Financial innovation, Asset Prices and Monetary Transmission in India: Some Issues and Evidence

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BY

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DECLARATION

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A. Published in the following publications:
   Subbarao, V.V., and Acharya, D. (2018). Financial Innovation and Stability of Money Demand Function in India: Do Equity Derivatives Matter?. The IUP Journal of Applied Economics. Vol. XVII No.4, October 2018. ISSN: 0972-6861
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Further, the student has passed the following courses towards fulfillment of the coursework requirement for Ph.D/was exempted from doing coursework (recommended by Doctoral Committee) on the basis of the following courses passed during his M.Phil. Programme and the M.Phil. degree was awarded:

Course Code	Name	Credits	Pass/Fail
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3. SE703	Research Methodology	4	Pass
4. SE751	Study Area	4	Pass

Supervisor **Dean of School**

Dedicated

to

Vangara Venkata Krishna Rao

Vangara Kanaka Durga

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By

Vangara Venkata SubbaRao

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ABBREVIATIONS

ADF - Augmented Dickey Fuller

ARDL - Autoregressive Distributed-lagged

BIS - bank for international settlements

BSE - Bombay Stock Exchange

CAGR- Compound Annual Growth Rate

CCIL - Clearing Corporation of India Limited

(CBOE)- Chicago Board of Options Exchange

(CBOT)- Chicago Board Of Trade

(CME)- Chicago Mercantile Exchange

(CME)- Chicago Mercantile Exchange

(CDS)- Credit default swaps

ET - Exchange traded

FEVD - Forecast error variance decomposition

FII - Foreign institutional investor

GDP: Gross Domestic Product

IIP - Index of Industrial Production

ISDA - International Swaps and Derivatives Association

LAF - liquidity adjustment facility

LIFFE - London International Financial Futures and Options Exchange

MSEI - Metropolitan Stock Exchange of India Ltd. Limited

NEER - Neal effective exchange rate

NSE - National Stock Exchange

OECD - Organisation for Economic Co-operation and Development

OPEC - Organization of the Petroleum Exporting Countries

OTC - Over the counter Exchange

PP - Phillips-Perron

RBI - Reserve Bank of India

REER - Real effective exchange rate

SCRA - Securities Contracts Regulation Act

SEBI - Securities and Exchange Board of India

SVAR - structural vector autoregressive

USE –United Stock Exchange

VAR: Vector Auto-Regressions
VECM - Vector Error Correction Model

WPI: Wholesale Price Index

VRI - variability of rate of inflation

LR: Likelihood-ratio

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

LM - Lagrange multiplier test

Chapter-I

Introduction, Objectives and Scope of the Study

> *"……targeting other asset prices, whether they are exchange rates, real estate or stock market prices, is likely to worsen the performance of monetary policy. This is because the response of monetary policy to asset price fluctuations depends on the nature of the shocks to asset prices and the degree of permanence of the shocks. Furthermore, targeting asset prices is likely to erode support for the independence of central banks because control of these asset prices is beyond central banks' capabilities".*
>
> ----------*Frederick Mishkin (2001)*

1.1 Background and Motivation for Research

The understanding of monetary transmission mechanism in developed and emerging market economies has attracted attention of monetary economists and monetary authorities since long. Of late, in the wake of financial innovation in different dimensions in the financial markets, the transmission channel has almost become a black box. This is especially so when it comes to empirical attempts to find out an answer the question, "Which monetary transmission channel works the best for a particular economy? Theoretically, several channels have been identified in the literature beginning with traditional interest rate channels, the famous credit view (bank lending and bank/household balance sheet channels) and finally the ones including the asset price and exchange rates. An excellent survey of such channels is given by Mishkin (1996). In the Indian context several studies have attempted identifying various transmission channels. Some of the recent works in this area include Mishra and Sengupta (2016), Goyal and Agarwal (2017) and Acharya (2015). These studies revisit the transmission mechanism in the Indian context using different theoretical intuitions and econometric methodologies. Few other select studies are reviewed and presented in a tabular form below.

Table 1.1: Select studies Reviewed

Author	Data	Methodology	Variables used	Major Findings
Aleem (2010)	1996 Q4 to 2007Q4	Standard VAR	WPI, Call Money rate, GDP, Bank Credit to commercial Sector, Primary lending rate, BSE Sensex, REER	1. Banking Lending Channel Effective.
Sengupta (2014)	April 1993 to March 2012	VAR Modelling	Real output (IIP), Price (WPI), Call rate (CR) and Broad money (M3), Primary lending rate, Bank Lending, BSE Sensex, REER Exogenous variables-oil price index and federal fund rate	Transmission through lending by banks is not strong after adoption of liquidity adjustment facility (LAF). After LAF the channel of interest rate and asset price seem to have become strong.
Pandit, Mittal, Roy and Ghosh (2006)	1993-94 to 2002-03 Monthly Data	VAR, structural VAR	IIP,WPI,M3,CPR,CRR, Bank rate, NEER, FII, BSE market cap etc.	
Khundrakpam, Jeevan Kumar and Rajeev Jain (2012)	Quarterly data for 1996-97:1 to 2011-12:1	SVAR	**Endogenous:** real GDP, WPI, Call Money Rate (CMRSA), **Exogenous:** GDP of OECD and gross portfolio inflows. total credit, Non-food credit BSE- SENSEX, REER	The results do find channels of credit, asset price and interest rates to be strong, but that of exchange rate is weak.

Singh and Pattanaik (2010)	1996:Q2 to 20010:Q2	SVAR	GDP,WPI, CALL Money, Bank credit, Stock price and housing prices.	Some ambiguity with regard to asset price channel. Interest rate causes stock prices.
Bhattachara, Patnaik and Shah (2011).	monthly dataset from 1997 to 2009	Vector Error Correcting Model (vecm)	WPI, rupee dollar rate, IIP, 91 TB, U.S.PPI, U.S. 3 TB.	The results show that aggregate demand is not influence by interest rates. Inflation is influenced by interest rate via exchange rates.

After the economic reforms of 1991, the financial sector has undergone several changes. The financial innovation has taken place in different dimensions such as new financial instruments, new payment technologies, and introduction of financial derivatives in a phased manner and new institutional regulations with a host of reform agenda. The peculiarities of the Indian economy in two aspects i.e. introduction of financial innovation driven derivatives on the one hand and a high level of informality in the financial market on the other make monetary transmission much more complex. Mishra and Montiel (2013) argue that financial markets having lot of informal elements make the transmission mechanism weaker in low-income countries. Few other studies mentioned in the table above focussed on role of asset prices in monetary transmission mechanism yielding mixed results. The role of asset prices has been found to be ambiguous though not insignificant.

It's evident from the literature that there has been enormous research on how the monetary sector influences the real sector including transmission mechanism, but with the introduction of financial innovation in the economy the debate has been intensified. The 2008 USA crisis spread ferociously from the sub-prime markets to USA financial markets and then transmitted around the world. This demonstrates the interconnectedness of financial systems and the spill-over of external developments on domestic policy actions. In this connection around the globe central bankers also

found that sentiment and confidence were remarkably correlated across countries. In the last few decades spectacular growth of derivatives markets has invited attention of researchers on the asset price discussion on monetary transmission mechanism.

The rationale for large scale derivatives usage is that, hedging, leveraging, and substitutability of assets. A study by the Deutsche Bundesbank (1994) says that financial derivatives give opportunity to a market participant to plan investment gaps in different market segments. This results in increasing substitutability of financial assets across a wide range of market segments and a broader scope of arbitrage possibilities between markets. It reduces the price volatility in the domestic market because of spill- over of the asset in different markets. Theoretically, the presence of derivatives markets is expected to speed up the transmission of monetary policy to the real economy by reducing market imperfections.

Derivatives had less relevance in financial markets up till 1970s. The changing economic structure due to the collapse of Bretton - Woods's arrangement, fixed exchange to floating exchange rate, and oil price shock, and debt crisis, change of monetary and fiscal policy structure led to higher level of uncertainty in the economic system. To hedge against these vulnerabilities, financial innovations played significant role in the financial markets. But at the same time the speculative activity had also grown in the market. With the advent of the economic reforms of 1991 in the Indian economy, Indian financial system started undergoing several changes. The role of capital markets assumed greater significance in the Indian financial system, which was primarily bank led earlier. The role of financial assets such as equities and derivatives assumed further importance in monetary policy and monetary transmission. Integration of the economy with the rest of the world in general and of the financial markets in particular also led to higher asset prices volatility. This has also played key role in the financial stability of the economy. To manage this uncertainty and

enable different stakeholders in the financial markets to manage their risks, Indian policy makers had introduced derivative products in the Indian financial system in a phased manner. The details of its evolution are discussed in the following chapter.

1.2 Statement of Problem

In view of the above background, the present study attempts to examine the role of derivatives in the financial assets segment in monetary transmission in India. This is further justified by looking at the global trends in the derivatives Market from 1998 to 2014 in exchange traded and OTC derivatives. The OTC market share in total derivatives was 71.98% in 1998, which went up to 84.10% in 2012. Further its share was 82.10% in 2014. Similarly, the exchange traded derivatives market share was 28.02% in 1998 and it gradually lost its market share to OTC pegged at 17.93% in 2014. Looking at the product wise market segmentation, interest rate derivatives enjoyed the major market share in both OTC and exchange traded platforms followed by forex, equity, and other derivatives. . The Indian financial derivatives market is one of the fastest growing markets in the world in the last decade. In the last fifteen years, this market has introduced a variety of derivative products in the segments of equity, currency, and interest rate both in exchange traded as well as OTC platforms. The Indian exchange traded market share is higher that the OTC markets. In terms of products equity derivatives had larger share than the interest rate derivatives. Thus, one finds equity derivatives to be playing prominent role in the India. The international comparison of equity derivatives trading with cash segment is presented in table 1.2 below.

Table 1.2: International comparison of equity derivatives

Country	Ratio of equity derivatives to equity cash segment notional values
Spanish	1.13
Euronext	1.87
Japan	1.90
Australia	2.32
Russia	3.92
Hong Kong	7.23
India	15.59
Korea	24.05

Source: SEBI

It's evident from the above table 1.2 the growth in equity derivatives transactions in Indian stock exchanges is next to Korea. Given this relevance of equity derivatives in the international financial market segment as of the year 2016the present study makes an attempt to examine the role of equity derivatives as a proxy of financial innovation on monetary policy transmission in India. The study thus adds to the existing empirical literature on monetary policy transmission in India emphasizing the role of derivatives in the financial assets segment.

1.3 Objectives

In view of the above background the following objectives have been formulated by examining three issues revolving around asset prices and monetary policy transmission. First, the objective is to examine the role of equity derivatives in money demand function. Secondly, an attempt is made to examine the role of equity prices as asset prices in the monetary transmission mechanism. Thirdly, the role of equity derivatives is analysed in monetary transmission mechanism.

1.4 Data sources and Methodology

1.4.1 Data

To achieve the above mentioned objectives the data are sourced from various official data bases. The data used in chapter 2 for various trends and stylised facts are from SEBI, BIS, BSE, NSE, World Bank database, CCIL, MCX, USE, MSEI. The data for chapter 3 i.e., data on GDP, VRI, Call Money (CM), and Money Supply (M3) are collected from the Handbook of Statistics on Indian Economy, RBI and Central Statistical Office, Government of India. The data on financial assets/transactions are collected from SEBI, BSE, NSE, USE, MSEI, and CCIL. Similarly, chapter 4 deploys the following variables for analysis. Data on GDP, Inflation (WPI), Call money rate, and Nonfood bank credit, real exchange rate (36- country currency index) are collected from the Handbook of Statistics on Indian Economy of RBI. The data on stock prices are collected from NSE. Finally, data used in chapter-5 on equity derivatives are collected from SEBI, BSE, and NSE. In chapter 4 and 5 all the variable used in growth rates, except interest rate. The data is quarterly in nature and the time period of study is from 2001 to 2014.The period of study is selected in line with Woodford (2001) i.e. "to study the monetary policy transmission effectiveness, the time period selection should be based on the monetary policy regime adopted by the country under consideration". The current study has selected the time period post introduction of the liquidity adjustment facility (LAF) in Indian monetary policy regime.

