (ADF) unit roots test, and the results are presented and discussed in table 24 below.

Table 24. Results of ADF Unit Test of Stationarity.

VARIABLES	**LEVELS: Test Critical Value**			**1st Difference Test Critical Value**		
	5% Level	ADF T- Statistics	Prob*	5 % Level	ADF T-Statistics	Prob*
GDP Growth ($\boldsymbol{GDP}$)	-3.493692	-5.524147*	0.0002	-1.947665	-5.904975**	0.0000
Inflation Rate ($\boldsymbol{\pi}$)	-1.946996	-1.611787	0.1002	-1.946996	-13.07919**	0.0000
Broad Money Supply	-2.915522	-4.201980*	0.0015	-2.916566	-7.122321**	0.0000
Financial Structure Index	-1.194878	0.716400	0.8669	-3.496960	-5.870804**	0.0001
External Openness Index	-2.916566	3.750944	1.0000	-1.947248	-1.877634	0.0582

*Computation of ADF Unit Roots Results. Note: *, **, *** indicate stationarity at the levels, 1st difference. The ADF has been conducted under the null hypothesis of unit roots.*

- *GDP growth and broad money supply are stationary at both levels and 1st difference.*
- *Inflation Rate is non-stationary at levels, but stationary at 1st difference.*
- *Financial Structure index is non-stationary at levels, but stationary at 1st difference.*
- *The external openness index is non-stationary at both levels and 1st difference. It is however stationary at 2nd difference.*
- *All the admissible variables are I (0) at 2nd difference.*

5.6.2 Results of Johansen Cointegration Test.

Another important test is the test of the existence of long run equilibrium relationships between the admissible variables. The result of this test determines whether the model is estimated as a Vector Error Correction Model (VECM) or an unrestricted VAR. If there are identified cointegrating relationships, the model will be estimated as a VECM. On the other hand, if the variables are found to not be cointegrated, the model will be estimated as an Unrestricted VAR. Johansen cointegration test is used to test for cointegration between all the admissible variables in the model. A Johansen Cointegration test estimates the number of cointegrating equations giving both a Trace Test and Maximum Eigenvalue test results. The results of the Trace and Maximum Eigenvalue Tests are discussed in table 25 below.

Table 25. Johansen Cointegration Test Results.

Unrestricted Cointegration Rank Test (Trace)					Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesised No. of CE(s)	Eigenvalue	Trace Statistics	0.05 Critical Value	Prob.**	Hypothesised No. of CE(s)	Eigenvalue	Trace Statistics	0.05 Critical Value	Prob.**
None*	0.603272	103.0921	69.81889	0.0000	None*	0.603272	49.92327	33.87687	0.0003
At most 1*	0.395535	53.16881	47.85613	0.0146	At most 1*	0.395535	27.18420	27.58434	0.0462
At most 2*	0.257814	25.98161	29.79707	0.2192	At most 2*	0.257814	16.10038	21.13162	0.2190
At most 3*	0.115889	4.884231	15.49471	0.2897	At most 3*	0.115889	6.651301	14.26460	0.5312
At most 4*	0.058112	3.232931	3.841466	0.0722	At most 4*	0.058112	3.232931	3.841466	0.0722

*Authors Computation of the Johansen Cointegration Maximum Eigenvalue Test Results. * denotes rejection of the null hypothesis at 5% significance level. ** denotes MacKinnon-Haug-Michelis (1999) p-values.*

- *Both the Trace Test and Maximum Eigenvalue Test indicate at least 1 cointegrating equation at the 5 % significance levels*
- *The model can thus be estimated as a Vector Error Correction Model (VECM), with 2 lags and 2 cointegrating equations.*

5.6.3. Estimation Results of the Benchmark Model.

The long run equilibrium relations between GDP growth, inflation and broad money supply are assessed. In particular, the existence of long run causality running from broad money supply to inflation and GDP growth are assessed. The vector error correction equations indicated that there is long run causality running from Broad Money Supply to GDP Growth, but not to inflation. For the GDP growth as the target variable, the vector error correction term is both negative (-1.852188) and significant, with a probability value of 0.0000. For inflation as the target variable, the vector error correction term is negative (-3.796163) but not significant (0.0769) indicating that there is no long run causality running from GDP growth and Broad Money Supply to inflation.

$$D(GDP\ GROWTH,2) = C(1) * (GDP\ Growth(-1) - 0.0882201341794 * D(Inflation(-1) + 0.218696461328 * D(Broad\ Money\ Supply(-1) - 0.120040802037 \quad (5.4)$$

*D (INFLATION,2) = C (1) *(GDP Growth (-1) - 0.0882201341794* D (Inflation (-1) + 0.218696461328 *D (Money Supply (-1) – 0.120040802037* (5.5)

*D (BROAD MONEY SUPPLY,2) = C (1) *(GDP Growth (-1) - 0.0882201341794* D (Inflation (-1) + 0.218696461328 *D (Broad Money Supply (-1) – 0.120040802037* (5.6)

Table 26: VECM Estimates of the Benchmark Model.

	Dependent Variables					
	GDP Growth		Inflation Rate		Broad Money Supply	
Independent Variables	Lag (-1)	Lag (-2)	Lag (-1)	Lag (-2)	Lag (-1)	Lag (-2)
GDP Growth	0.58 (0.26) Prob. (0.0664)	0.24 (0.17) Prob. (0.1705)	2.03 (1.79) Prob. (0.2081)	-1.01 (0.96) Prob. (0.2999)	0.53 (0.29) Prob. (0.0716	0.31 (0.17) Prob. (0.0845)
Inflation Rate	0.12** (0.02) Prob* (0.0000)	0.03 (0.02) Prob* (0.1247)	0.83** (0.14) Prob. (0.0000)	0.36** (0.11) Prob. (0.0034)	0.005 (0.02) Prob. (0.8418	0.03 (0.02) Prob. (0.0753)
Broad Money Supply	0.13 (0.14) Prob* (0.3525)	-0.07 (0.13) Prob* (0.5748)	0.12 (0.79) Prob. (0.8776)	0.60 (0.73) Prob. (0.4180)	0.53** (0.14) Prob. (0.0007	0.27** (0.13) Prob. (0.0498)
	$R^2 = 0.68$		$R^2 = 0.75$		$R^2 = 0.41$	

*Author's computation based on data collected. Note: Figures in () are HAC standard errors. R^2 indicate the goodness of fit of the variables fitted the regression line ** indicate significance at the 5% value.*

- *The results indicated that key relationships of the estimated benchmark model are of the expected signs, but most are not significant in explaining GDP growth and inflation. Broad money supply was significant in explaining the behaviour of broad money supply, but not GDP growth and inflation. Inflation was significant in explaining GDP growth and Inflation.*
- *The results indicate that the dynamics of GDP growth and inflation in the benchmark model, are not significantly influenced by broad money supply dynamics, potentially indicating that MTM based on money supply growth by the BOG to be weak and potentially ineffective.*

5.6.4 Estimation Results of the Augmented Model.

For the GDP growth as the target variable, the error correction term is both negative (-0.674751) and significant, with a probability value of 0.0004. For inflation as the target variable, the error correction term is both negative (-6.053247) and significant (0.0000) indicating that there is a long run causality running from GDP growth and Broad Money Supply to inflation.

*D (GDP GROWTH,2) = C (1) *(GDP Growth (-1) + 0.293258040748* D (Inflation (-1) - 0.25457956605 *D (Financial Structure Index (-1) + 0.803592952036 D (Broad Money Supply (-1) + 1.13865932991*D (External Openness Index (-1) + 0.189447519204* (5.7)

*D (INFLATION,2) = C (8) *(GDP Growth (-1) + 0.293258040748* D (Inflation (-1) + 0.25457956605 *D (Financial Structure Index (-1) + 0.803592952036*D (Money Supply (-1) + 1.138659332991*D (External Openness Index (-1) + 0.189447519204* (5.8)

*D (BROAD MONEY SUPPLY,2) = C (22) *(GDP Growth (-1) + 0.293258040748* D (Inflation (-1) - 0.25457956605 *D (Financial Structure Index (-1) + 0.803592952036*D (Money Supply (-1) + 1.138659332991*D (External Openness Index (-1) + 0.189447519204* (5.9)

Table 27**:** VECM Estimates of the Augmented Model.

	Dependent Variable		
	GDP Growth	Inflation Rate	Broad Money Supply
Independent Variables	Lag (-1)	Lag (-1)	Lag (-1)
GDP Growth	-0.23 (0.13) Prob. (0.0850)	3.07** (0.47) Prob. (0.0000)	0.14** (0.08) Prob. (0.0264)
Inflation Rate	0.12** (0.02) Prob* (0.0000)	0.07 (0.09) Prob. (0.4595)	0.03 (0.01) Prob. (0.0698)
Financial Structure Index	0.07 (4.91) Prob. (0.9877)	37.9** (17.1) Prob: (0.0316)	-17.06** (3.18) Prob (0.0000)
Broad Money Supply	0.29** (0.14) Prob* (0.0444)	1.72** (0.53) Prob. (0.0025)	-0.48** (0.10) Prob. (0.0000)
External Openness Index	4.26 (8.09) Prob. (0.6013)	46.6 (28.1) Prob. (0.1055)	6.96 (5.24) Prob. (0.1912)
	R^2 = 0.62	R^2 = 0.89	R^2 = 0.69

*Author's computation based on data collected. Note: Figures in () are HAC standard errors. R^2 indicate the goodness of fit of the variables fitted the regression line ** indicate significance at the 5% value.*

- *The augmented model, with financial structure and external openness indices, exhibit a significantly improved results. Most of the key relationships in are of the expected signs, and are significant compared to the benchmark model.*
- *The estimation results of the augmented model indicated fundamental structural change in the MTM, showing the inclusion of the financial structure and external openness motivated the presence of long run causality running from; (a) inflation, financial structure index, broad money supply and external openness index to GDP growth.*
- *The results also indicated that there is long run causality running from inflation, financial structure index, Broad Money Supply and external openness index to inflation. This is significant as under the benchmark model, there was no long run causality running GDP growth and broad money supply to inflation*.

5.6.5 Model Diagnostics Tests: The Augmented Model.

The estimated augmented model is subjected to diagnostic test, before any reliable inference on structural change, and from impulse responses can be deduced from the model. The diagnostics tests thus assesses the robustness of the estimated parameters. Two diagnostic tests are conducted on the augmented model (inclusive of the financial structure and external openness indices); (1) residual autocorrelations test, which tests the model assumption of the error terms from the estimated model are serially uncorrelated, and (2) residual Heteroskedasticity test, which tests the assumption of constancy of variance in the error terms across observations. Ideally, the estimated FAVAR model needs to pass these tests for the estimated parameters to be deemed robust for any reliable inference on change in the MTM can be drawn. The results of these diagnostic tests are presented and analysed in the next sections.