1.4.2 Methodology

The time series methods suiting different objectives are employed in chapters 3 to 5.The methods are selected based on existing literature and its relevance for the study objectives. In chapter 3 ARDL bounds test and co-integration method is used to assess the importance of equity derivatives in the demand for money function in India. For the chapters 4 and 5 the main focus

is monetary transmission. Towards this Structural Vector Autoregression (SVAR) models are employed. Specifically, to examine the long-run relationship in the demand for money specifications in chapter 3, ARDL Bounds test due to Pesaran et al. (2001) is employed. This has a comparative advantage over other methods owing to its ability to produce asymptotically long run estimates regardless of the order of integration of variables used in the specifications. . Before applying the ARDL methodology, ADF and PP unit root tests have been carried out to check the order of integration of the variables.

A structural vector auto regression (SVAR) model is estimated to examine the monetary policy and asset price interactions in chapter 4. Before going for SVAR estimation unit root tests by using ADF and PP tests are employed to confirm the stationarity properties of the variables considered in the model. After confirming the stationarity property, the lag order for the model are determined. Based on earlier empirical literature transmission channels are assessed by the impulse response function (IRFs) and variance decomposition. Some diagnostics test is employed to test the model stability. IRFs trace out the response of the variables in the model to one standard deviation shock given to one variable in the model. Similarly, the forecast error variance decomposition (FEVD) explains the percentage of forecast error variance in each endogenous variable that is determined by the other variables in the model**.** Historical variance decomposition analyses the contribution of the different accumulated structural shocks to each observed variable**.**

To study monetary policy transmission with and without equity derivatives, two SVAR models are estimated using the following variables: GDP (y), Inflation (p), Call money rate (r), Money Supply (M3), equity derivatives (e). The SVAR model incorporates the theoretical restrictions, which are deployed to identify various structural shocks.

1.5. Organisation of the thesis

The rest of the thesis is divided into five chapters. arranged as follows, Chapter 2 tries to trace the evolution of global and Indian derivatives market since its inception and explain the difference between derivatives market broadly divided into exchange traded (ET) and over the counter Exchange (OTC) derivatives.

In the Chapter-3 the demand for money functions have been re-estimated by employing equity derivatives as proxy of financial innovation. This chapter attempts to investigate the role of total equity derivatives, equity futures, and equity options in a set of money demand functions. The demand for money functions have been estimated by ARDL bounds test and co-integration method.

Chapter-4 revisits the role equities (as financial assets) in the monetary transmission mechanism. In Chapter-5 an attempt is made to examine the role of equity derivatives in monetary transmission. Finally, chapter 6 summarizes and offers some concluding remarks. Each chapter reviews relevant literature and presents the methodology employed to achieve that objective. In the absence of any study examining the role of derivatives in monetary policy and in view of the ambiguous findings on role of asset prices in monetary transmission in the Indian context, the present study fills a major gap by examining the ole of equity derivatives in monetary transmission.

Chapter-II

Evolution of the Market for Derivatives: The Global and Indian Scenarios

2.1 Introduction

The market for derivatives gained momentum in the financial markets in general after the 1970s. Globally, the underlying factors for the growth in derivatives lied in the changing economic structure due to the collapse of Bretton Woods's arrangement, transition from fixed exchange regimes to floating exchange rates, oil price shock, debt crisis, and changes in monetary and fiscal policies leading to uncertainty in the economic systems. To hedge against these vulnerabilities, derivative markets played significant role in the financial markets. In addition, the speculative activity also grew in the market. The modern market in financial derivatives began in the year 1972 when the Chicago Mercantile Exchange (CME) started trading futures in seven currencies. The OPEC's 1973 reduction in the supply of oil was followed by high and variable oil prices. The interest rates in U.S. became more volatile following inflation and recessions in the 1970s. The market for natural gas deregulated gradually since 1978, resulting in a volatile market and the introduction of futures in 1990 and the deregulation of electricity began in the 1990s.

2.2 Evolution of Global Derivatives Market

The following table presents the summary of global derivatives market development since its beginning.

Table 2.1: Evolution of global market for derivatives: The Time Line

Period	Description
Around 1730	Dojima Rice Exchange was established in Japan, in Choaimai the first Rice futures market contract took place.
1865	Chicago Board Of Trade (CBOT) in small scale futures contracts on the exchange.
1874	Commodity Futures
1919	Chicago Mercantile Exchange established. Traded contracts with wide variety of commodities and later metal was introduced
1972	CME first Introduced the Futures on Financial Instruments. Seven currency futures contracts were launched.
1973	The popular paper by Black and Scholes on Derivatives established methodological support for pricing options and explained other economic functions of Derivatives markets. In the Chicago Board of Options Exchange (CBOE) Call Options started with 16 Stocks
1974	Chicago Board of Exchange Trading floor opened.
1975	CBOT launched futures on US Treasury Bonds
1977	CBOE floated Put Option
1981	CME Started Euro dollar futures contracts underlying on short term US$ Interest rates
1982	CBOT Introduced exchange traded option on Bond Futures. London International Financial Futures and Options Exchange (LIFFE) were formed in London. Philadelphia Stock Exchange (PHLX) was an innovator on Options On Currencies. PHLX promoted the Options on currencies World-wide.
1983	CBOE published Option Indices (Stock Market Index Like S& P 500)
1985	British Bank Association's (BBA) LICOM Agreement on standard terms, conditions, procedures for London OTC currency options Trading Revolution in OTC Forex Market.
1987	Over the counter (OTC) Compound and average Options.
1989	Qaunto options, Interest rate swaps on Futures
1990	Swaps on Equity Index
1996	Credit Default Swaps Market

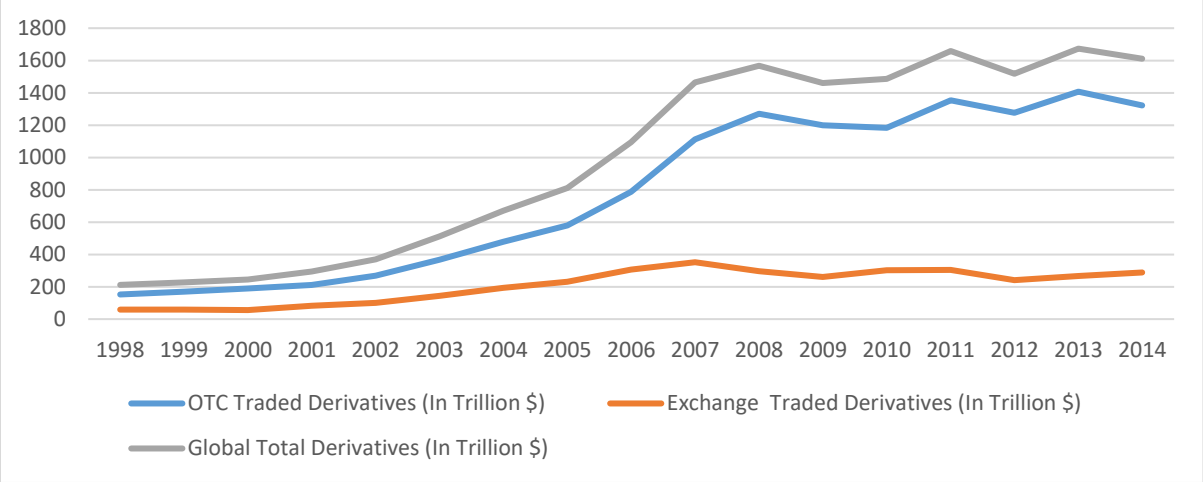
Source: CMIE

The derivatives market is broadly divided into exchange traded (ET) and over the counter exchange (OTC). González-Hermosillo (1994) has highlighted the basic differences between ET over OTC characteristics in the following way: Instruments are standardized, clearing housing to reduce counter party default, market supervision and regulation, trading platform and a variety of instruments traded.

2.3 Global Derivatives Market: Trends

The global derivatives trading in terms of notional amount was $211 trillion in 1998 [Fig. 2.1], then went up to $1673 trillion in 2013 and finally reached $1610 trillion in 2014. Its CAGR was 13.52% for the period of 1998 to 2014. It's seen that the OTC derivatives dominate in the global derivatives market. Its Notional amount was $152 trillion in 1998, $1407 trillion in 2013, and $ 1321trillion in 2014. The CAGR in this segment for the period 1998 to 2014 was 14.45%. Another important segment in the derivatives market is the Exchange Traded Derivatives. Their notional amount outstanding was $59 trillion in 1998, and it rapidly reached to $ 351 trillion in 2007. Its traded volume in 2014 was $288. Its CAGR was10.38% for the period 1998 to 2014 [Fig. 2.1].

Figure 2.1: Global Derivatives Market Turnover Volume (in trillion dollars)

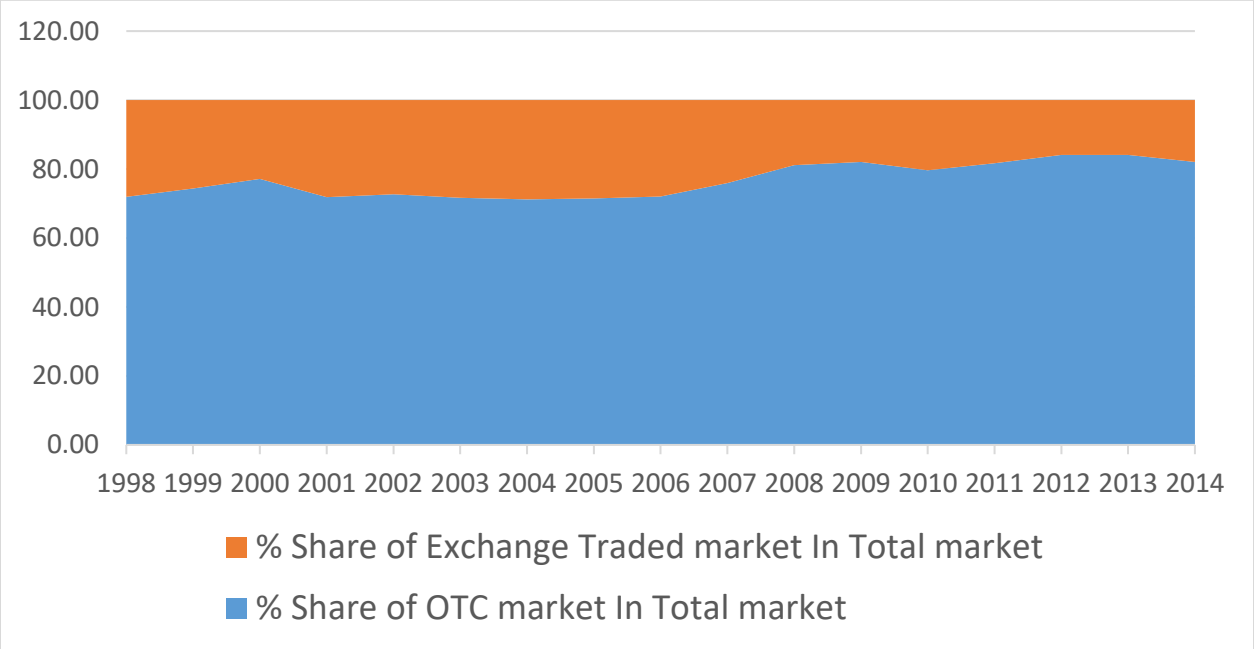


Source: BIS

2.3.1 Share of OTC and Exchange Traded Derivatives in Global Market (In Notional amounts)

The share of Exchange and OTC traded derivatives market in the total global derivatives market is shown in Fig. 2.2. The share of OTC market was 71.98% in 1998 and went up to 84.10% in 2012. Further, its share came down to 82.10% in 2014. The share of exchange traded derivatives market was 28.02% in 1998. It gradually lost its market share to OTC with 17.93% in 2014. The underlying reasons cited for an increased market share of OTC Derivatives is reported in O'CONNOR (2013), which explains it as the improved regulatory transparency in OTC market due to the use of central clearing houses reducing credit and counter party risk. Further, the dealers followed Universal central reporting system and dynamic margin system to mitigate the pro-cyclical problems.