5.6.5.1 Results of VEC Residual Autocorrelations.

To further test the soundness of the FAVAR model specification, a residual autocorrelation and residual heteroskedasticity tests are conducted on the estimated model. The residual autocorrelation examines for autocorrelations between the estimated residuals. This effectively tests to ensure that not only the uncorrelated error terms assumption (see equation 5.1) for the FAVAR model holds, but

also that OLS estimators are BLUE. Residual autocorrelation could lead to spurious regression results (Newey and West, 1987). Further, the estimated FAVAR model is tested for residual heteroskedasticity. This ensures the assumptions of constant variance of error terms holds for the estimated FAVAR model, for if the error terms are heteroskedastic, the standard errors will be biased. The implication is that standard VAR estimation method employed for the FAVAR model may inefficient. With biased standard errors, such estimates as the t-statistics, F-statistics and LM-statistics cannot be used for drawing inferences. In tables 30 and 31, the results of the residual autocorrelations and Heteroskedasticity tests are discussed:

Table 28. VEC Residual Serial Correlations LM Test Results.

Lags	LM-Stat	Prob.
1	19.13956	0.7904
2	26.90881	0.3605
3	22.19271	0.6246

Authors computation of the residual autocorrelations test results. Probability from chi-square with 25 df. A lag length of 3 is selected automatically. Residual autocorrelation estimated under a null hypothesis of no serial autocorrelation.

- *The probability values of > 5% significance value, means that we accept the null hypothesis of no serial autocorrelation.*
- *The results concluded that assumption of serially uncorrelated error terms for the FAVAR model holds.*
- *The implications are that the OLS estimators are BLUE and thus reliable inferences can be drawn from the estimated VEC-FAVAR model.*

5.6.5.2 Results of Residual Heteroskedasticity Tests.

Table 29. VEC Residual Heteroskedasticity (Joint) Test Results: Joint Test.

Chi-sq	Df	Prob
326.5167	330	0.5438

Author's computation of the Heteroskedasticity Test Results. Residual Heteroskedasticity estimated under a null hypothesis is no Heteroskedasticity.

- *The joint test probability value of > 5% significance value, means that we test accept the null hypothesis of no residual heteroskedasticity.*

- *The result shows that the residuals are homoscedastic across observations, with indication that the standard errors are not biased, and the T-statistics, F-statistics and LM-statistics can be relied upon for drawing inferences for the FAVAR model.*
- *The econometric implication is that the residual heteroskedasticity test provides further indication that the FAVAR model specification is adequate for drawing inference.*

The FAVAR model diagnostics / specification test conclude that reliable inferences can be reliably drawn from estimated model. I then proceed to examine and draw inferences on structural change in the identified FAVAR model of the MTM in Ghana, employing structural break test (likelihood ratio approach) and stability test of impulse response functions. The results of these inferences are examined and discussed in section 5.6.4 and 5.6.5

5.6.6 Results of Structural Break Test (Likelihood Ratio (LR)).

I test the hypothesis that this reforms (and hence the broader SARs) motivated structural break in the identified FAVAR model, and thus long run dynamics of the MTM in Ghana. Thus, a structural break test is conducted, using Likelihood Ratio (LR) approach. This involves the incorporation of dummy variables to model structural break. Two dummy variables are calculated; $D = 0$ and $D = 1$. Thus two versions of the FAVAR model are estimated; a restricted FAVAR[1] model, with no dummy variables incorporated, and an unrestricted FAVAR[2] model, with dummy variables $D = 0$ and $D = 1$.

The functional representations of both models are:

$$A[Y_t, FI_t, EO_t, M_t] = B(L)\left(gdp_{t-p} + \pi_{t-p} + fi_{t-P} + eo_{t-P}\right) + M_t + \varepsilon_t \qquad (5.10)$$

$$A[Y_t, FI_t, EO_t, M_t] = D_t + B(L)\left(gdp_{t-p} + \pi_{t-p} + fi_{t-P} + eo_{t-P}\right) + M_t + \varepsilon_t \qquad (5.11)$$

Where equation 5.10 is the restricted FAVAR[1] model without dummy variables. Equation 5.11 is the unrestricted FAVAR[2] model with dummy variables, where D_t represents dummy variables $D =$

0 and $D = 1$. The restriction on the dummy variables are; $D = 0$ (1966-1985) and $D = 1$(1986-2015). The hypothesis tested is that structural break in the model occurred in 1985/1986. This assumption is robust as it has similarly been assumed in Kruger, 1988, and World Bank 1992. For both estimated models (5.2 and 5.3), a lag length of 1 is selected automatically, using Schwartz Information Criterion (SIC). The following Likelihood Ratio (LR) equation is calculated to estimate the significance of structural break, which draws on critical values from the estimated restricted (equation 5.10) and unrestricted (equation 5.11) FAVAR models.

$$LR = (T - m) * (In/\Sigma_r/-In/\Sigma_u/) * x^2/q \qquad (5.12)$$

Where T represents the number of observations, m is the number of parameters in each equation of the unrestricted model plus constant. In/Σ_r represents the determinant of the residual covariance matrix for the estimated restricted FAVAR (equation 5.10) and In/Σ_u represents the determinant of the residual covariance matrix for the estimated unrestricted FAVAR (equation 5.11). q represents the number of degrees of freedom, estimated as number of dummies multiplied by the number of equations. The determinant residual covariance values for each estimated model is tabulated in table 30 below.

Table 30. Restricted and Unrestricted FAVAR Models: Determinant Residual Covariance Values.

Restricted FAVAR Model		Unrestricted FAVAR Model	
Determinant resid covariance (dof adj.)	953.9768	Determinant resid covariance (dof adj.)	798.6691
Determinant resid covariance	87.24375	Determinant resid covariance	87.79841

Authors computation of determinant resid covariance results for the restricted and unrestricted FAVAR models.

Incorporating the values for the LR equation;

$$T = 56, \quad m = 5 \times 10 + 1 + 2 = 52, \; In\Sigma_r = 97.29405, \quad In\Sigma_u = 91.735, \quad q = 1 \times 5 = 5.$$

Probability Value (PV) at 0.05 significance level is 1.070.

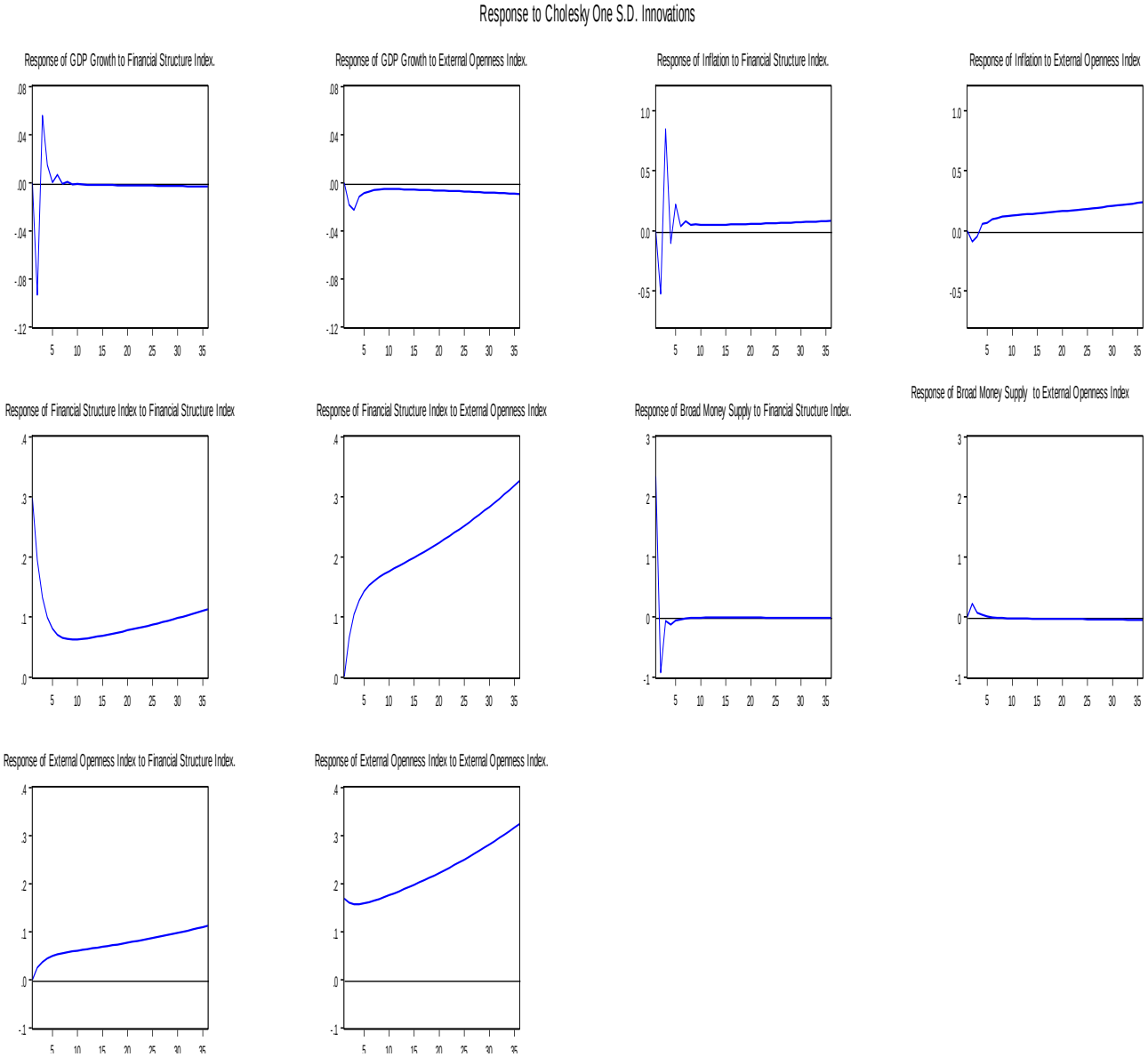
$$LR = (56 - 52) \times (In97.294 - In91.735) \times 5 = 1.176 \quad (5.13)$$

The estimated Likelihood Ratio (LR) value of 1.176 is more than the test critical value of 1.070 ($1.176 > 1.070$), supporting the null hypothesis of a significant structural change around the period 1985/1986, which was the beginning of the monetary transmission mechanism. The conclusion is that such changes as the change in financial structure and external openness reforms were significant in motivating structural change in the post reform dynamics of the monetary transmission mechanism in Ghana. In the next section, the responses of inflation, GDP growth and broad money supply to structural shocks in the financial structure and external openness indices are examine using impulse response analysis.

5.6.7 Impulse Responses Analysis.

The impulse responses function analysis enables the responses of the augmented model variables to shocks in the financial structure and external openness indices to be trace. Thus, this section assesses the responses of GDP growth, inflation and broad money supply to structural change induced shocks to financial structure and external openness. The results of the impulse responses are presented in figure 26 below.

Figure 26: Responses to Shocks in the Financial Structure and External Openness Indices.



Authors computation of the impulse responses from a structural shock in the financial structure and external openness indices

CHAPTER 6. ASSESSING THE EFFECTIVENESS OF POST REFORM INDIRECT MONETARY POLICY TOOLS IN GHANA (1985-2015).

6.1 Introduction.

A Central bank's choice of monetary policy frameworks and tools are fundamentally influenced by its perception and understanding of the institutional and structural dynamics of the monetary transmission mechanism. Evolution or transformative changes in the MTM, largely driven by changes in the underlying institutional and structural features. Minsky (1957) for example linked the efficacy of monetary policy to such institutional structure as financial system. Evolutionary changes in the Bank of Ghana's monetary policy frameworks, tools and objectives, were inherently driven by the post reform institutional and structural changes associated with the structural adjustment reforms. A key institutional change in the structure of the MTM included post reform changes in financial system structure and credit markets dynamics. The financial structure much more diversified, the banking credit market liberalised, and the banking sector became much less concentrated. These institutionalised changes in the financial system would in theory, influence the dynamics of the MTM and the evolution of monetary policy in Ghana. Notwithstanding, these post reform changes in a key institutional structure of the monetary transmission motivated fundamental transitions in the BOG's monetary policy frameworks, tools and objectives. A fundamental aspect of this evolution is the transition from direct policy framework to institutionalised market based indirect monetary policy regimes. The post reform regimes included an indirect monetary targeting regime and inflation targeting regime, both of which rely on the market based institutional structure of the post reform financial system to support an effective transmission mechanism. The indirect monetary targeting regime targets the liquidity of the banking system using such indirect tools as open market operations and discount windows. Inflation targeting became the official monetary policy framework, using the BOG monetary policy rate as the exclusive tool, and price stability as the objective of monetary

policy. However, due to potential concerns about structural weaknesses in the financial system, the bank continued to complement its inflation targeting framework, with liquidity targeting operations. The post reform transitions to the indirect monetary policy regime imply that the market based financial system was not only structurally developed to support a market based indirect monetary policy regimes. Additionally, the regime transitions also implied that that transmission mechanism and underlying channels of transmissions were reliably defined. This chapter tests these implications by assessing transmissions effectiveness of the Bank of Ghana's post reform monetary targeting and inflation targeting regimes. To achieve this, empirical estimations and analysis are conducted using VAR based econometric models and annualised time series data covering the period 1985 to 2015.

This chapter presents the models, estimation results, and analysis of the findings. The chapter is organised into five sections. Section 6.2 presents some stylised facts about the monetary transmission mechanism and monetary policy in Ghana. Section 6.3 sets out the identified inflation targeting and monetary targeting models. Section 6.4 presents the estimation results and analysis of the inflation targeting model. These include the results and analysis of Augmented Dickey Fuller Unit Roots Test results and the Johansen Cointegration Test results. The section also presents the VECM estimation results and analysis of the inflation targeting, followed by diagnostic tests. The diagnostic test presents the results and analysis of residual autocorrelations and residual Heteroskedasticity test results. Further in section 6.4.5 the results of an analysis of the structural dynamics of the MTM under the inflation targeting model are presented. These include the results of causality tests and the impulse response functions. The causality test presents and analysis both the long run causality and short run causality running from the MRP to inflation, bank deposit rate and bank loan rate. This analysis the sign and significance of the error correction term. The result of the short run causality test presents and analysis the Wald test. The results of the IRF presents the responses of inflation, bank deposit rates and bank loan rates to a policy induced shock in the MPR.

Section 6.5 presents the estimation results and analysis of the monetary targeting model. These include the results and analysis of Augmented Dickey Fuller Unit Roots Test results and the Johansen Cointegration Test results. The section also presents the VECM estimation results and analysis of the monetary targeting model, followed by the results of model diagnostic tests. The diagnostic test presents the results and analysis of residual autocorrelations and residual Heteroskedasticity test results. Further in section 6.4.5 the results of an analysis of the structural dynamics of the MTM under the inflation targeting model are presented. These include the results of causality tests and the impulse response functions. The causality test presents and analysis both the long run causality and short run causality running from the OMO to GDP, inflation and credit supply from banks to the private sector. This analysis the sign and significance of the error correction term. The result of the short run causality test presents and analysis the Wald test. The results of the IRF presents the responses of, GDP inflation and credit supply from bank to private sector, to a policy induced open market operation.

6.2 Some Stylised facts about Bank of Ghana's Post Reform Monetary Policy.

- The Bank of Ghana has always perceived the monetary transmission mechanism as the causative effects of monetary policy on inflation and GDP. The financial system, particularly the banking system has been perceived as a key institutional link between monetary policy, and its final targets.
- The banking sector has been the key institutional platform/ target for the implementation of monetary policy. Monetary policy implementation has fundamentally involved targeting the liquidity of the banking system (and their capacity to create deposits) and the cost of bank loans as intermediate targets.
- Following the structural adjustment reforms (beginning the early 1980s), the Bank of Ghana's monetary policy regimes transitioned from directly monetary targeting regime to indirect institutionalised markets based regimes following the structural adjustment reforms. The post reform regimes included indirect monetary (liquidity) targeting regime and an inflation targeting regime. These regime transitions appear to the reflect the post reform changes in the institutional and structural dynamics of the monetary transmission mechanism, especially of the financial system.
- The inflation targeting regime implies that the monetary transmission mechanism as the causative effects of short term interest rates on inflation. The BOG's inflation targeting regime relies on the deployment of the monetary policy rate (MPR) as the explicit tool to achieve is price stability. The MPR is effectively the cost of reserves, assuming that the banking systems relies on the reserves market to raise additional short term capital. The cost of reserves will thus influence the cost of loans, deposits and hence demand for deposits. Demand for deposits is thus passively responsive to the MPR through the cost of loans, as well. The supply of deposits is influenced by the cost of reserves, cost of deposits, inflation and GDP growth dynamics. The inflation targeting

regime is thus premised on influencing the demand and supply of deposits through the cost of reserves, which influences the cost of deposits.

- The indirect monetary targeting regime, while targeting the liquidity of the financial system, does show through an institutionalised markets based framework. This regime perceives the monetary transmission mechanism as the causative effects of changes in money supply on inflation and GDP growth. The regime is premised on a framework in which Bank of Ghana, through such tools as reserve requirements ratio, open market operations and reserve discount windows, influences the liquidity of the financial system and thus the capacity to supply deposits and the cost of such deposits. Inflation and GDP growth, are therefore seen as a money supply phenomenon, and banking sector supply of deposits is seen as a key source of money supply. Money supply thus comprises of endogenous money supply (deposits created by the financial system) and exogenous money supply (fiat money). The Bank of Ghana's indirect monetary targeting regime is underscored by targeting the endogenous money supply.
- Due largely to weaknesses in the financial system and its potential implications for the transmissions of monetary policy, the Bank of Ghana has been operationalising both inflation targeting and elements of monetary targeting regimes. The inflation targeting regime is the official policy tool, and is underlined by the use of the monetary policy rate. The monetary targeting regime is underlined by Open Market Operations and Discount Windows. The use of open market operations is supported by the use of the Bank of Ghana Treasury bill, while the discount window is operational through the 28-day and 56-day discount rates. The effects of the tools underlying both frameworks are assumed to transmit through different pathways to influence both inflation and GDP growth.

6.3. The Post Reform Monetary Policy Frameworks.

The Bank of Ghana's post reform monetary policy regime involved dual alternative framework. These include an inflation targeting regime, exclusively using the BOG Monetary policy rate as the exclusive tools of monetary policy, and price stability as the exclusive objective of monetary policy. The second regime is the indirect monetary targeting regime involving the targeting of the liquidity (balance sheets) of commercial banks, and macroeconomic stability (focusing on inflation and GDP growth) as the objective of monetary policy.

6.3.1. The Inflation Targeting Model.

The MPR is postulated to have a negative effect on inflation, such that expansionary monetary policy (lowering of the MPR) regime the MTM is postulated as the causative effects of policy induced innovation in the exogenously determined MPR, on the Bank Loan Rate (BLR), Bank Deposit Rates (BDR) and Inflation rate (π). The specified VAR model of the MTM under the inflation targeting regime is thus:

$$[Z_t, MPR_t] = A(L)\left[\pi_{t-p} + BDR_t + BLR_{Lt-p}\right] + MPR_t + \varepsilon_t \qquad (6.1)$$

Where Z_t is assumed to be a $M \times 1$ vector of observed final and intermediate targets of monetary policy. Where $Z_t = \{\pi_t, BDR_t, BLR_{Lt},\}$, π_t is inflation rate, BDR_t is the deposit (savings) rates and BLR_t is the bank lending rate. MPR_t is the exogenously determined cost of bank reserves in the money market. $B(L)$ represents the p^{th} order matrix polynomial. A represents the matrix of coefficients determining the relationships. $\varepsilon_t \sim N(O, \Omega)$ represents a vector of structural shocks, assumed to be is uncorrelated. The reduced form representation of the BOG's inflation targeting framework estimable with data is thus:

$$\left[Z_{t,}MPR_{t,}\right] = C(L)\left[(-)\,\pi_{t-p} + bdr_{t-p} + blr_t\right] + mpr_t + u_t \qquad (6.2)$$

Where $u_t \equiv A^{-1}\varepsilon_t \sim (0, \Sigma)$ represents the vector of reduced form residuals, and more readily interpretable and focused on identification. The model first estimates the dynamic relationships between the BOG monetary policy rate (mpr), bank deposits rates (bdr), bank loan rate (blr), inflation (π_t), as representative of the structural dynamics of the monetary transmission mechanism under the BOG's inflation targeting framework. The model assumed the following recursive ordering of the variables:

$$[Z_t, MPR_t] = [\pi_t, bdr_t, blr_t, mpr_t] \tag{6.3}$$

The recursive structure allows the causative direction to be from the BOG policy rate, through the retail bank loan rate, to inflation and then to GDP growth. The recursive ordering of the variables has significance for the identification of the effects of shocks to the monetary policy rate by the Bank of Ghana. Accordingly, the recursive structure of the model, assumes a recursive identification of shocks to mpr. This is significant as it allows for the impulse responses of the admissible variables (π, bdr, blr) to a shock in mpr to be effectively identified and analysed.