Figure 2.2: Market Share of OTC and Exchange Traded Derivatives



Source: BIS

2.3.2 Global Derivatives Market and Global GDP

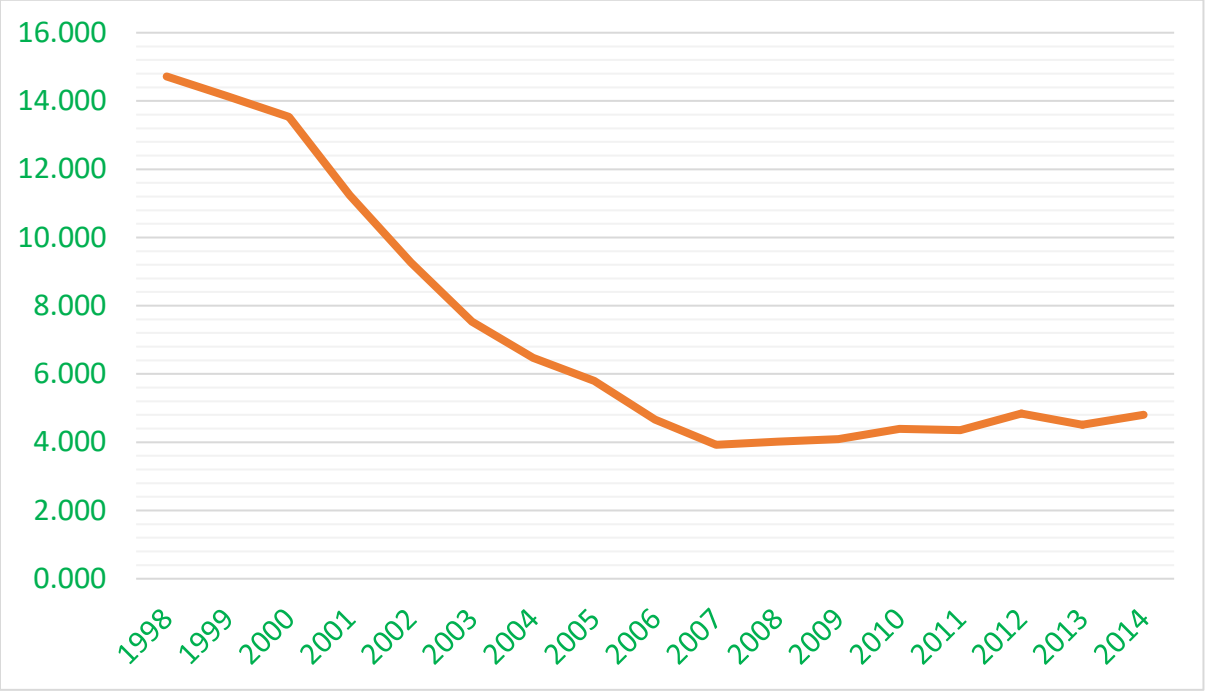
The CAGR of global derivatives has been 13.52% as compared to global GDP CAGR of 5.84% during the period 1998 - 2014. As shown in Table 2.2 figure 2.3, the global GDP to global total derivatives ratio declined over a period of 1998 to 2014. In 1998 it was 14.71% and then steeply declined to 3.92% in 2007. This indicates how speculative financialization of global GDP has triggered the great recession around the world. In 2014 it was 4.8%. Markose (2012) explains that size of off- balance sheet activities of financial firms and institutions has grown multiple times over its asset size. This has posed potential threat to derivatives' underlying instruments, which further weakened the financial stability of the financial market and this has transmitted to real economy. This also triggered the great recession around the world during 2008.

Table 2.2: Global GDP to Global Total Derivatives Market

Year	Global Total Derivatives (In Trillion $)	Global GDP (In $ trillion)	% Global GDP to Global Total Derivatives Market
1998	211.798	31.17	14.718
1999	228.067	32.24	14.135
2000	245.112	33.18	13.537
2001	293.464	32.97	11.236
2002	370.111	34.28	9.263
2003	511.749	38.56	7.534
2004	671.116	43.42	6.470
2005	810.376	47.02	5.802
2006	1093.831	50.97	4.660
2007	1463.937	57.46	3.925
2008	1567.045	63.00	4.020
2009	1459.868	59.71	4.090
2010	1486.486	65.21	4.387
2011	1658.416	72.19	4.353
2012	1518.508	73.48	4.839
2013	1673.410	75.47	4.510
2014	1610.069	77.30	4.801

Source: BIS, World Bank

Figure 2.3: Percentage of global GDP to global total derivatives market



Source: BIS

2.3.3 Stylized Facts on Over the Counter (OTC) Derivatives Market

Khader (2014) has defined the OTC Derivatives market as a trading activity that does not take place on a regulated exchange and the contracts in OTC are negotiated (or traded) in different ways. The OTC market is divided into two parts: the bilateral OTC market and the cleared OTC market. The major participants in the OTC market are Banks, multinational corporations, Insurance companies, Investment banks, brokers, dealers, clearing agents, Hedge funds, and many others various economic agents.

The expansion of global OTC Market over a period is seen as OTC derivatives segment dominating the market in the global derivatives market. According to BIS, OTC Derivative

market may be broadly divided into the following; i) Interest rate; ii) Forex; iii) Equity; iv) Commodities; v) Credit Default Swaps; vi) Unallocated Market.

To understand to Economic logic behind derivatives transmission, BIS publishing various reports on OTC derivatives market activity. The following are the highly used measurement method:-

1. The notional amount outstanding: "Nominal or notional amounts outstanding provide a measure of market size and a reference from which contractual payments are determined in derivatives markets. However, such amounts are not those truly at risk". It simply sums of all the contract positions, adjusted to double counting problem.

2. The Gross Market Values: "Gross market values are defined as the sums of the absolute values of all open contracts with either positive or negative replacement values evaluated at market prices prevailing at the reporting date".

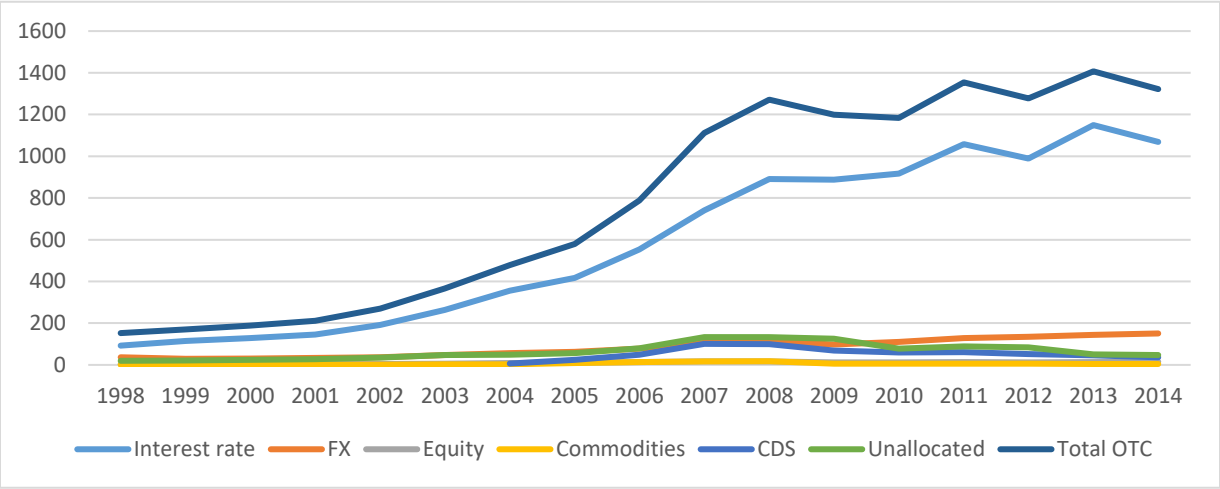
3. Gross Credit Exposure: This is the "gross market value minus amounts netted with the same counterparty across all risk categories under legally enforceable bilateral netting agreements. The gross credit exposure provides a measure of exposure to counterparty credit risk (before collateral)".

2.3.4 Growth in OTC Market

In order to explain the total OTC Market, Fig. 2.4., and the table 2.3 about Market Share show that the notional amount is $152 trillion in 1998, reached $1321 trillion in 2014. The CAGR for the period 1998 to 2014 is 14.45, and breakup of different market segments shows that interest rate derivatives market plays a dominant role in the overall market structure. Its size grew from $92 trillion in 1998 to $1068 trillion in 2014. Its market share is 60.59 in 1998, and it went up to 81.69 in 2013. It clearly explains the dominant position of interest derivatives in the market. In

this market interest rate swaps, forward rates, and options exist in the sub category. Interest rate swaps is the larger player in this market.

Figure 2.4: OTC Derivatives Market in Notional amount (In $ Trillion)



Source: BIS

Table 2.3: Share of different derivative in total OTC Derivative market (in %)

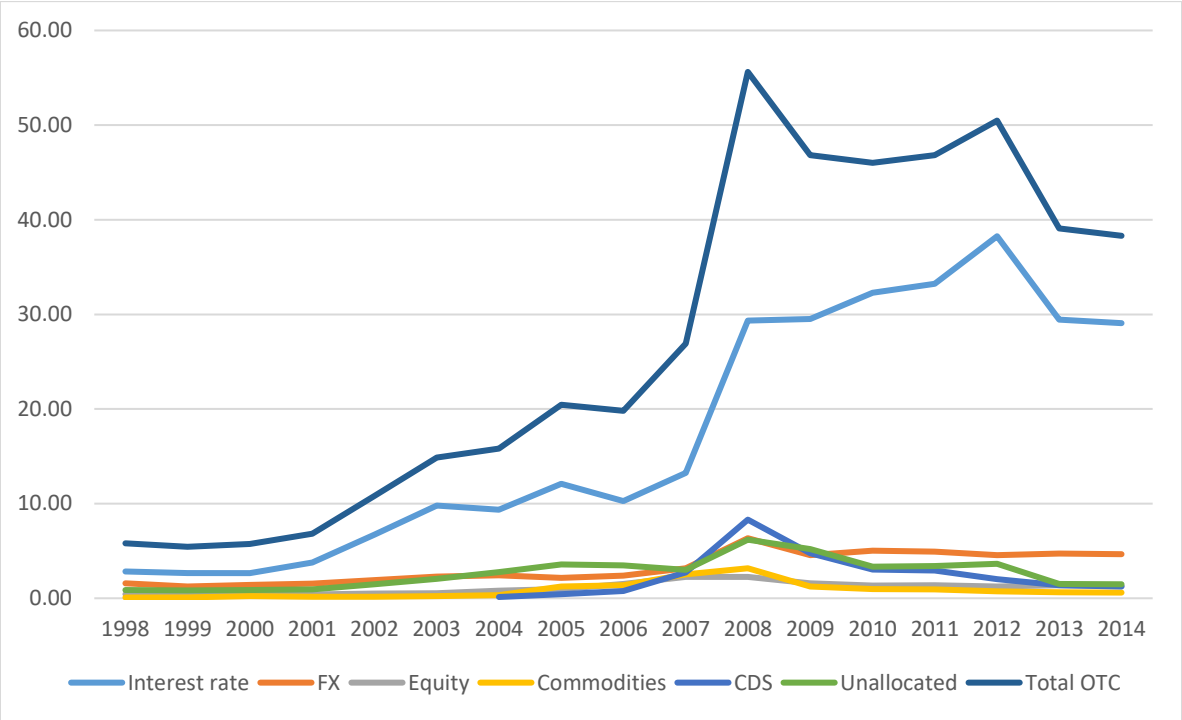
Year	Interest rate	FX	Equity	Commodities	CDS	Unallocated	Total
1998	60.59	24.09	1.81	0.57	-	12.93	100.00
1999	67.29	17.24	1.96	0.58	-	12.93	100.00
2000	68.08	16.47	1.87	0.64	-	12.94	100.00
2001	68.76	15.96	1.78	0.56	-	12.94	100.00
2002	71.19	13.57	1.68	0.63	-	12.94	100.00
2003	71.91	12.69	1.80	0.67	-	12.94	100.00
2004	74.30	11.78	1.86	0.57	1.34	10.15	100.00
2005	71.96	10.78	1.79	1.45	4.16	9.86	100.00
2006	70.29	9.95	1.81	1.71	6.22	10.02	100.00
2007	66.58	9.43	1.53	1.44	9.07	11.95	100.00
2008	70.12	8.89	1.31	1.39	7.81	10.48	100.00
2009	74.02	8.17	1.04	0.55	5.74	10.48	100.00
2010	77.47	9.37	1.00	0.49	5.08	6.58	100.00
2011	78.06	9.46	0.95	0.46	4.49	6.58	100.00
2012	77.43	10.50	0.98	0.44	4.07	6.58	100.00
2013	81.69	10.21	0.95	0.33	3.22	3.59	100.00
2014	80.86	11.40	1.14	0.31	2.71	3.59	100.00

Source: BIS

Another segment in this market is forex derivatives; its size grew from $36 trillion in 1998 to $150 trillion in 2014 with a CAGR of 9.22. But its market share declined to 11.40 in 2014 from 24.09. Credit default swaps (CDS) are the most import market innovation in the loan credit market. Its journey started with $6 trillion notional amount in 2004 and expanded up to $100 trillion within a short span period. This seems to have triggered the global financial crisis through the failure CDS market. The CAGR of this segment during 1998-2014 has been 18.82. Further, the Equity Derivatives market expanded from $2.7 trillion to $15 in the study period. Its CAGR has been 11.17. The last category is Unallocated OTC Derivatives, which includes foreign exchange, interest rate, equity, commodity and credit derivatives of non-reporting institutions, based on the latest Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity. Its market share was 12.93 in 1998 and gradually reduced to 3.59 in 2014. It is because of improvement in regulatory, technology, information transparency by major central banks, financial institutions, efforts of international agencies. Its Notional Value grew from $19 trillion to $47 trillion during 1998 -2014.