6.3.2. The Monetary Targeting Model.

Under the BOG's monetary targeting regime, the MTM is postulated as the causative effects of policy induced innovation by way of an open market operation, bank loan rate (BLR), credit supply from banks (CBS), credit supply from the financial sector (CSF), inflation rate and GDP growth (GDP). The specified VAR model of the MTM under the monetary targeting regime is thus:

$$[Q_t, MS_t] = A(L)\left[GDP_{t-p} + \pi_{t-p} + CSB_{t-p}\right] + OMO_t + \varepsilon_t \tag{6.4}$$

Where Q_t represents a $M \times 1$ vector of observed monetary policy target variables under the BOG's monetary targeting framework. Similar to the inflation targeting framework, the BOG's monetary

targeting framework targets elements of $Z_t = \{GDP_t, \pi_t, CSB_t\}$, where GDP_t is the GDP growth, π_t is inflation rate and CSB_t is the credit supply from the banks. OMO_t represents an open market operation by the Bank of Ghana. We use changes in the exogenously determined Money and Quasi money supply, as a proxy for the open market operation. $B(L)$ represents the p^{th} order matrix polynomial. A represents the matrix of coefficients determining the relationships between the system's variables. $\varepsilon_t \sim N(O, \Omega)$ represents a vector of structural shocks, assumed to be is uncorrelated. The reduced form representation of the BOG's monetary targeting framework estimable with data is thus:

$$[Y_t, MS_t,] = C(L)\,[gdp_{t-p}, -\pi_{t-p}\, csb_t] + tsr_t + u_t \qquad (6.5)$$

Where $u_t \equiv A^{-1}\varepsilon_t \sim (0, \Sigma)$ represents the vector of reduced form residuals, and more readily interpretable and focused on of identification. The model estimates the dynamics relationships between an open market operation by the BOG (tsr_t), credit supply from banks (csb_t), inflation (π_t) and GDP growth (GDP_t), as representative of the structural dynamics of the MTM under the indirect monetary targeting regime. The model assumed the following recursive structure:

$$[Y_t, MS_t] = [gdp, \pi, csb, tsr] \qquad (6.6)$$

This structure allows the causative direction to be from open market operations to Inflation and GDP growth, via its effects on credit supply from banks. The recursive ordering of the variables has significance for the identification of the effects of shocks through an open market operation by the Bank of Ghana. Accordingly, the recursive structure of the model, assumes a recursive identification of shocks to monetary policy. This is significant as it allows for the impulse responses of the admissible variables (gdp, π, csb) to a shock in tsr to be effectively identified and analysed.

6.4 Model Estimations Results: Inflation Targeting Model

The monetary targeting is also estimated using Vector Autoregressive (VAR) econometric modelling techniques, allowing for the dynamic relationships between all the admissible variables to be simultaneously estimated. As part of these estimation process of the model, the time series properties of the admissible variables, including ADF unit roots test Johansen Cointegration method. The estimated monetary targeting model is then subjected to a number of model diagnostics tests, including the residual autocorrelations and heteroskedasticity tests. The structural dynamics of the estimated model is assessed using long run and short run causality tests, and Impulse Response Function (IRF) analysis. The results of these tests and estimations, and their implications are analysed and discussed in the next sections.

6.4.1 Results of the Augmented Dicky-Fuller (ADF) Units Roots Test.

Traditionally, time series variables tend to have long term trends. Trending time series variables are non-stationary, and their inclusion in estimated VARs at levels (if non-stationary), can potentially produce spurious regression results. Under such conditions, estimated coefficients may indicate significance of a variables when in reality, it may not be significant. To avoid potential spurious regression results, any non-stationary variable would need to be transformed to motivate stationarity.. ADF is thus a methodology test whether the variables are non-stationary or stationary. Ensuring stationarity in the variables thus helps avoid potential spurious regression problems for the models. The ADF is performed under a null of units roots and the results are discussed in table 31 below.

Table 31. Results of ADF Unit Test of Stationarity.

VARIABLES	LEVELS: Test Critical Value			1st Difference Test Critical Value		
	5% Level	ADF T- Statistics	Prob*	5 % Level	ADF T-Statistics	Prob*
Inflation Rate (π)	-3.568379	-4.107206*	0.0155 (t+c)	-3.574244	-5.907762**	0.0002 (t+c
Monetary Policy Rate	-3.568379	-2.119351	0.5148 (t+c)	-1.952910	-5.682075**	0.0000 (n)
Bank Lending Rate	-2.963972	-3.735907*	0.0351 (t+c)	-3.574244	-6.536914**	0.0000 (t+c)
Bank Deposit Rate	-3.568379	-1.949213	0.6042 (t+c)	-1.952910	-5.380155**	0.0000 (n)

Authors Computation of the ADF Unit Roots Test Results.

Note: *, **, *** indicate stationarity at the levels, first difference and second difference respectively.

Note: (c) denotes intercept, (t+c) denotes trend and intercept and (n) denotes no trend and no intercept.

The ADF test has been conducted under the null hypothesis of unit roots.

- *The ADF test results indicate that Inflation rate and bank lending rate are stationary at the levels I (0).*
- *The monetary policy rate and bank deposit rate the variables with the exception of inflation are stationary at 1st difference (I (1).*
- *The implications are that to avoid potential spurious regression problems for the identified inflation targeting model, monetary policy rate (mpr) and bank lending rates (blr), would need to be de-trended by first differencing them. De-trending the variables would motivate stationarity.*

6.4.2. Results of Johansen Cointegration Test: Inflation Targeting Model.

The Johansen Cointegration test, is used to test for cointegration between the admissible variables in the both models. The Johansen Cointegration test examines whether the variables incorporated in each model have long run equilibrium relationships. For the Johansen methodology, reports results for both a Trace Test and Maximum Eigenvalue Tests, both of which should indicate cointegration. The admissible variables ($\pi_t, bdr_t, blr_t, mpr_t$) in the inflation targeting model are tested to cointegration, using the Johansen cointegration test. A lag of 3 is selected automatically. The results of both the trace and maximum eigenvalue test are presented in table 34 below.

Table 32. Results of Johansen Cointegration Tests.

Unrestricted Cointegration Rank Test (Trace)					Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesised No. of CE(s)	Eigenvalue	Trace Statistics	0.05 Critical Value	Prob.**	Hypothesised No. of CE(s)	Eigenvalue	Trace Statistics	0.05 Critical Value	Prob.**
None*	0.937741	151.5416	47.85613	0.0000	None*	0.937741	72.18758	27.58434	0.0000
At most 1*	0.840987	79.35400	29.97907	0.0000	At most 1*	0.840987	47.80800	21.13162	0.0000
At most 2	0.679100	31.54600	15.49471	0.0001	At most 2	0.679100	29.55226	14.26460	0.0001
At most 3*	0.073816	1.993740	3.841466	0.1579	At most 3*	0.073816	1.993740	3.841466	0.1579

*Authors Computation of the Johansen Cointegration Test Results for variables. * denotes rejection of the null hypothesis at 5% significance level. ** denotes MacKinnon-Haug-Michelis (1999) p-values.*

- *Both the Trace Test and Maximum Eigenvalue Test indicate at least 3 cointegrating equation at the 5 % significance levels*
- *The implication of the Johansen Cointegration test results is that the BOG's monetary policy rate (mpr), the inflation rate (π), the bank deposit rate (bdr) and the bank lending rate (blr), have long run associationship.*

6.4.3 Results Vector Error Correction Model Estimation: Inflation Targeting Framework.

Table 33 presents the results of the inflation targeting model. Pass-through is investigated for the effects of the Bank of Ghana monetary policy rate on key links in the monetary transmission mechanism, as well as on the final target of monetary policy. Under the inflation targeting regime, the BOG uses the Monetary Policy Rate (mpr) as its explicit tool. The key institutional links are bank deposit rates (bdr) and the bank lending rates (blr). Given that price stability is the objective of monetary policy, the final target of monetary policy is thus the inflation rate (π).

Table 33**:** VECM Result: Inflation Rate as the Target Variable.

	Dependent Variable: Inflation Rate (π)				
Independent Variables	**Lag (-1)**	**Lag (-2)**	**Lag (-3)**	**R^2**	**Adj.R^2**
Inflation Rate (Lags)	0.99** (0.35) Prob* (0.0158)	1.13** (0.25) Prob* (0.0038)	0.47 (0.24) Prob* (0.0811)	0.86	0.70
Bank Deposit Rates (lags)	1.32 (0.78) Prob* (0.1183)	0.50 (0.63) Prob* (4360)	0.25 (0.51) Prob* (0.6305)		
Bank Lending Rates (lags)	-0.05 (0.22) Prob* (0.3488)	1.31** (0.30) Prob* (0.0500)	1.75** (0.26) Prob* (0.0172)		
Monetary Policy Rate (lags)	-2.29** (0.36) Prob* (0.0501)	-1.65** (0.32) Prob* (0.0493)	-0.78 (0.47) Prob* (0.2740)		

Author's computation based on data collected. Note: Figures in () are HAC standard errors. R^2 indicate how the variable fitted the regression line ** indicate significance at the 5% value.

From the estimated inflation (as the target variable) model, the lagged Inflation for periods; lag (-1), lag (-2) and lag (3) are of the expected positive sign. Lagged monetary policy rate for periods; lag (-1), lag (-2) and lag (-3) are all of the expected negative sign. Inflation rate, bank lending rate and the monetary policy rate are all significant in explaining the dynamics of inflation in Ghana.

6.4.4 Diagnostic Tests: Estimated (Full) Inflation Targeting Model.

Two key assumptions are made about the residual (error terms) of the estimated inflation targeting model. The first assumption is that the residuals / error term from one period are uncorrelated with residuals from another period ($\varepsilon_t \sim N(O, \Omega)$. The consequence of correlated residuals is that the usual standard errors and t-statistics will no longer valid. Thus for the estimated model it is vital that the residuals are uncorrelated. The second is the assumption of constant variance of the error terms. Failing this, the standard errors in estimated model would have been biased and hence, may be

inefficient. Thus to ensure that reliable inferences regarding the effects of a policy induced shock in the Monetary Policy Rate, diagnostics tests are conducted to test these assumptions. Two diagnostics tests conduct on both estimated models; (a) residual autocorrelations test, and (b) residual heteroskedasticity test. The results of both diagnostics test for the estimated inflation targeting model are presented in table 37 below, with a discussion of their implications.

Table 34: Results of Autocorrelations and Heteroskedasticity Diagnostic Test.

Residual Autocorrelations Test Results			Residual Heteroskedasticity Test Result		
Lags	LM-Stat	Prob.	Chi-sq	Df	Prob.
1	15.25467	0.5061	160.8898	180	0.8347
2	13.73633	0.6183			
3	20.09686	0.2159			

Authors Computation of the Residual Autocorrelation Test Results. Probability from chi-square with 16 df. A lag length of 3 is selected automatically. Residual autocorrelation estimated under a null hypothesis of serial autocorrelation.

- *The estimated VECM model passes both the residual autocorrelations and residual heteroskedasticity tests. This means structural model assumptions of residual uncorrelation, and constant variance holds for the estimated inflation targeting model.*
- *Thus for the residual autocorrelations test, we reject the null hypothesis of autocorrelations and accept the alternative hypothesis of no autocorrelations. The probability values of 0. 5061; 0.6183 and 0.2159 are more than the 0.05% significance value.*
- *For the residual heteroskedasticity test, we also reject the null hypothesis of residual heteroskedasticity and accept the alternative hypothesis of no residual heteroskedasticity. The probability value of 0.8347 is more than the 0.05% significance value.*
- *The implication is that the estimated model is statistically robust, and the estimated coefficients are not potentially spurious or sub-optimal.*
- *Thus, reliable inferences on the effects of policy induced shocks in the Bank of Ghana monetary policy rate can be drawn from the estimated inflation targeting model.*

In the next section, the effects of a policy induced shock in the monetary policy rate (mpr) on bank lending rate (blr), bank deposit rate (bdr) and inflation rate (π) are assessed using Impulse Response analysis.

6.4.5 Structural Dynamics of the Transmission Mechanism: Inflation Targeting Framework.

Key structural dynamics of the MTM under the inflation targeting framework are assessed. These include the assessment of long run and short run causality running from the MPR, as the explicit monetary policy tool under the BOG's inflation targeting framework. Also assessed, is the responses of the admissible variables (inflation rate, bank deposit rate and bank loan rate) to a policy induced shock in the MPR, using Impulse Response Function (IRF) analysis. The results of these assessments are presented and analysed in sections 6.4.5.1 and 6.4.5.2.

6.4.5.1 Assessment of Long Run and Short Run Causality Running from the Monetary Policy Rate.

The existence of long run and short run causality running from monetary policy to the endogenous variables is used as indication of the definition of the monetary transmission mechanism. Thus, the existence of long run and short run running from the MPR, through the bank loan rate, bank savings rate, to inflation rate is assessed. To assess long run causality, the signage and significance of the error correction term is analysed. Additionally, Wald test is used to assess the existence of short run causality running from MPR to inflation. The estimates show that there exist both long run and short run causality running from monetary policy rate to inflation rate.

6.4.5.1.1 Results of Long Run Causality Test.

The estimated cointegrating equation for inflation as the target variable indicates long run causality running from the monetary policy rate to inflation rate.

D(INFLATION) = C (1) *(INFLATION (-1) - 0.85* monetary Policy Rate (-1) + (C2) *Deposit Interest Rates (-1) – 0.77*Monetary Policy Rate (-1) + C3(3) *(Bank Lending Rates (-1) – 0.81*Monetary Policy Rate (-1)) (6.7)

Table 35: Long Run Causality Running to Inflation Rate.

Target Variable	Coefficient	Std. Error	t-Statistic	Prob.
Inflation Rate	-2.288073	0.461982	-4.952736	0.0003

- *The estimated coefficient is both negative (-2.288073) and significant (0.0003)*
- *The results indicate that there is long run causality running from monetary policy rate, to the inflation rate.*

6.4.5.1.2 Results of Short Run Causality Test: Wald Test.

Wald Test is employed to test short run causality running from bank deposit rate, bank lending rate and BOG monetary Policy Rate to the inflation rate.

Table 36: Short Run Causality to Inflation Rate

Variables	Null Hypothesis	Probability
		Chi-Square: 0.0029
Bank Deposit Rate: Lags (-1); (-2); (-3)	C (7) =C (8) =C (9) =0	F-Statistic: 0.4392
		Chi-Square: 0.4061
Bank Lending Rate: Lags (-1); (-2); (-3)	C (10) =C (11) =C (12) =0	F-Statistic: 0.0516
		Chi-Square: 0.0159
Monetary Policy Rate: Lags (-1); (-2); (-3)	C (13) =C (14) =C (15) =0	F-Statistic: 0.2080
		Chi-Square: 0.1531

Authors computation of the results of Wald Test on short run causality from bank deposit rate, bank lending rate and monetary policy rate to inflation rate.

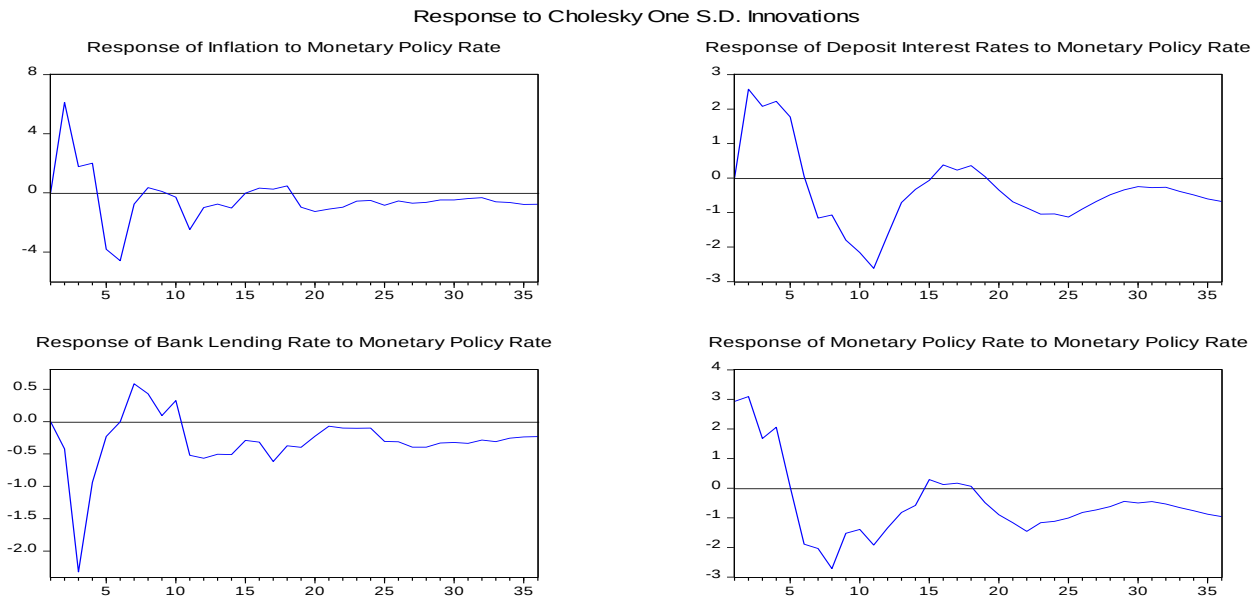
The implication of the estimation results is that the existence of both long run and short run causality running from MPR to inflation is significant. From the estimated cointegrating equation, the error correction term C (1) is both negative (-2.288073) and significant (0.0003) indicating long run causality is significant. The results of the Wald Test, means we reject the null hypothesis of no short run causality, and accept the alternative hypothesis of short run causality. All the probability values are more than the 5% significance value. Both results indicate that there is both a long run causality and

short run causality running from the bank deposit rates, bank lending rates and the monetary policy rates to the inflation rate. This further indicates a defined, and probably reliable transmission link from the monetary policy rate to inflation. This provides evidence that there is an institutional basis for an inflation targeting framework in post reform Ghana.

6.4.5.2 Effects of Policy Induced Shocks in the Monetary Policy Rate (MPR).

. The cost of money, including both the bank lending rates and savings rates, are assumed to be a key institutional link between the monetary policy rate and inflation rate. In line with the Post Keynesian predictions, both bank lending rates (BLR) and bank deposit rates (BDR) are positively influence by the MPR. These perceptions of the inflation targeting framework of the nature of the MTM are assessed, by examining the effects of a shock in the monetary policy rate on inflation, bank lending rates and bank savings rates over a 36 horizon (3-year) policy cycle. In this section, the results of the responses of inflation rate (π), bank deposit rate (bdr) and bank loan rate (blr), to a policy induced shock in the BOG monetary policy rate are presented, and discussed.

Figure 27. Responses of Inflation, bank deposit rates and bank loan rates to Monetary Policy Rate.



Responses of GDP, Inflation and Bank Loan Rate to a policy induced shock in the Monetary Policy Rate.

- *The IRFs indicate that the inflation rate (π), bank deposit rate (bdr) and bank lending rate (blr) are significantly responsive to policy induced shocks in the BOG Monetary policy rate.*
- *There is a strong and significant short run response of the inflation rate, to a policy induced contraction is the BOG monetary policy rate. While there are long run responses, there are weaker after about 6 months*
- *There is also a strong and significant response of the bank lending rates to a policy induced contraction in the policy rate. Changes in the monetary policy rate positively and quickly pass-through to bank lending rates, indicating that MPR has a positive effect on bank lending rates.*
- *The effect of policy induced contraction in the MPR on bank deposit rates are insignificant.*

6.5. Model Estimations Results: Monetary Targeting Model.

The monetary targeting is also estimated using Vector Autoregressive (VAR) econometric modelling techniques, allowing for the dynamic relationships between all the admissible variables to be simultaneously estimated. As part of these estimation process of the model, the time series properties of the admissible variables, including ADF unit roots test Johansen Cointegration method. The estimated monetary targeting model is then subjected to a number of model diagnostics tests, including the residual autocorrelations and heteroskedasticity tests. The structural dynamics of the estimated model is assessed using long run and short run causality tests and Impulse Response Function (IRF) analysis. The results of these tests and estimations, and their implications are analysed and discussed in the next sections.