2.3.5 Stylized facts on Gross Market Value: Notional amounts of outstanding provide the method of measuring the Market size. But it lacks proving information on the size of the market risk, which is an important variable to know the direction of the concentration risk accumulation in the OTC derivatives market. Gross market value means the cost of replacing all the outstanding contracts at current market prices prevailing at the reporting date. It provides the possible risk exposure in the OTC derivatives market. It can be used as economic significance that can be comparable to market different products or with market microstructure.

Figure 2.5: OTC Derivatives Gross Market Value (in $ Trillion)



Source: BIS

The Fig.2.5. (and the table 2.4 about Market Share) shows that OTC Derivatives' Gross Market Value was $5.81 trillion in 1998, which reached $38.32 trillion in 2014. Among different market segments, interest rate derivatives market plays a dominant role in the overall market structure. The size of this market grew from $2.83 trillion in 1998 to $29.07 trillion in 2014. Its market share increased from 48.77 in 1998 to 75.86 during 1998-2013. The forex derivatives grew from $1.59 trillion in 1998 to $4.67 trillion in 2014, the CAGR being 6.98. But the market share declined to 12.18 in 2014. CDS are the most import market innovation in the loan credit market; its journey official started with $ 0.13 trillion in 2004. It expanded up to $ 8.31 trillion within a short span period, which has triggered the GFC around through the failure CDS market. In 2014 the gross market value is $ 4.67 trillion. Its CAGR is 24.89 over the study period of 1998 to 2014.

The Equity Derivatives market has expanded from $ 0.43 trillion to $ 1.29 in the 2014 period. Its CAGR is 7.19. The last category is Unallocated OTC Derivatives includes foreign exchange, interest rate, equity, commodity and credit derivatives of non-reporting institutions, based on the latest Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity. Its market share is 15.23 in 1998 and gradually reduced to 3.85 in 2014. It is because of improvement in regulatory, technology, information transparency by major central banks, financial institutions, efforts of international agencies. Its value was $ 0.885 trillion and $1.47 trillion respectively, in 1998 and 2014.

Table 2.4: Share of different derivative in total OTC Derivative Gross market value

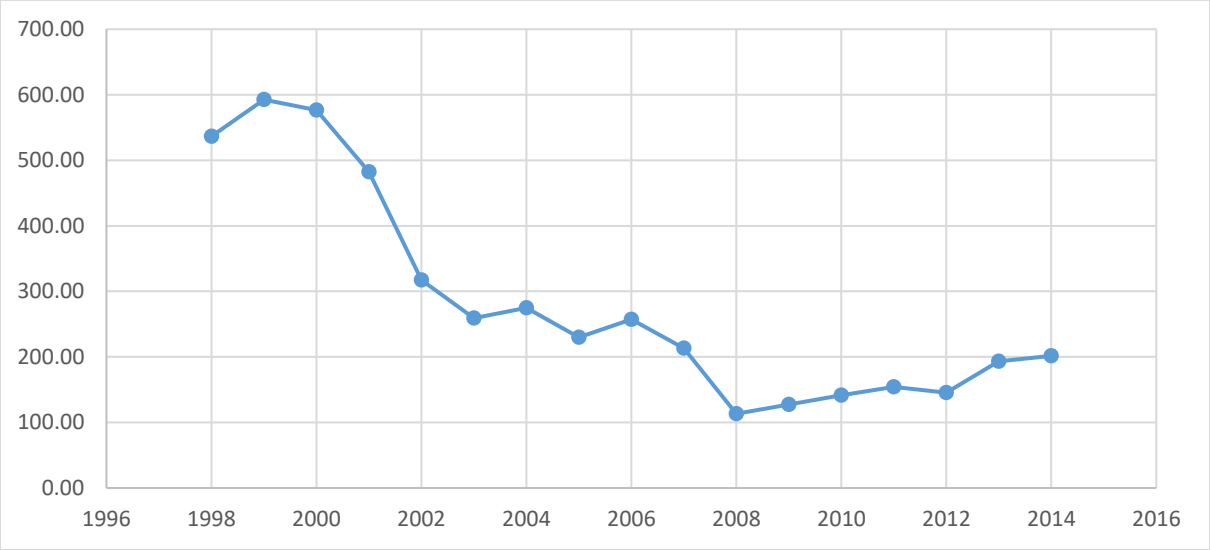
Year	Interest rate	FX	Equity	Commodities	CDS	Unallocated
1998	48.77	27.28	7.33	1.39		15.23
1999	48.90	22.87	11.10	1.91		15.23
2000	46.16	24.79	10.11	3.70		15.23
2001	55.36	22.71	5.92	2.32		13.69
2002	62.29	17.88	4.61	1.52		13.69
2003	65.75	15.44	3.59	1.53		13.69
2004	59.29	15.27	5.02	2.13	0.84	17.45
2005	59.17	10.46	4.72	6.10	2.11	17.45
2006	51.87	12.13	7.69	7.00	3.86	17.45
2007	49.18	11.71	8.39	9.41	10.18	11.13
2008	52.77	11.41	4.06	5.70	14.94	11.13
2009	62.98	9.69	3.39	2.62	10.19	11.13
2010	70.18	10.93	2.94	2.14	6.56	7.25
2011	71.03	10.53	2.94	2.00	6.26	7.25
2012	75.79	9.04	2.46	1.44	4.03	7.25
2013	75.35	12.06	3.56	1.66	3.53	3.85
2014	75.86	12.18	3.37	1.53	3.20	3.85

Source: BIS

2.3.6 Relation between OTC Derivatives Gross Market value and Global GDP

The CAGR of OTC derivatives Gross market value has grown 12.51 as compared to global GDP only grown at CAGR 5.84 during the period 1998 - 2014. As shown in the Table 2.5, figure 2.6, the % of global GDP to global OTC derivatives Gross market value continual decline over a period of 1998 to 2014. In 1998 it is 536% steeply decline to 113% in 2007. This indicates how speculative financialization of global GDP has triggered the great recession around the world. In 2014 it is 201%. It is clear that still we are on the dangerous side of the global economic development path as depicted in the above analysis.

Figure 2.6: % Global GDP to OTC Derivatives Gross Market Value



Source: BIS, World Bank

Table 2.5: Share of different derivative in total OTC Derivative (In gross market value)

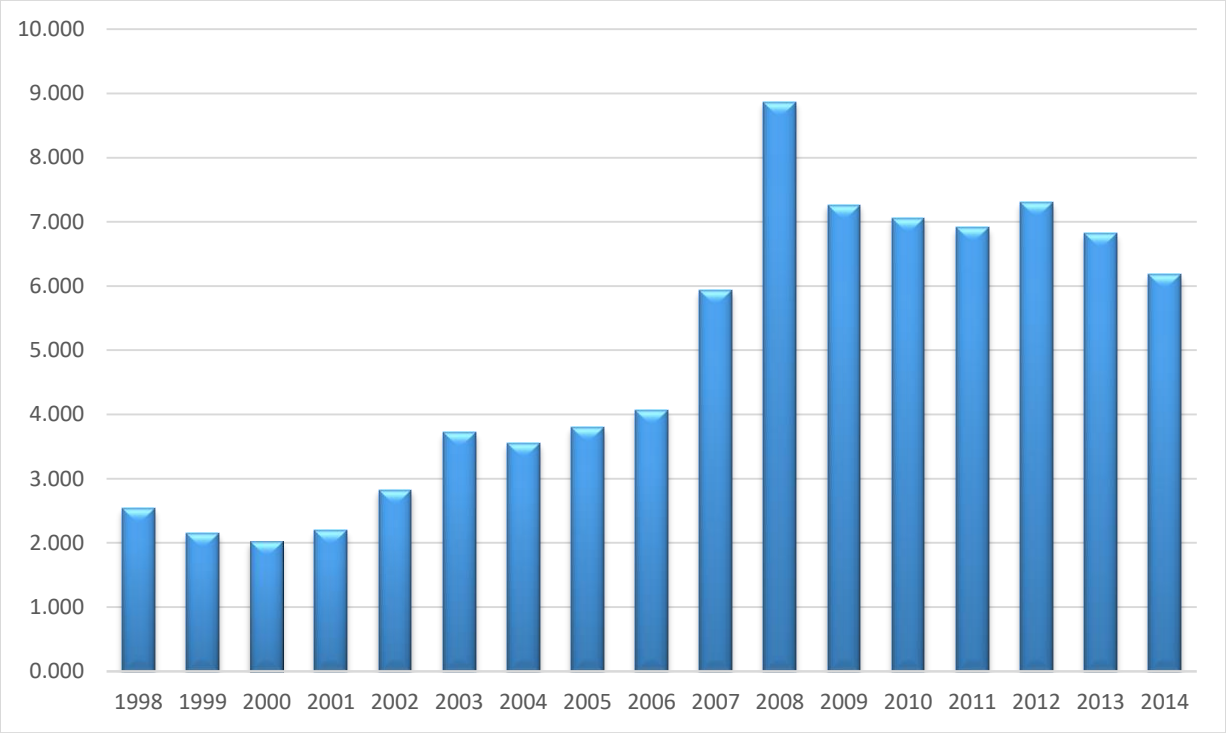
Year	OTC Gross Market Value (In $ trillion)	Global GDP (In $ trillion)	% Global GDP to OTC Derivatives Gross Market Value
1998	5.81	31.17	536.39
1999	5.44	32.24	592.52
2000	5.76	33.18	576.55
2001	6.83	32.97	482.52
2002	10.81	34.28	317.16
2003	14.88	38.56	259.06
2004	15.80	43.42	274.80
2005	20.44	47.02	229.99
2006	19.80	50.97	257.40
2007	26.92	57.46	213.43
2008	55.62	63.00	113.27
2009	46.84	59.71	127.48
2010	45.99	65.21	141.77
2011	46.81	72.19	154.22
2012	50.47	73.48	145.58
2013	39.07	75.47	193.17
2014	38.32	77.30	201.74
CAGR	12.51	5.84	

Source: BIS, World Bank

2.3.7 Gross Credit Exposure

The trends in the Gross Credit Exposure in the OTC Derivatives market at global level is presented in fig. 2.7. The Gross Credit Exposure was $ 2.53 trillion in 1998, and it steeply increased to $ 8.86 trillion in 2008. After the global financial crisis, it moderated to $ 6.18 trillion. According to Vause. N (2011), the large-scale total counterparty credit exposures passed over the total collateral posted by market participants; this systemic risk triggered the counter party risk fear in the OTC Derivatives market. This process created a havoc in financial market, and it led to the failure of financial Institutions like Lehman Brothers, AIG, etc. and finally to crisis.