6.5.1 Results of Augmented Dickey Fuller Unit Roots Test.

Table 37: Augmented Dickey-Fuller Unit Test

VARIABLES	**LEVELS: Test Critical Value**			**1st Difference Test Critical Value**		
	5% Level	ADF T- Statistics	Prob*	5 % Level	ADF T-Statistics	Prob*
GDP Growth (***GDP***)	-2.963972	-3.073766*	0.0395 (c)	-1.952910	-7.195873**	0.0000 (n)
Inflation Rate ($\boldsymbol{\pi}$)	-3.568379	-4.107206*	0.0155 (t+c)	-3.574244	-5.907762**	0.0002 (t+c)
BOG Treasury Security Rate	-2.954972	-5.032719*	0.0017 (t+c)	-2.998064	-7.272437**	0.0000 (n)
Credit Supply (by Banks)	-3.568379	-3.127362	0.1184 (t+c)	-3.574244	-6.416138**	0.0001 (n)

Authors Computation of the ADF Unit Roots Test Results.

Note: *, **, *** indicate stationarity at the levels, first difference and second difference respectively.

Note: (c) denotes intercept, (t+c) denotes trend and intercept and (n) denotes no trend and no intercept.

The ADF test has been conducted under the null hypothesis of unit roots.

- *The ADF test results show that GDP growth, Inflation rate and the Bog Treasury Security Rate are stationary at the levels I (0).*
- *Credit supply from bank to private sector is stationary at 1st difference (I (1).*

- *The implications are that to avoid potential spurious regression problems for the identified inflation credit supply from banks (csb) would need to be de-trended by first differencing them. De-trending the variables would motivate stationarity.*

6.5.2 Results of the Johansen Cointegration Test.

The admissible variables ($gdp\,\pi, csb, tsr$) in the monetary targeting model are tested to cointegration, using the Johansen cointegration test. The Johansen Cointegration test on GDP growth (y), inflation rate (π), credit supply from the banking sector (csb) and the BOG Treasury Security Rate (tsr) indicate long run associationship between the variables.

Table 38. Results of Johansen Cointegration Tests

Unrestricted Cointegration Rank Test (Trace)					Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesised No. of CE(s)	Eigenvalue	Trace Statistics	0.05 Critical Value	Prob.**	Hypothesised No. of CE(s)	Eigenvalue	Trace Statistics	0.05 Critical Value	Prob.**
None*	0.635131	49.01914	47.85613	0.0381	None*	0.635131	28.23004	27.58434	0.0413
At most 1*	0.376851	20.86110	29.97907	0.3664	At most 1*	0.376851	13.24314	21.13162	0.4301
At most 2	0.224557	7.617962	15.49471	0.5071	At most 2	0.224557	7.120964	14.26460	0.4750
At most 3*	0.017593	0.496998	3.841466	0.4808	At most 3*	0.017593	0.496998	3.841466	0.4808

*Authors Computation of the Johansen Cointegration Test Results for variables. * denotes rejection of the null hypothesis at 5% significance level. ** denotes MacKinnon-Haug-Michelis (1999) p-values.*

- *Both the Trace test and Maximum Eigenvalue test results indicate at least 1cointegrating equation.*
- *The implication is there is a long run equilibrium relationship between the variables in the model.*

6.5.3. Vector Error Correction Estimation Results: Monetary Targeting Model.

Table 39 presents the results of the inflation targeting model. Pass-through is investigated for the effects of the Bank of Ghana monetary policy rate on key links in the monetary transmission mechanism, as well as on the final target of monetary policy. Under the inflation targeting regime, the BOG uses the Monetary Policy Rate (mpr) as its explicit tool. The key institutional links are bank deposit rates (bdr) and the bank lending rates (blr). Given that price stability is the objective of monetary policy, the final target of monetary policy is thus the inflation rate (π).

Table 39: VECM Result: GDP Growth Rate as Target Variable.

	Dependent Variable: GDP Growth Rate			
Independent Variables	**Lag (-1)**	**Lag (-2)**	R^2	**Adj.R^2**
GDP Growth Rate (Lags)	0.05 (0.26) Prob* (0.0846)	0.03 (0.21) Prob* (0.8724)	0.56	0.31
Inflation Rate (lags)	-0.03 (0.05) Prob* (0.5857)	-0.06 (0.04) Prob* (0.1900)		
Credit Supply from the Banking Sector (lags)	0.41 (0.28) Prob* (0.1612)	0.64** (0.28) Prob* (0.0389)		
BOG Treasury Security Rate	-0.02 (0.07) Prob* (0.7874)	0.07 (0.08) Prob* (0.3639)		

*Author's computation based on data collected. Note: Figures in () are HAC standard errors. R^2 indicate the goodness of fit of the variables fitted the regression line ** indicate significance at the 5% value.*

Table 40**:** VECM Result: Inflation Rate as Target Variable.

	Dependent Variable: Inflation Rate			
Independent Variables	**Lag (-1)**	**Lag (-2)**	R^2	**Adj.R^2**
GDP Growth Rate (Lags)	-1.52 (1.34) Prob* (0.2709)	0.09 (1.08) Prob* (0.9298)	0.57	0.33
Inflation Rate (lags)	0.80** (0.30) Prob* (0.0163)	0.48 (0.25) Prob* (0.069)		
Credit Supply from the Banking Sector (lags)	3.87** (1.43) Prob* (0.0149)	0.45 (1.44) Prob* (0.7587)		
BOG Treasury Security Rate	1.24** (0.39) Prob* (0.0059)	0.01 (0.41) Prob* (0.9689)		

*Author's computation based on data collected. Note: Figures in () are HAC standard errors. R^2 indicate the goodness of fit of the variables fitted the regression line ** indicate significance at the 5% value*.

From the estimated models, the result for GDP as the dependent variable are all of the expected signs. For equation with Inflation as the dependent variable, the lag GDP growth is of the expected negative signed while lags of inflation rate and credit supply from banks are of the expected positive signs. BOG treasury security rate however indicates a price puzzle.

6.5.4 Diagnostic Tests: The Estimated Monetary Targeting Model.

As with the estimated inflation targeting model, two key assumptions are made about the residual (error terms) of the estimated monetary targeting model. The first assumption is that the residuals / error term from one period are uncorrelated with residuals from another period ($\varepsilon_t \sim N(O, \Omega)$. The second is the assumption of constant variance of the error terms. Thus to ensure that reliable inferences regarding the effects of a policy induced shock in the BOG Treasury Rate, diagnostics tests are conducted to test these assumptions. Two diagnostics tests conduct on both estimated models; (a) residual autocorrelations test, and (b) residual heteroskedasticity test. The results of both diagnostics test for the estimated inflation targeting model are presented and interpreted in table 37.

Table 41. Results of the Residual Autocorrelations and Residual Heteroskedasticity Tests.

Results of Residual Autocorrelations Test			Result of Residual Heteroskedasticity Test.		
Lags	LM-Stat	Prob.	Lags	LM-Stat	Prob.
1	19.03932	0.2666	172.8344	180	0.6359
2	16.38937	0.4261			
3	14.17031	0.5860			

Authors Computation of the Residual Autocorrelation Test Results. Probability from chi-square with 16 df. A lag length of 3 is selected automatically. Residual autocorrelation estimated under a null hypothesis of serial autocorrelation.

- *The estimated monetary targeting model passed both the residual autocorrelations and residual heteroskedasticity tests.*
- *For the both estimations, the null hypotheses are rejected and the alternative hypotheses of no serial residual autocorrelation and residual heteroskedasticity.*
- *The implications are that the regression results are not spurious, and that reliable inferences can be drawn from the estimates regarding the structural dynamics of the MTM under the monetary targeting framework.*

6.5.5 Structural Dynamics of the Transmission Mechanism: Monetary Targeting Framework.

The thesis also assesses key structural dynamics of the MTM under the monetary targeting framework. This includes the long run and short run causality running from the policy induce open market operations, as a key monetary policy tool under the BOG's monetary targeting framework. In addition, the responses of the admissible variables (inflation rate, bank deposit rate and bank loan rate) to a policy induced open market operation. The results of these assessments are presented and analysed in sections 6.5.5.1 and 6.5.5.2.

6.5.5.1 Long Run and Short Run Causality Running from Open Market Operations.

The monetary targeting framework assumes the monetary transmission mechanism as the causative effects of policy induced shocks in endogenous money supply (using open market operations (OMO) and discount windows) on GDP growth and inflation. The capacity of the banking system to create deposits (lending to the private sector) is assumed to be a key institutional link between monetary policy on one hand, and GDP growth and inflation rate on the other. The BOG thus postulates that causality run from monetary policy (OMO), through bank credit supply to inflation and GDP. This postulation of causality is assessed. The significance of the error term is assessed for long run causality, while Wald test is used to test for the significance of short run causality. The results of these estimates are presented and analysed in the next section

6.5.5.1.1 Results of Long Run Causality Test.

Test of long run causality assesses potential causality running from; GDP (-), inflation (-1); credit supply from banks (-1), and BOG Treasury security rate to GDP growth and inflation. There is said to be long run causality of GDP growth and inflation, if the error correction terms for the respective estimated VEC equations are both negative and significant. This would imply that there is a long run transmission relationship running from the BOG Treasury security rate, potentially through the credit supply from banks, to GDP growth and inflation in Ghana. This would provide indication that the BOG's view of the transmission mechanism could have some significance. The results of the long run causality tests are presented and analysed below.

D(GDP) = **C (-1)** *(GDP (-1) + 4.81* BOG Treasury Security Rate (-1)) + **C (2)** *(Inflation (-1) - 3.06*BOG Treasury Security Rate (-1)) +**C (3)** *(Credit Supply from Banks (-1) + 11.45*Treasury Security Rate (-1)) (6.8)

D(INFLATION) =**C (12)** *(GDP (-1) +4.81* BOG Treasury Security Rate (-1)) + **C (13)** *(Inflation (-1) - 3.06* BOG Treasury Security Rate (-1)) +**C (14**) *(Credit Supply from Banks (-1) + 11.45*Treasury Security Rate (-1)). (6.9)

From the estimated VEC equations (of GDP growth and inflation rate), we assess the signage of the respective coefficients and their significance at the 0.05% critical value.

Table 42: Long Run Causality to GDP Growth Rate and Inflation Rate.

Target Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP Growth Rate	-0.71928	0.247822	-2.904612	0.0099
Inflation Rate.	2.894936	1.238336	2.319037	0.0331

Authors tabulation of the error correction terms on long run causality.

- *The coefficient of the error correction model, with GDP growth as the target variable, is both negative (-0.71928) and significant (prob. 0.0099).*
- *The coefficient of the error correction model, with inflation rate as the target variable, is positive (2.894936) but significant (0.0331).*

6.5.5.1.2 Results of Short Run Causality Test: Wald Test.

Wald Test is employed to test for short run causality running from GDP growth, inflation rate, credit supply from banks and the BOG Treasury security rate to GDP growth rate and inflation rate, as a test of the monetary targeting framework's view of the monetary transmission mechanism. The results of the Wald test are presented and interpreted in tables 43 and 44.