Figure 2.7: Gross Credit Exposure ($ Trillions)



Source: BIS

2.3.8 Global Exchange Traded Derivatives Market

The International Swaps and Derivatives Association (ISDA) defines the exchange traded derivatives as the trades that are executed on the formal exchanges, standardised contracts, all trades through exchange clearing mechanism, compulsory margin requirement, and also trades that have to maintain with exchange initial and variable margins, daily settlement through mark to market and margin calls.

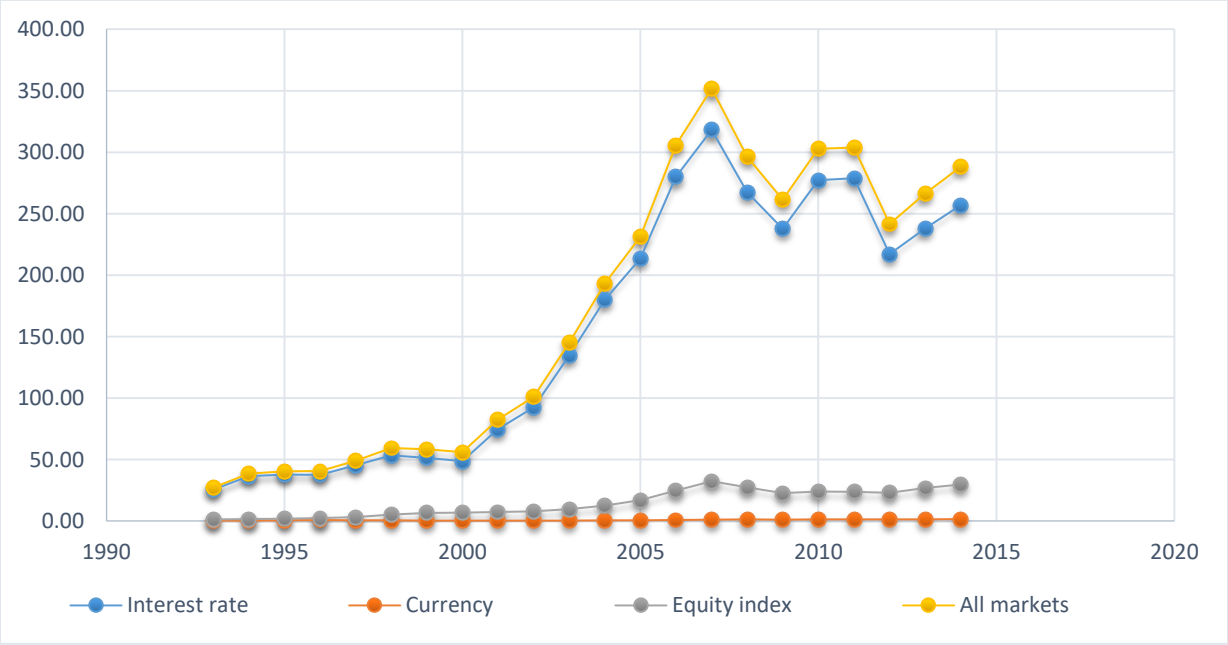
2.3.9 Exchange Derivatives

The Global Exchange Traded Derivatives [Fig 2.8.] has a CAGR 11.88 for the period 1993 to 2014. The notional amount outstanding grew from 27.29 $ trillion in 1993, to $ 288 trillion in

2014. The different assets in global exchange traded derivatives are interest rate, equity, and currency derivatives. Interest rate derivatives play a crucial role in the overall market size and operating in the market. Its size was $25.58 trillion in 1993, and went up to $ 318 trillion in 2007. Further, it reached $257 trillion in 2014. Its market share declined to 89.15 in 2014 from 93.73 in 1993.

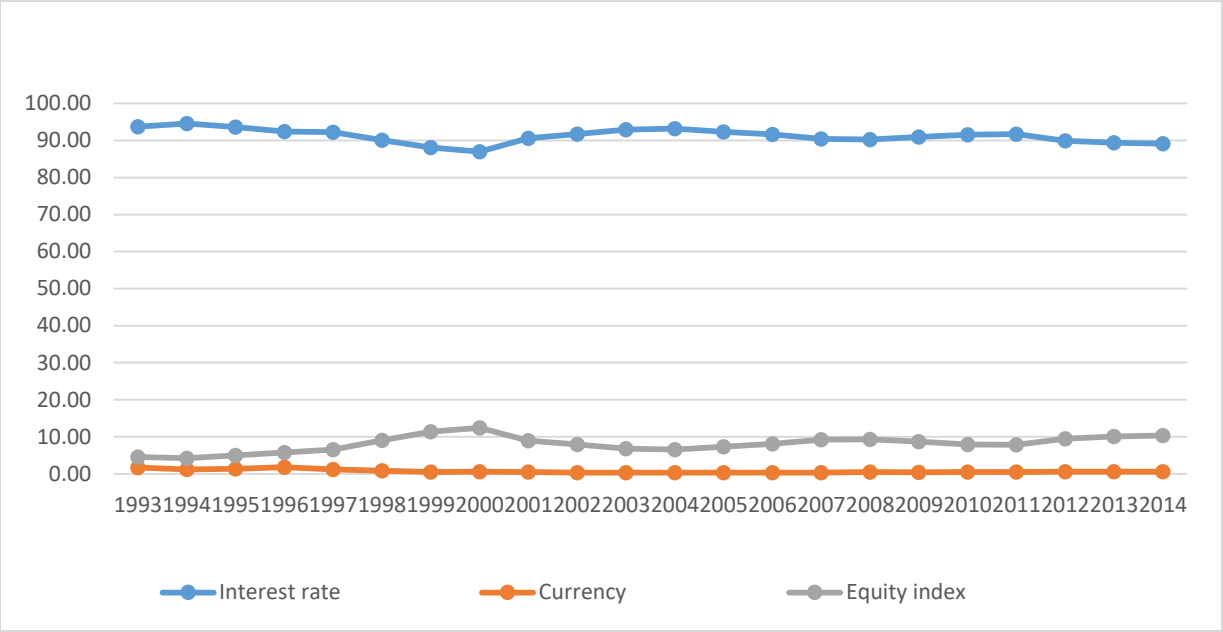
In this market one finds interest rate swaps, futures and options for short term and long term interest rates. The size of currency derivatives currency derivatives was $0.47 trillion in 1993 and increased to $1.57 trillion in 2014. Its market share declined during the same period. However, the equity derivatives market expanded from $ 1.24 trillion in 1993 to $ 29.71 in the 2014 period. The trends and shares of derivatives instruments broadly in futures and options market are given in figures 2.9 to 2.11. The options market seems to have taken over futures market in terms of market share.

Figure: 2.8 Global Exchange Traded Derivatives (In $ Trillion)



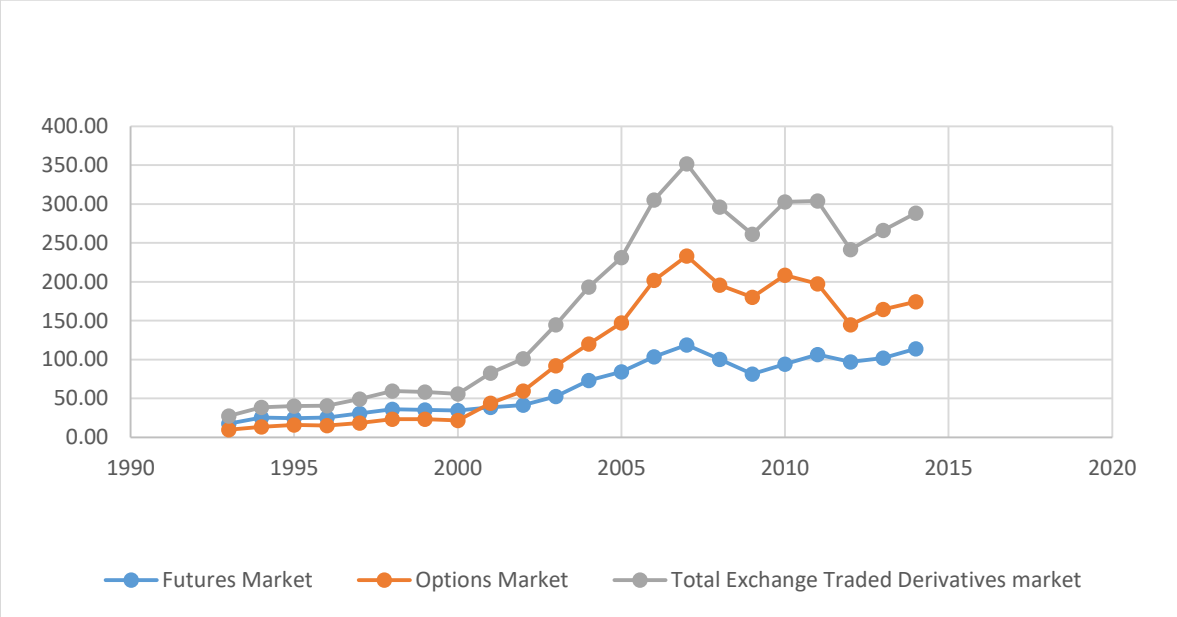
Source: BIS

Figure 2.9: Share of different segment derivative in total Exchange Traded Derivative market



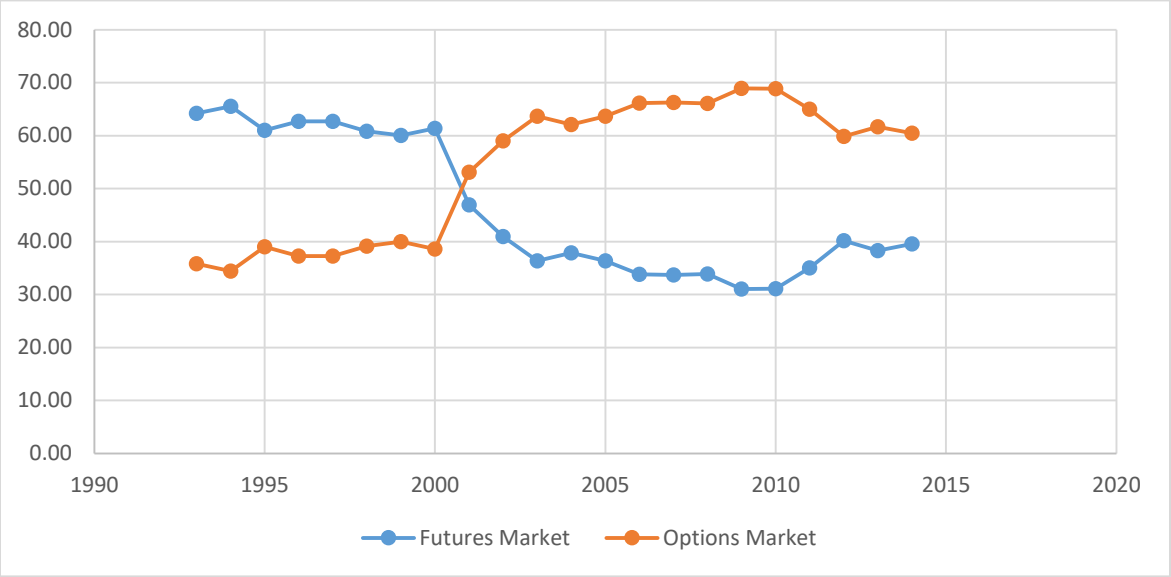
Source: BIS, World Bank

Figure 2.10: Future and Options Markets in Total Exchange Traded Derivatives Market (In $ Trillion)



Source: BIS

Figure 2.11: Share of Futures and Options in Total Exchange Traded Derivatives market



Source: BIS

2.4 Evolution of India Derivatives market

The Indian Financial Derivatives market is one of the fastest growing markets in the last decade in the last fifteen years, this market introduced a variety of products like equity, currency, interest rate derivatives both in Exchange traded as well as OTC markets. The historical evolution of the Indian financial derivatives market is presented below.

Table 2.6: Evolution of Derivatives Market in India

1980	OTC Currency forward market
1995	The prohibition on options in SCRA is removed in 1995. Foreign currency options in currency pairs other than Rupee were the first options permitted by RBI.
18 November 1996	Appoint of L.C Gupta committee, which developed a regulatory framework on trade and settlement of contracts. The focus was on equity derivatives.
1997	OTC Derivatives - Long Term Foreign Currency –Rupee Swaps
June 1998	Prof. J.R. Varma is setting up of a group to recommend measures for risk containment in the derivative market in India. SEBI
July 1999	OTC Derivatives – Interest Rate Swaps and Forward Rate Agreements
June 1999	Trading of Interest rate swaps and Forward Rate Agreements
December 1999	Derivatives were declared as securities under section 2(h) (iia) of the SCRA and suitable amendment in the notification issued by the Central Government in June 1969 under section 16 of the SCRA.
May 2000	SEBI gave approval to NSE, BSE for trading futures
June 2000	Index futures started in BSE, NSE
April 30, 2001	CCIL Incorporated as India's first clearing house for settlement of market trades in Government Securities and inter-bank foreign exchange transactions.
June 2001	Index Options started in BSE, NSE
July 2001	Single Stock Options Started in BSE, NSE
Nov 2001	Single Stock Futures Started in NSE
Nov 2001	Single Stock Futures Started in BSE
June 2003	Interest Rate Futures in NSE
July 2003	OTC Derivatives- Foreign Currency Rupee Options

August 30, 2007	CCIL's reporting platform for the transactions in OTC Interest Rate Derivatives (Interest Rate Swaps and Forward Rate Agreements (IRS/FRA)) became operational.
August 2007	CCIL has running a trade repository for the OTC Interest Rate Swaps (IRS) and Forward Rate Agreements (FRA) for Market Makers
29th August 2008	First Currency Futures Product Launched on NSE
OCT 2008	BSE Currency Derivatives Started Operation and then due poor response relaunched on Nov 2013
OCT 2008	Metropolitan Stock Exchange of India Ltd. Limited (MSEI) formerly MCX-SX is started Currency Futures
November 27, 2008	CCIL commenced Non- Guaranteed Settlement of OTC Trades in Rupee Derivatives through RTGS (MNSB).
Aug 2009	Relaunch of Interest Rate Futures
Sep 2010	United Stock Exchange Started Operation on Currency Futures
October 29, 2010	Starting at Currency Options in NSE
Apr 2011	United Stock Exchange Started Operation on Currency Options
July 28, 2011	CCIL on July 28, 2011, successfully carried out a Portfolio Compression exercise in the OTC Interest Rate Swaps market.
July 9, 2012	Trade Repository service for OTC Foreign Exchange Derivatives started.
Aug 2012	Metropolitan Stock Exchange of India Ltd. Limited (MSEI) formerly MCX-SX is started Currency Options
November 5, 2012	Launch of Phase II of the Reporting Platform for Inter-bank OTC Forex Derivatives.
Jan 2014	BSE launched of Interest Rate Futures

Source: BSE, NSE, MCX-SX, CCIL, SEBI

2.4.1 Trading Financial Derivatives Markets

In India, financial derivatives market is classified into exchange traded and over the counter exchange market trading (OTC) platforms. In the exchange traded segment we have four major Exchanges offering the products, namely, National Stock Exchange (NSE), Bombay Stock Exchange (BSE), United Stock Exchange (USE), Metropolitan Stock Exchange of India Ltd.

Limited (MSEI) formerly MCX-SX. In the OTC segment Clearing Corporation of India Ltd (CCIL), offering the Platform for trading and clearing contacts in the market. Table 2.7 presents the products offered by the various exchanges

Table 2.7: Products offered by the various exchanges in India

Name of the Exchange	Products offering
National Stock Exchange	**Equity Derivatives** – Index Futures, Stock Futures, Index Options, Stock Options. **Currency Derivatives** – Currency Futures and Options. **NSE Bond Futures** – Short and Long Interest Rate Futures
Bombay Stock Exchange	**Equity Derivatives** – Index Futures, Stock Futures, Index Options, Stock Options. **Currency Derivatives** – Currency Futures and Options. **Interest Rate Derivatives** - 91-day Government of India Treasury Bill Futures, ten year Government of India Security Futures.
Metropolitan Stock Exchange of India Limited (MSEI)	**Currency Derivatives** – Currency Futures and Options. **Equity Derivatives** – Index and Stock Futures, Index and Stock Options. **Interest Rate Derivatives-** 10 year Government of India Security Futures
United Stock Exchange (USE)	**Currency Derivatives** – Currency Futures and Options. Note: Dec 2014 On wards stopped Trading In this Exchange.
OTC segment Clearing Corporation of India Ltd (CCIL)	**Interest Rate Derivatives –** Forward Rate Agreement, Interest Rate Swaps **Currency Derivatives** – Currency Forward Agreements

Source: BSE, NSE, USE, CCIL, MSEI, SEBI

2.5 Indian Financial Derivatives Market: An Overview

2.5.1 Product wise Derivatives Trading:

The different segments in this market refer to Equity, Currency, and Interest Rate Derivatives. The trends and share of various products are presented in the table 2.8. The CAGR of derivatives

has been 105.06 for the period of 2000 to 2014. The notional amount was Rs.0.04 Trillion in 2000, and increased to Rs.938.58 trillion in 2014. When it comes to the different asset class, the Indian market has equity, currency, and interest rate derivatives. Equity Derivatives grew with a CAGR of 101.99 during 2000 to 2014. It started with in 2000 is Rs.0.04 Trillion Notional amount, Over a period reached to Rs.759.69 in 2014.Its Market share is 2002 is 78.21 at the end of the period of study in 2014 is 80.94. It clearly explains to us that In Indian Financial Derivatives market Equity Derivatives is the dominant position as contrary to global derivatives market where Interest Rate is the major share in the market as shown section global derivatives analysis in this chapter.

Next segment in this market is currency derivatives; its market size a Rs.1.22 trillion in 2002, and it went up to Rs.249.23 trillion in 2011 and end study period it went down to Rs.152.65 trillion in 2014. CAGR for the period 2002 to 2014 is 49.50. Its market share is 21.69 in 2002, and it went up to 41.86 in 2011 and gradually down to 16.26 in 2014. Its Market shares lost to Equity derivatives market. Next segment Interest rate derivatives play size Rs.49.75 trillion in 2007 and it went down the end of the study period is Rs.26.23 trillion in 2014. CAGR for the period 2007 to 2014 is Negative 8.74. Its market share is 22.93 in 2007 and it down up to 2.79 in 2014.It clearly explains to us that lost to market share to equity and currency Markets.

Table 2.8: Derivatives Trading (Notional volume in Trillions Rupees)

Derivatives Trading (Notional volume in Trillions Rupees)												
Year	Equity			Currency			Interest Rate			Total		
	Exchange Traded	OTC	Total	Exchange Traded	OTC	Total	Exchange Traded	OTC	Total	Exchange Traded	OTC	Total
2000	0.04		0.04							0.04		0.04
2001	1.04		1.04							1.04		1.04
2002	4.42		4.42		1.22	1.22				4.42	1.22	5.65
2003	23.63		23.63		6.27	6.27				23.63	6.27	29.90
2004	23.43		23.43		8.36	8.36				23.43	8.36	31.79
2005	48.24		48.24		10.74	10.74				48.24	10.74	58.98
2006	74.15		74.15		15.52	15.52				74.15	15.52	89.67
2007	133.33		133.33		33.68	33.68		49.75	49.75	133.33	83.43	216.76
2008	110.22		110.22	3.12	50.35	53.48		32.90	32.90	113.35	83.26	196.60
2009	176.64		176.64	37.27	69.72	107.00	0.03	15.11	15.14	213.94	84.83	298.78
2010	292.48		292.48	82.32	126.38	208.70	0.00	23.97	23.97	374.80	150.35	525.15
2011	321.58		321.58	98.97	150.26	249.23	0.04	24.53	24.57	420.59	174.79	595.38
2012	387.04		387.04	87.11	146.59	233.69	0.00	20.23	20.23	474.14	166.81	640.96
2013	475.73		475.73	69.81	128.06	197.87	0.40	22.98	23.38	545.94	151.04	696.98
2014	759.69		759.69	56.35	96.31	152.65	4.74	21.49	26.23	820.78	117.80	938.58
CAGR	**101.99**		**101.99**	**61.95**	**43.87**	**49.50**	**175.69**	**-11.30**	**-8.74**	**103.11**	**46.30**	**105.06**

Source: SEBI

2.5.2 Exchange Traded Vs OTC Markets

When it comes to the different market platforms within the financial derivatives market, Indian exchange traded and OTC markets are showing that the trading services are the economic agents. The Tables 2.8 provide the total financial derivatives market between exchanges traded and OTC. Exchange traded market Notional amount is Rs.0.04 Trillion in 2000, and its Notional

amount went up to Rs.820.78 Trillion in 2014. CAGR for the period 2000 to 2014 is 103.11. Its market share is 87.45 in 2014. OTC market CAGR is 46.30 and its Notional amount is Rs.1.22 in 2002, and it went up to Rs.174.79 Trillion in 2011, at the end of the period down to Rs.117.80 Trillion in 2014. Its Market Share is 12.55 in 2014. Next, we turn to Product market trading these two platforms. In Equity Derivatives markets 100% market share by the exchange traded market platform.

When it comes to Currency derivatives, OTC Notional amount is Rs. 1.22 Trillion in 2002 it raised up to 150.26 in 2011 and gone down to 93.31 in 2014, its CAGR for the period of 2002 to 2014 is 43.87, and its market share is 63.09 in 2014. Currency Derivatives Exchange Traded Notional amount is Rs. 3.12 Trillion in 2008 and it reached to Rs. 98.97 Trillion in 2011and it went down to Rs.56.35 Trillion. Its CAGR is 61.95 for the period of 2008 to 2014.its market share is 36.91 in 2014. From the above analysis of the currency derivatives market, the OTC market is playing the major role in the financial market sphere. Next segment is Interest Rate Derivatives, OTC segment market CAGR for the period of 2007 to 2014 is negative 11.30 and its notional amount is Rs.49.75 Trillion in 2007 and went down to Rs.21.49 Trillion in 2014, its market share is 81.94 in 2014. In exchange-traded segment marker Notional amount is Rs.0.03 Trillion in 2009, and then the market has picked up in 2014 to the Notional amount of Rs.4.74 Trillion, its market share is 18.06 in 2014.

The overall conclusion from the above analysis explains to us that Indian financial derivative market trading through Exchange market, but in global derivative market position is opposite, it means OTC Market plays the dominant position in the market Microstructure. The majority of analyst's opinion that the prominent role of the OTC market, triggering global financial Crisis (GFC), which through Credit Default Swaps and it has transmitted to the other segments in the

OTC market, and it has spread to the capital markets within a short span of time. In India, we have the majority of Trading on financial derivatives taking place on exchange trading platforms, and we have proper regulation placed on these markets, which helped Indian Financial markets compared to the global counterparts during the GFC Period.

2.5.3 Exchange wise Trading of Financial Derivatives

Table 2.9: Exchange wise trade (Notional amount in Trillions Rupees)

Year	NSE	BSE	MSEI	USE	OTC	Total
2000	0.024	0.017				0.040
2001	1.019	0.019				1.039
2002	4.399	0.025			1.225	5.648
2003	21.304	0.121			6.267	27.692
2004	25.470	0.161			8.359	33.990
2005	48.242	0.000			10.737	58.979
2006	73.563	0.590			15.519	89.672
2007	130.905	2.423			83.430	216.758
2008	111.730	0.126	1.488		83.256	196.601
2009	194.492	0.002	19.447		84.835	298.776
2010	325.273	0.002	41.940	7.585	150.353	525.152
2011	360.287	8.081	37.324	14.896	174.791	595.380
2012	368.075	71.625	33.112	1.329	166.815	640.956
2013	422.519	94.663	25.743	3.016	151.043	696.984
2014	590.519	223.132	6.603	0.522	117.801	938.577
CAGR	106.11	97.09	28.19	-48.78	46.30	105.06

Source: SEBI

Table 2.10: Share of Exchange wise trading (in %)

Year	NSE	BSE	MSEI	USE	OTC	Total
2000	58.57	41.43				100.00
2001	98.15	1.85				100.00
2002	77.87	0.44			21.69	100.00
2003	76.93	0.44			22.63	100.00
2004	74.93	0.47			24.59	100.00
2005	81.80	0.00			18.20	100.00
2006	82.04	0.66			17.31	100.00
2007	60.39	1.12			38.49	100.00
2008	56.83	0.06	0.76		42.35	100.00
2009	65.10	0.00	6.51		28.39	100.00
2010	61.94	0.00	7.99	1.44	28.63	100.00
2011	60.51	1.36	6.27	2.50	29.36	100.00
2012	57.43	11.17	5.17	0.21	26.03	100.00
2013	60.62	13.58	3.69	0.43	21.67	100.00
2014	62.92	23.77	0.70	0.06	12.55	100.00

Source: SEBI

Exchange wise trading of Financial Derivatives table reveals that NSE is the leader in the market. The tables 2.9 and 2.10 shows that, NSE financial derivatives Notional Volume in 2000 is Rs.0.024 Trillion over a period, it went to Rs.590.519 Trillion in 2014. It's CAGR for the period 2000 to 2014 is 106.11. Its Market Share is 58.57 in 2000 and over period its market fluctuated, settled around 60.92. Next Exchange is BSE, its financial derivatives Notional Volume between 2000 and 2014 is Rs. 0.017 and Rs.223.132 Trillion. It's CAGR for the period 2000 to 2014 is 97.09. Its market Share is 41.43 in 2000, and it went down to 23.77 in 2014. MSEI and USE marginal player in this market. Alternative to this market exchange platform, OTC is most popular in the financial derivatives market segment. OTC Notional Volume in 2002 is 1.225 Trillion it went to 117.801 Trillion in 2014. It's CAGR for the period 2002 to 2014 is 46.30. Its market share is 21.69 in 2002, and fluctuated over a period, and it went down to 12.55 in 2014, due to more trading taking place in the exchange market platforms and other regulatory issues.