Table 43: Wald Test Result on Short Run Causality: GDP Growth Rate as Target Variable.

Target Variable: GDP Growth Rate		
Explanatory Variables	**Null Hypothesis**	**Probability**
GDP Growth Rate: Lags (-1); (-2);	C (4) =C (5) =0	F-Statistic: 0.9791
		Chi-Square: 0.9791
Inflation Rate: Lags (-1); (-2)	C (6) =C (7) =0	F-Statistic: 0.4131
		Chi-Square: 0.3939
Credit Supply from Banking Sector	C (8) =C (9) = 0	F-Statistic: 0.0901
		Chi-Square: 0.0619
BOG Treasury Security Rate	C (10) =C (11) =0	F-Statistic: 0.5752
		Chi-Square: 0.5648

Authors computation of the results of Wald Test on short run causality running from GDP Growth, Inflation, Credit Supply from Banks and BOG Treasury Security Rate, to GDP Growth Rate.

Table 44. Wald Test Result on Short Run Causality: Inflation Rate as Target Variable.

Target Variable: Inflation Rate		
Explanatory Variables	**Null Hypothesis**	**Probability**
GDP Growth Rate: Lags (-1); (-2);	C (15) =C (16) =0	F-Statistic: 0.4230
		Chi-Square: 0.4043
Inflation Rate: Lags (-1); (-2)	C (17) =C (18) =0	F-Statistic: 0.0383
		Chi-Square: 0.0187
Credit Supply from Banks	C (19) =C (20) = 0	F-Statistic: 0.0410
		Chi-Square: 0.0207
BOG Treasury Security Rate	C (10) =C (11) =0	F-Statistic: 0.0162
		Chi-Square: 0.0050

Authors computation of the results of Wald Test on short run causality running from GDP Growth, Inflation, Credit Supply from Banks and BOG Treasury Security Rate, to the inflation rate.

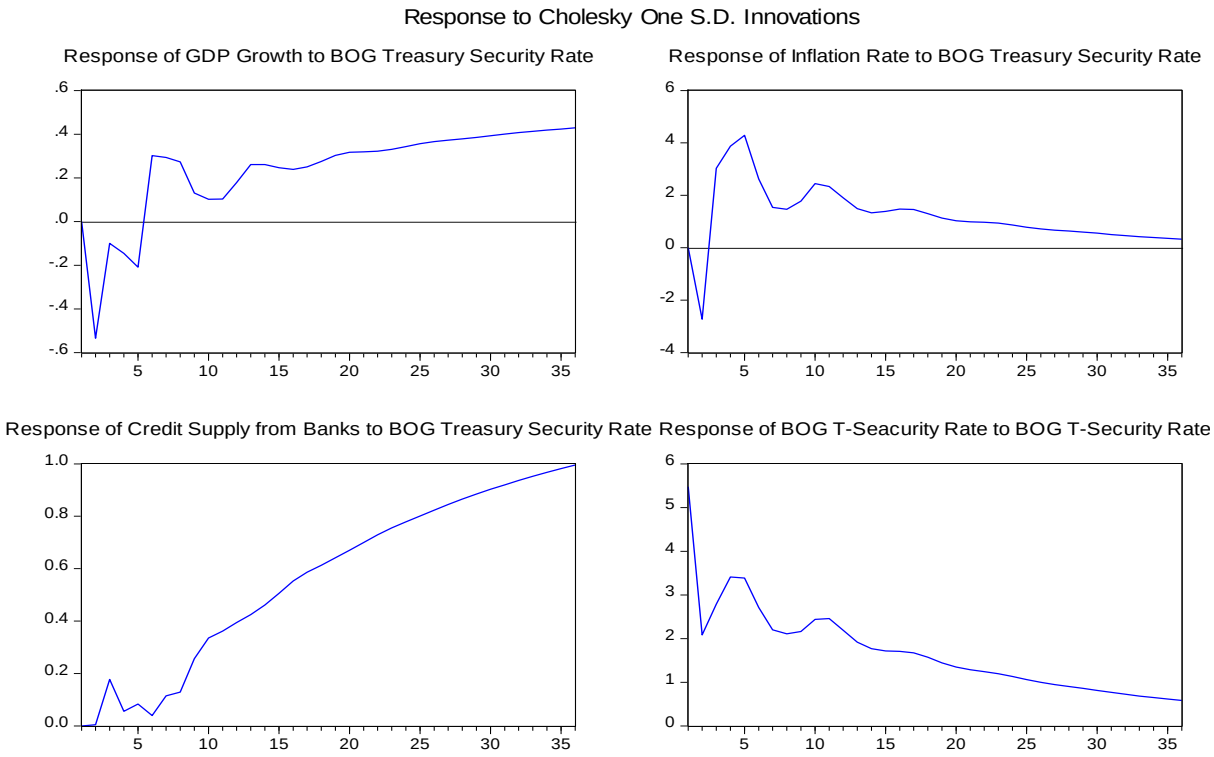
- *Tables 43 and 44 above, are the results of the Wald Test of short run causality running from GDP growth, inflation rate, credit supply from banks and the BOG Treasury security rate, to GDP growth and inflation.*
- *The results indicate that there is short run causality running from all the explanatory variables to GDP growth in the short run. This suggest that GDP growth is responsive to shocks to the BOG treasury security rate and credit supply from banks.*
- *The results however indicate that while there is causality running from GDP to inflation in the short run, there is no such causality running from inflation rate (-1), credit supply from banks and the BOG Treasury security rate. This suggest that inflation may not be responsive to these changes in these variables in the short run.*

6.5.5.2 Effects of Policy Induced Open Market Operations: Impulse Response Analysis.

Impulse response analysis is used to simulate the responses of GDP growth, inflation rate and credit supply from banks, to a policy induced open market operation by the Bank of Ghana. Impulse responses analysis is used to trace the responses of a system's variables, to a shock in one of the variables. A Cholesky decomposition shock (standard deviation) in the BOG Treasury security rate is used to simulate a policy induced shock using OMO. Functionally, an OMO by the BOG is used to as part of the bank's liquidity management (of banks) monetary framework. A recursive

identification scheme is used to trace the effects of shocks in the BOG policy rate. This methodology restricts shocks in GDP growth, Inflation rate and credit supply from banks, allowing for only the effects of shocks in the BOG treasury security rate to be traced. This allows for the effects of a monetary policy action, under the indirect monetary targeting regime to be assessed. The results of impulse responses of the model variables to a policy induced shock in the BOG Treasury securities rate are presented and analysed in figure 28 below.

Figure 28: Impulse Responses to a Policy Induced Shock in the BOG Treasury Security Rate.



- *The IRFs indicate that the responses of GDP growth, inflation rate and credit supply from banks to policy induced shocks in the BOG Treasury security rate are significant.*
- *Policy induced open market operation also has responsive effects on inflation rate.*
- *There is no response of credit supply from banks in Q1, to a policy induced open market operation by the BOG. This response becomes significantly respond by the Q3.*

CHAPTER 7: ANALYSIS AND DISCUSSION OF THE EMPIRICAL FINDINGS, AND IMPLICATIONS FOR MONETARY POLICY IN GHANA.

7.1. Summary of The Thesis.

This thesis tested the broad hypothesis that institutional and structural in the financial system and external openness were significant for explaining changes the long run dynamics of the monetary transmission mechanism, and observed evolutions in the Bank of Ghana's monetary policy frameworks and tools. This is against the backdrop of the structural adjustment reforms that Ghana undertook in the 1980s. The motivation is that the general consensus of the broad theoretical literature is that the nature and dynamics of the monetary transmission mechanism, and a central bank's choice of monetary policy frameworks and tools, is fundamentally influenced by the financial system development and external openness. Hence, changes in the MTM and the evolution in a central bank's monetary policy frameworks and tools could be linked to, or explained by changes in financial development and external openness. This thesis tested this broad consensus, using Ghana and her experience with the structural adjustment reforms, beginning in 1985/1986, as a case study. Ghana's structural adjustment reforms was arguably the most significant macroeconomic reform event in its post-independence period. Key elements of the reforms included, amongst other policies, financial structure reforms and financial sector liberalisation, and external openness reforms.

Two main hypotheses on the significance of the structural adjustment reforms for the monetary transmission mechanism and monetary policy are tested. Firstly, the thesis tested the hypothesis that institutional and structural changes in financial structure and external openness where significant in explaining change in the long run dynamics of the monetary transmission mechanism in Ghana. This hypothesis is tested by estimating a benchmark model (with GDP, inflation and broad money supply), against an augmented model (with a financial structure index and external openness index incorporated). This assesses structural change in the MTM. Change in the long run dynamics of the monetary transmission mechanism is assessed by analysing changes in long run causality running

from monetary policy, structural change test (likelihood ratio test) motivated by the beginning of the structural adjustment reforms, and impulse response analysis. Against the backdrop of the post reform institutional and structural changes, and the Bank of Ghana's monetary policy regime transitions, the thesis also assessed the effects of the Bank of Ghana's post reform indirect monetary targeting and inflation targeting tools. The motivation is that these regime transitions would have reflected the bank's emerging view that the post reform financial system is sufficiently institutionalised to support indirect monetary policy tools. Given the institutional weaknesses as a developing country the motivation is to empirically assess the post reform transitions, by assessing the effectiveness of these post reform inflation targeting and monetary targeting tools. Using annualised time series data for the period 1980 to 2015, an inflation targeting and monetary targeting VAR models are estimated. From the estimated models short run and long run causality are assessed, and impulse response analysis used to assess the responses to policy induced shocks in the Bank of Ghana's Monetary Policy Rate, and Open Market Operations. The data are sourced mainly from the Bank of Ghana, Global Financial Development Data (GFDD), International Financial Statistics and World Development Indicators published by the World Bank.