2.5.4 Product, Exchange wise Trading of Financial Derivatives

2.5.4.1 Equity Derivatives

Table 2.11: Equity Derivatives Exchange- wise Notional Volume (In Trillions Rupees)

Year	NSE	BSE	MSEI	Total
2000	0.024	0.017	0.000	0.04
2001	1.019	0.019	0.000	1.04
2002	4.399	0.025	0.000	4.42
2003	21.304	0.121	0.000	21.43
2004	25.470	0.161	0.000	25.63
2005	48.242	0.000	0.000	48.24
2006	73.563	0.590	0.000	74.15
2007	130.905	2.423	0.000	133.33
2008	110.105	0.118	0.000	110.22
2009	176.637	0.002	0.000	176.64
2010	292.482	0.002	0.000	292.48
2011	313.497	8.081	0.000	321.58
2012	315.330	71.625	0.080	387.04
2013	382.092	92.194	1.447	475.73
2014	556.065	203.627	0.001	759.69
CAGR	**105.23**	**95.80**		

Source: SEBI

Table 2.12: Market Share (%)

Year	NSE	BSE	MSEI
2000	58.57	41.43	0.00
2001	98.15	1.85	0.00
2002	99.44	0.56	0.00
2003	99.44	0.56	0.00
2004	99.37	0.63	0.00
2005	100.00	0.00	0.00
2006	99.20	0.80	0.00
2007	98.18	1.82	0.00
2008	99.89	0.11	0.00
2009	100.00	0.00	0.00
2010	100.00	0.00	0.00
2011	97.49	2.51	0.00
2012	81.47	18.51	0.02
2013	80.32	19.38	0.30
2014	73.20	26.80	0.00

Source: SEBI

Exchange wise trading of Equity Derivatives table reveals that NSE is the leader in the market. The Tables 2.11 and 2.12 shows that NSE Equity derivatives Notional Volume in 2000 is Rs.0.024 Trillion over a period; it went to Rs.556.065 Trillion in 2014. It's CAGR for the period 2000 to 2014 is 105.23. Its Market Share is 58.57 in 2000 and over period its market fluctuated, settled around 73.20. Next Exchange BSE, its equity derivatives Notional Volume between 2000 and 2014 is Rs. 0.017 and Rs.203.627 Trillion. It's CAGR for the period 2000 to 2014 is 95.80. Its market Share is 41.43 in 2000, and it went down to 26.80 in 2014. MSEI marginal player in this market.

2.5.4.2 Currency Derivatives

Table 2.13: Currency Derivatives Exchange Wise Notional Volume (In Trillions Rupees)

Year	OTC	NSE	MSEI	USE	BSE	Total
2002	1.22					1.22
2003	6.27					6.27
2004	8.36					8.36
2005	10.74					10.74
2006	15.52					15.52
2007	33.68					33.68
2008	50.35	1.63	1.49	0.00	0.01	53.48
2009	69.72	17.83	19.45	0.00	0.00	107.00
2010	126.38	32.79	41.94	7.59	0.00	208.70
2011	150.26	46.75	37.32	14.90	0.00	249.23
2012	146.59	52.74	33.03	1.33	0.00	233.69
2013	128.06	40.13	24.22	3.02	2.44	197.87
2014	96.31	30.24	6.50	0.52	19.09	152.65

Source: SEBI

Table 2.14: Market Share (%)

Year	OTC	NSE	MSEI	USE	BSE
2002	100.00				
2003	100.00				
2004	100.00				
2005	100.00				
2006	100.00				
2007	100.00				
2008	94.16	3.04	2.78		0.02
2009	65.16	16.66	18.17		0.00
2010	60.56	15.71	20.10	3.63	0.00
2011	60.29	18.76	14.98	5.98	0.00
2012	62.73	22.57	14.13	0.57	0.00
2013	64.72	20.28	12.24	1.52	1.23
2014	63.09	19.81	4.26	0.34	12.50

Source: SEBI

Exchange wise trading of Currency Derivatives table [2.13] reveals that OTC is the leader in the market. Table 2.13 and Table 2.14 provides analytical evidence. Consider the OTC Currency derivatives Notional Volume in 2002 is Rs. 1.22 Trillion over a period, it went to Rs.96.31 Trillion in 2014. It's CAGR for the period 2002 to 2014 is 43.87. Its Market Share is 100% in 2002 and over period its market declined due to the entry of new currency derivatives trading exchanges like NSE, BSE, MSEI, and USE. Still, it is the dominant market player and settled around 63.09 shares.

Next Exchange is NSE, its Currency derivatives Notional Volume between 2008 and 2014 is Rs. 1.63 and Rs.30.24 Trillion. It’s CAGR for the period 2008 to 2014 is 62.78. Its market Share is 3.04 in 2008, and it went up to 19.81 in 2014. MSEI one of the player in this market, its Currency derivatives Notional Volume is Rs. 1.49 in 2008 and it went up to Rs.41.94 Trillion; it came down to Rs. 6.5 Trillion in 2014. It's CAGR for the period 2008 to 2014 is 27.85. Its market Share is 2.78 in 2008, and it went up to 20.10 in 2010, it lost market share to other market players

at the end of 2014 market share is 4.26. USE is a small player, and recently it shut its operations. BSE started its operation in 2008, but 2013 onwards only its market picks up, and its Notional volume in Rs. 19.09 Trillion, its market share is 12.5%.

2.6 Conclusion

This chapter presents the global and Indian scenarios of the derivatives market. It has also traced the historical evolution over a long period of time. The general trends of global derivatives from 1998 to 2014 in exchange traded and OTC markets in brief are as follows. The OTC market share was 71.98 in 1998 the same increased to 82.10 in 2014.The exchange traded derivatives market share was 28.02% in 1998 which gradually lost market share to OTC The % of global GDP to total global derivatives continually declined over a period of 1998 to 2014. In 1998 it was 14.71 and it steeply declined to 3.92 in 2007 and further to 4.8 in 2014. Interest rate derivatives enjoyed the major market share in both OTC and ET platforms followed by forex, equity, and other derivatives. The Indian financial derivatives market has been one of the fastest growing markets in the world in the last decade. In the last fifteen years, this market has introduced a variety of products such as equity, currency, and interest rate derivatives both in Exchange traded as well as OTC markets. The Indian Exchange traded market share is higher that the OTC markets. Looking at the market product wise, one finds equity market to have had more share than the interest rate derivatives markets as compared to the global markets. The above analysis reveals that, in India equity derivatives play a prominent role. Based on the above trends in the Indian derivative market, the present study attempts testing the impact of financial innovation (taking equity derivatives as proxy of financial innovation) on monetary policy transmission mechanism in India.

Chapter - III

Financial Innovation and Stability of Money Demand Function in India: Role of Equity Derivatives

3.1 Introduction

Estimation of a standard demand for money function involves the inclusion of a scale variable like income and an opportunity cost variable like interest rate. In the advent of financial innovations in different dimensions such as new assets/instruments, new services, new payment systems etc. in the emerging market economies, the demand for money functions have been re-estimated by scholars employing variables that proxy financial innovation. This paper attempts to examine the stability of money demand functions including some derivative variables that represent the ensuing financial innovation process in India since the year 2000.

In a classic paper dealing with asset prices and money demand, Friedman (1988) dealt with money and stock prices by laying down the logic underlying the money-stock price relationship. The two channels discussed by Friedman (1988) refer to the wealth (positive) effect and substitution (negative) effect. First, higher stock prices lead to a higher nominal wealth and higher wealth/income ratio, which in turn is reflected in higher money/income ratio. Thus, part of the increased demand for money is attributed to higher demand for transactions caused by higher asset prices and higher rupee volume of transactions. Another part of this wealth effect induces people to park some money in liquid instruments. On the other hand, the substitution effect works like the following. A rise in real stock prices works as an incentive for economic agents to switch from

money to equities. The relative strength of the wealth effects and the substitution effect rests on empirics. A good number of studies support this argument of wealth and substitution effects[1]. The said money-stock price relationship and the underlying channels could be extended to the newer assets like the derivative class of assets including equity derivatives, futures, and options etc.

With regard to derivatives, a recent study by Bank of Italy (1995) observes that derivatives increase liquidity and substitutability in the market and help speed up the monetary transmission mechanism. To quote Greenspan (2003), "….However, in the past two decades, what constitutes money has been obscured by the introduction of technologies that have facilitated the proliferation of financial products and have altered the empirical relationship between economic activity and what we define as money, and in doing so has inhibited the keying of monetary policy to the control of the measured money stock". Butler (2013) argues that there is a clear cut impact of derivatives on the macroeconomic performance. To quote Butler (2013), "…hedging with derivatives can make spending decisions of agents less sensitive to equity prices via the Tobin's q mechanism". Driffill, *et al*. (2006) are of the view that futures market play a role in financial stability, which is one of the goals of central banks while formulating monetary policy.

The rest of the paper is organized as follows. Section 2 presents a select review of the major and relevant literature relating to this paper. Section 3 presents the models with empirical details. The data and method are briefly discussed in section 4. Section 5 reports a discussion of the empirical results and the last section offers some concluding remarks.

[1] Ireland (1995) Fase &Winder (1998), Dow & Elmendorf (1998), Mishkin (1996) Reynard (2004),Choi and Cook (2007), Hsing (2007), Noyer (2007) Boone & Van den Noord (2008), Singh, Razi, Endut, & Ramlee (2008) Mehrotra & Ponomarenko (2010), Hall, Swamy & Tavlas (2012)

3.2 A Brief Review of Past Studies

This section presents some major past studies both in the global and Indian context, though not exhaustive. Friedman (1988) in a seminal paper explores the role of stock prices in the macro-money demand function for the USA for the period 1961-1986. Use of quarterly data by the author renders evidence in favour of both wealth and substitution effects for the full sample with different sub-samples. Adam (1991) presents that financial innovation in UK economy has had substantial impact on the demand for money function. Yi (1993) analyzes the pre and post reform demand for money function in the Chinese economy. The intent of this paper is to know the changing demand for money function with economic reforms. The results indicate that the monetization process has had an important contribution to the demand for money function. He has also found that nature of demand for money function changes with structural changes of the Chinese economy. Thorton (1998) in his study evaluates demand for money with the inclusion of stock price for Germany. The study finds wealth effect with stock prices. Conte and Oldani (2004), explore the role of equity futures in the demand for money function for the USA. The main aim of this paper is to check for stability of demand for money function using equity futures as one of the major determinants. The paper finds wealth effect with futures. Baharumshah et al. (2009) analyse Chinese demand for money function with asset price as an additional determinant of demand for money. The inclusion of stock prices yields wealth effect meaning a positive association between M2 and stock prices. The conclusion of the paper is that from the policy point of view, exclusion of stock price and foreign interest rates in the demand for money function leads to ambiguous results. Avouyi et al. (2011) examine demand for money for the Euro area. The main focus of this paper is to know stability of demand for money, and another important aspect is inclusion of financial asset (equity prices) in the demand for money model. The results yield the asset price augmented version of

demand for money to have better stability compared to traditional formulations of demand for money. They also find substitution effect *i.e*. inverse association between financial asset and money holding, which is in line with Friedman's (1988) views.