7.2 Summary of Key Empirical Findings:

7.2.1 Hypothesis One: Findings on Structure of the Monetary Transmission Mechanism in Ghana.

Hypothesis one is tested by estimating a benchmark model with GDP, inflation and broad money supply is estimated, against an augmented model with a financial structure index and external openness index incorporated. The financial structure index and external openness index are constructed using Dynamic Factor Modelling (Principal Factor Analysis). Assessment of changes in the long run dynamics of the monetary transmission mechanism examined three main factors; (a) assessment of changes in long run causality running from monetary policy to GDP growth and inflation, (b) significance structural change (likelihood ratio test) in the model and hence the MTM,

and (c) assessment of the significance of the responses of GDP growth, inflation and broad money supply to structural induced shocks in the financial structure (financial development) index and external openness index, using Impulse Response Function (IRF) analysis. The overall empirical findings indicate that the structural adjustment reform, and the underlying institutional and structural changes, was significant in motivating structural changes in the monetary transmission mechanism in Ghana. On changes in long run causality running from monetary policy to GDP growth and inflation, the result found that financial structure and external openness were significant. The results from the benchmark model (without financial structure and external openness indices) indicated that, there was a long run causality running from broad money supply to GDP growth (the error correction term is both negative (-1.852188) and significant, with a probability value of 0.0000. However, there was no such long run causality running to inflation, for which the vector error correction term is negative (-3.796163) but not significant (0.0769). The estimation results of the augmented model of the MTM outlined the significance of the financial system and external trade and financial transaction to the structure of the MTM in Ghana. With the incorporation of financial structure index and external openness index, the results found significant long run causality running from broad money supply to both GDP and inflation. For the GDP growth as the target variable, the error correction term is both negative (-0.674751) and significant, with a probability value of 0.0004. For inflation as the target variable, the error correction term is both negative (-6.053247) and significant (0.0000) indicating that there is a long run causality running from GDP growth and Broad Money Supply to inflation. The findings on long run causality indicate that the financial system (banking system) and external openness are fundamental and significant systematic/ structural components of the monetary transmission mechanism in Ghana. This suggest that the financial system provides defined transmission links between monetary policy and GDP growth and inflation, and provides explanation as to why the banking system is the main platform for the implementation of monetary policy in

Ghana. It probably explains why the bank of Ghana has largely relied on commercial bank liquidity management, and targeting the cost of money as it key monetary policy implementation strategy.

The findings indicate that the institutional and structural changes, associated with the structural adjustment reforms motivated significant post reform change the long run dynamics of monetary policy in Ghana. Against the backdrop of the import substitution industrial development macroeconomic restriction, the long run dynamics of pre-reform inflation was high and volatile, while that of GDP was long and volatile. The state-owned banking system was highly concentrated, with a long run trend of financial disintermediation. The exchange rate was fixed, restricting its shock absorbing role. These pre-reform policies probable contributed to a weak, ineffective and no reliable effects of monetary policy on developments in inflation and GDP growth. The overall objective of the structural adjustment reforms was to engender a macroeconomic shift to a liberalised open financial and external openness. The broad reforms programme was underscored by financial sector and external openness reforms policies. The findings indicate that these reforms were significant for fundamentally changing the long run dynamics of the MTM in Ghana. This is evidence by the result of the structural breaks test (likelihood ratio test). The estimated Likelihood Ratio (LR) value of 1.176 is more than the test critical value of 1.070 ($1.176 > 1.070$), supporting the null hypothesis of a significant structural change around the period 1985/1986. This is supported by the results of the structural change break test in the augmented model (with financial structure index and external openness index) concluded 1985/86 marked a significant structural change point. The results provide evidence of significant structural change. This is reflected in amongst other structural changes, with the average volatility of inflation fell from 31.4 % (1960-1985 to 9.97% (1986-2015). The average volatility of GDP growth fell from an average of 5.9% between 1966-1985, to an average of 0.69% between 1986-2005. In the financial sector, the evidence of structural change in the MTM is also probably driven by the fall in the 4-bank concentration ratio showing with data showing that total banking sector assets attributable to the big- 4 bank fell from 85.5% to 73.7%; deposits fell from

89.9% to 76.5% and Loan Advances from 79.5 % to 59.3% for periods 1980-1985 and 1990-1996 respectively. This evidence of post reform structural change provided evidence that the structural adjustment reforms fundamentally changed the long run dynamics of the monetary transmission mechanism in Ghana.

The result of the impulse responses trade flows significant effects on domestic GDP growth, inflation and broad money supply in Ghana are significantly responsive to system shocks in the financial sector and international financial and trade flows. Given that financial structure and external openness are modelled as indices, the results of the impulse response analysis reflect the responses of GDP growth, inflation and broad money supply, to shocks in the constituent variables of each index. The implication of the results of responses to a shock in the financial structure index, is that GDP growth, inflation and Broad Money Supply, are responsive to developments in the dynamics of banking sector balance sheets variables. This includes developments in Bank Deposits (% GDP), Broad Money to Total Reserve, Deposit Money to Bank Assets, Bank Assets to Central Bank Assets, Domestic Credit provided by banks, Domestic Credit provided by non-bank financial institutions, Banking Sector Liquid Liabilities Private Sector Credit to Bank Deposits, Total Bank Reserves to GDP and Bank Credit to Bank Deposits. This further supports the significance of the banking sector as a key institutional link in the monetary transmission mechanism in Ghana. Additionally, the implication of the results of responses to a shock in the external openness index, is that GDP growth, inflation and Broad Money Supply, are responsive to developments in key balance of payment account variables. This includes developments in current account balances, the official exchange rate, exports of goods and services, imports of goods and services, external short term debt stock, external long term debt, foreign direct investment, net inflows and net foreign assets. This results of the significance of the external openness index, provides further indication that external openness has a significant influence of domestic developments in GDP growth, inflation and broad money supply in Ghana.

7.2.2 Hypothesis Two: Findings on the Effects of Open Market Operations and the Monetary Policy Rate.

Key findings on the effects of Open Market Operations (under the monetary targeting regime) and policy induced shocks in the monetary policy rate (under the inflation targeting regime) is that both can potentially be effective as tools of macroeconomic and price stability. The results indicate that the post reform financial system supports the transmissions of policy induced OMO's to GDP growth and inflation, with bank credit supply to the private sector providing an effective transmission link. Under the monetary targeting regime, the results of the long run and short run causality test indicate that a strong causality running from a policy induced open market operation to GDP growth and inflation and GDP. The results of long run causality concluded that the vector error term is both negative The coefficient of the error correction model with GDP growth as the target variable is both negative (-0.71928) and significant (prob. 0.0099). Additionally, the short run causality test indicates that there is short run causality running from open market operations to GDP growth, potentially through its effects on credit supply from banks to the private sector. The Wald test rejection of the null hypothesis of the C (4) =C (5) = 0, and the acceptance the alternative hypothesis, indicated a short run causality running from OMO to GDP growth. The implication of the Wald test results is that policy induced open markets operations by the Bank of Ghana affects GDP growth both in the short run and long run. With to the relationship between open market operations and inflation rate, the error correction term positive (2.894936) but significant (0.0331), indicating that there is not long run causality running from open market operations to inflation. However, the results of the Wald Test indicated that there is short run causality running from open market operations to inflation.

The Bank of Ghana's inflation targeting regime is premised view policy induced shocks in the Bank of Ghana monetary policy rate has a reliable and predictive effect inflation. This relationship is perceived to be such that the monetary policy rate can be used to control the dynamics of inflation. Interest rates on bank loans and bank deposits are viewed as key institutional links. This view is

tested by assessing the effects of policy induced shocks in the monetary policy rate on bank lending rate, bank deposit rate and inflation rate. The strength of the transmission mechanism under the inflation targeting is examined by assessing the short run and long run causality, and impulse responses from the estimated model. The causality test results indicate long run and short run causality running from the monetary policy rate to inflation rate. The result of the long run causality test concluded that the error correction term is both negative (-2.288073) and significant (0.0003). This concludes that policy induced shocks in the BOG monetary policy rate has long run effects on inflation in Ghana. Additionally, the Wald test rejection of the null hypothesis, and acceptance of the alternative hypothesis also indicate short run causality running from the BOG monetary policy rate to inflation. The impulse responses functions also indicate that the inflation responds to policy induced shocks in the monetary policy rate. Overall, there is a strong institutional case for the use of indirect monetary policy by the Bank of Ghana. These probably motivated, and provided the platform for the observed post reform evolutions in the Bank of Ghana's monetary policy frameworks and tools to indirect monetary targeting and inflation targeting.

7.3. Implications for Post Reform Monetary Policy in Ghana.

The main theoretical consensus is that a central bank's choice of monetary policy frameworks and tools is a function of the structure and dynamics of the monetary transmission mechanism. Structural changes in the such institutional structures as the financial system in the form of financial development will inevitably lead to transitional changes in the programming and conduct of monetary policy. In the case of Ghana, and in the context of the empirical findings of this thesis, this view seems to hold. In other words, the post reform developments in the MTM and particularly the developments in the financial system and external openness, seems to be linked or motivated the observed transitions to indirect, institutionalised monetary policy frameworks. The implications of the significance of the financial structure index in influencing the dynamics of GDP growth and inflation, is that relevant banking sector balance sheets variables became significant intermediate

target for monetary policy. This probably provided the structural institutional evidence suggesting the post reform financial system, providing a reliable link between monetary policy, and GDP growth and inflation. And that this link could operate through such bank balance sheet variables as Bank Deposits (% GDP), Broad Money to Total Reserve, Deposit Money to Bank Assets, Bank Assets to Central Bank Assets, Domestic Credit provided by banks, Domestic Credit provided by non-bank financial institutions, Banking Sector Liquid Liabilities Private Sector Credit to Bank Deposits, Total Bank Reserves to GDP and Bank Credit to Bank Deposits. The significance of these bank balance sheet variables may have provided the institutional platform for the BOG's transition to indirect monetary targeting, using Open Market Operations. Not least because the essence of open market operations is to target the liquidity (balance sheets) of banks, as an intermediate platform to influence GDP growth and inflation.

The research findings also had implications for the institutional and structural rationale for the transition to an inflation targeting regime. Transition to inflation targeting was a major part of the BOG regime upgrades. Under the inflation targeting regime, the primary objective of monetary policy is price stability. This was generally defined as a medium term target of inflation target of 8 %, with a symmetric band of ± 2. The inflation target is assumed to be optimal for full potential economic growth. The inflation targeting framework involves the use of the Monetary Policy Rate (MPR) to set the bank's monetary policy stance and anchor inflation expectations. The mechanism of the bank's inflation targeting framework involves positioning the MPR to neutralise any differentials between the inflation target and actual inflation. Monetary policy positioning is thus guided by expected developments in actual inflation. The institutional mechanism of inflation targeting relies on an institutionalised financial system, driven by the cost of bank loans providing a reliable institutional link between the BOG's policy induced changes in the MPR, and the inflation rate. The empirical findings on the indicate that both banking sector balance sheets and the cost of

bank loans provided this institutional condition, thus probably explaining why there was a post reform regime transition to inflation targeting.

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