In the Indian context, Paul (1992) evaluates demand for money with stock market capitalization for India. The paper finds wealth effect in quarterly data and substitution effect in annual data. Joshi and Saggar (1995) study the stability of Indian demand for money function with an inclusion of market capitalization as a proxy for the financial asset and find financial assets to have had a significant effect on stability of demand for money in India. Singh and Pandey (2010) trace out the demand for money in the post reform period and they find the money demand function to be unstable in India. Giri and Kamaiah (2011) in their study examine the demand for money for India with stock market capitalization, call Money, and variability of rate of inflation (VRI). The cointegration results confirm demand for money having long run, positive and significant relation with market capitalization, i.e. wealth/transaction effect. VRI carries a positive coefficient and confirms the evidence for precautionary demand for money holding. In view of the above review of some major past studies, the present study attempts to fill the gap in the Indian context by evaluating the money demand functions including derivatives as proxy for financial innovation. Derivative trading were introduced in the Indian financial markets in the year 2000 with index futures S&P CNX NIFTY.

It's evident from the review above no study has examined the role of derivatives as proxy of financial innovation in the money demand functions in India and the underlying stability properties of such money demand functions. This paper attempts to fill this gap in the Indian literature.

3.3 Money Demand Specification with Derivatives

In the literature one finds the scale variables like income and wealth to be positive and interest rate as an opportunity cost of holding money balances to be negative in the money demand functions. Knell and Stix (2003) present a meta-analysis of demand for money functions and a brief review of issues underlying money demand specification and estimation.

The Standard semi- log linear form of demand for money function usually estimated is given as the following,

$$\ln(m)_t = \beta_0 + \beta_1 \ln(y_t) + \beta_2 i_t + \beta_3 \pi_t + \varepsilon_t \qquad (3.1)$$

Where m_t = real money balances, y_t= real gross domestic product , i_t = nominal interest rate, π_t = inflation rate , ε_t = error term .

The augmented demand for money function with financial innovations is dealt by many including Friedman (1988), Choudhry (1996), Thorton (1998), Baharumshah et al. (2009), and Avouyi et al.,(2012). The result common to these papers indicate a positive relationship between money demand and financial assets through the wealth effect channel and an inverse relationship with financial assets/transactions through the substitution effect. Hence, the above demand for money function can be augmented as the following:

$$lnm_t = \beta_0 + \beta_1 \ln(y_t) + \beta_2 i_t + \beta_3 \pi_t + \beta_4 lnFI_t + \varepsilon_t \qquad (3.2)$$

Where FI_t is a proxy for financial Innovation. The expected sign of the coefficient β_4 may be positive (+) i.e. through the wealth effect, ornegative (-) i.e. Substitution effect.

In light of the above discussion the following variables are chosen to examine the role of equity derivatives in demand for money function in India. Call money is chosen to proxy the short term

interest rate variable. GDP is taken as the income variable. The variability of the rate of inflation (VRI) is used to proxy for the uncertain price behavior. It is one of the important determinants of demand for money. Many authors including Friedman (1968), Klein (1977), Khan (1977), and Paul (1981) find VRI to be important in a typical money demand function. Further, studies by Khan (1982), and Giri and Kamaiah (2011) find a positive association between demand for money and VRI. For the financial Innovation proxies the variables chosen are, volume of equity future, volume of equity options, and volume of total equity derivatives.

Accordingly the following models are estimated.

$$lnM3_{t} = \beta_0 + \beta_1 \ln(GDP_t) + \beta_2 CM_t + \beta_3 VRI_t + \varepsilon_t \quad (3.3)$$

$$lnM3_{t} = \beta_0 + \beta_1 \ln(GDP_t) + \beta_2 CM_t + \beta_3 VRI_t + \beta_4 \ln(EF) + \varepsilon_t \quad (3.4)$$

$$lnM3_{t} = \beta_0 + \beta_1 \ln(GDP_t) + \beta_2 CM_t + \beta_3 VRI_t + \beta_4 ln(EO)_t + \varepsilon_t \quad (3.5)$$

$$lnM3_{t} = \beta_0 + \beta_1 \ln(GDP_t) + \beta_2 CM_t + \beta_3 VRI_t + \beta_4 \ln(TED_t) + \varepsilon_t \quad (3.6)$$

where$M3_t$ = real money balance, GDP_t = real Gross domestic product at factor cost, CM= Call Money rate, VRI_t = Variability of rate of inflation, EF =equity future, EO= equity options, TED =total equity derivatives. The derivative variables are in real terms of their transactions i.e. notional values

3.4 Data and Method

For the empirical analysis data on GDP at factor cost, Wholesale Price Index(WPI) , Call money rate (CM), and Money Supply (M3) are collected from the Handbook of Statistics on Indian Economy, RBI and Central Statistical Office, Government of India. The data on derivative transactions are collected from SEBI (Securities and Exchange Board of India), BSE (Bombay Stock Exchange), NSE (National Stock Exchange of India), USE (United stock exchange), MSEI (Metropolitan Stock Exchange Of India Ltd), and CCIL (Clearing Corporation of India Ltd. The period of the study is driven by the availability of data on the financial transactions of derivatives and therefore quarterly data for the period 2001Q1 to 2014Q2 is employed. The measure of variability of rate of inflation is based on WPI.

To examine the long-run relationship in the demand for money specifications discussed above, ARDL Bounds test due to Pesaran et al. (2001) is employed. This has a comparative advantage over other methods owing to its ability to produce asymptotically long run estimates regardless of the order of integration of variables used in the specifications. . Before applying the ARDL methodology, ADF and PP unit root tests have been carried out to check the order of integration of the variables.

The basic ARDL model estimated refers to the standard money demand function of the following form.

Model- 1

$$\Delta \ln M3_t = a0 + \sum_{i=1}^{p} b_i \Delta \ln M3_{t-i} + \sum_{i=0}^{p} c_i \Delta \ln GDP_{t-i} + \sum_{i=0}^{p} d_i \Delta CM_{t-i} + \sum_{i=0}^{p} e_i \Delta VRI_{t-i} + \delta_1 \ln M3_{t-1} + \delta_2 \ln GDP_{t-1} + \delta_3 CM_{t-1} + \delta_4 VRI_{t-1} + \varepsilon_t \quad \textbf{(3.1)}$$

Model- 2 to 4

$$\Delta \ln M3_t = a0 + \sum_{i=1}^{p} b_i \Delta \ln M3_{t-i} + \sum_{i=0}^{p} c_i \Delta \ln GDP_{t-i} + \sum_{i=0}^{p} d_i \Delta CM_{t-1} + \sum_{i=0}^{p} e_i \Delta VRI_{t-i} + \sum_{i=0}^{p} f_i \Delta FI_{t-i} + \delta_1 \ln M3_{t-1} + \delta_2 \ln GDP_{t-1} + \delta_3 CM_{t-1} + \delta_4 VRI_{t-1} + \delta_5 \ln FI_{t-1} + \varepsilon_t \quad \textbf{(3.2)}$$

The variables EF, EO, and TED are used as proxies for financial Innovation in models 2, 3, and 4 respectively.

In model-1, b_i, c_i, d_i, and e_i are short run coefficients whereas $\boldsymbol{\delta_1}, \boldsymbol{\delta_2}, \boldsymbol{\delta_3}, \boldsymbol{\delta_4}$ are the long-run coefficients. To test for the presence of a possible long run relationship the ARDL bounds F-test is employed following Pesaran et al. (2001). It provides with a pair of asymptotic critical values for the F-test. One critical value assumes all the variables in the model to be stationary i.e. I (0) and the other assumes all the variables in the model to be non-stationary I (1). The null hypothesis of no Cointegration is H_0: $\boldsymbol{\delta_1 = \delta_2 = \delta_3 = \delta_4}$ against the alternative of Ha: $\boldsymbol{\delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq 0}$. For models 2 to 4, b_i, c_i, d_i, e_i, and f_i are short run coefficients whereas $\boldsymbol{\delta_1}, \boldsymbol{\delta_2}, \boldsymbol{\delta_3}, \boldsymbol{\delta_4}, \boldsymbol{\delta_5}$ **are the** long run coefficients. Based on the above procedure, the ARDL Bounds F- statistic is computed. If the computed F- statistic is higher than the upper critical value the null hypothesis is rejected, i.e. there is a long run relationship among variables in the model. If the computed F-statistic is in between the upper and lower bound critical value the null hypothesis is accepted i.e. there is no long run relationship among variables in the model.

In the next step the long run coefficients are estimated by the ARDL model for $M3_t$ (demand for money balances) employing the following specifications. Model 1 is as the following.

$$\Delta lnM3_t = a0 + \sum_{i=1}^{p} \delta_1 lnM3_{t-\mathrm{i}} + \sum_{i=0}^{p} \delta_2 lnGDP_{t-\mathrm{i}} + \sum_{i=0}^{p} \delta_3 CM_{t-\mathrm{i}} + \sum_{i=0}^{p} \delta_4 VRI_{t-\mathrm{i}} + \varepsilon_t$$

(3.3)

The specification for models 2 to 4 includes the financial innovation variable.

$$\Delta \ln M3_t = a0 + \sum_{i=1}^{p} \delta_1 lnM3_{t-\mathrm{i}} + \sum_{i=0}^{p} \delta_2 lnGDP_{t-\mathrm{i}} + \sum_{i=0}^{p} \delta_3 CM_{t-\mathrm{i}} + \sum_{i=0}^{p} \delta_4 VRI_{t-\mathrm{i}} + \sum_{i=0}^{p} \delta_5 lnFI_{\,t-\mathrm{i}} + \varepsilon_t$$

(3.4)

All the above models use lag lengths selected by the SIC criterion. Following estimation of long run coefficients the underlying error correction models of the following form are estimated.

Model-1

$$\Delta lnM3_t = \mu + \sum_{i=1}^{p} b_i \Delta lnM3_{t-i} + \sum_{i=0}^{p} c_i \Delta lnGDP_{t-i} + \sum_{i=0}^{p} d_i \Delta CM_{t-i} + \sum_{i=0}^{p} e_i \Delta VRI_{t-i} + \emptyset ECM_{t-i} + \varepsilon_t$$

(3.5)

Model 2 to 4

$$\Delta lnM3_t = \mu + \sum_{i=1}^{p} b_i \Delta lnM3_{t-i} + \sum_{i=0}^{p} c_i \Delta lnGDP_{t-i} + \sum_{i=0}^{p} d_i \Delta CM_{t-i} + \sum_{i=0}^{p} e_i \Delta VRI_{t-i} + \sum_{i=0}^{p} f_i \Delta lnFI_{t-i} + \emptyset ECM_{t-i} + \varepsilon_t \quad \textbf{(3.6)}$$

In the above specifications, μ, b, c, d, e, f are the short run coefficients and $\emptyset$ is the speed of adjustment.

3.5 Results

In this section the results of ARDL estimation of the money demand functions are presented. Before presenting these results the growth of the financial innovation proxies as ratio of GDP and the descriptive statistics are presented. The following figure presents some ratios highlighting the growth of quarterly broad money, volume of equity Futures (EF), volume of equity options (EO), and volume of total equity derivatives (TED) in relation to GDP for the period 2001Q1 to 2014Q2. The M3/GDP ratio grew from 2.70 in 2001Q1 to 3.54 in 2014Q2. Similarly, the EF/GDP ratio rose from 0.003 in 2001Q1 to 1.57 in 2014Q2 and EO/GDP ratio from 0.0005 in 2001Q1 to 5.71 in 2014Q2. The TED/GDP ratio has also risen from 0.003 in 2003Q4 to 6.76 in 2014Q2. There has been significant growth in derivative transactions as indicated by these ratios.

Figure 3.1: Trend of M3/GDP, EF/GDP, EO/GDP, TED/GDP

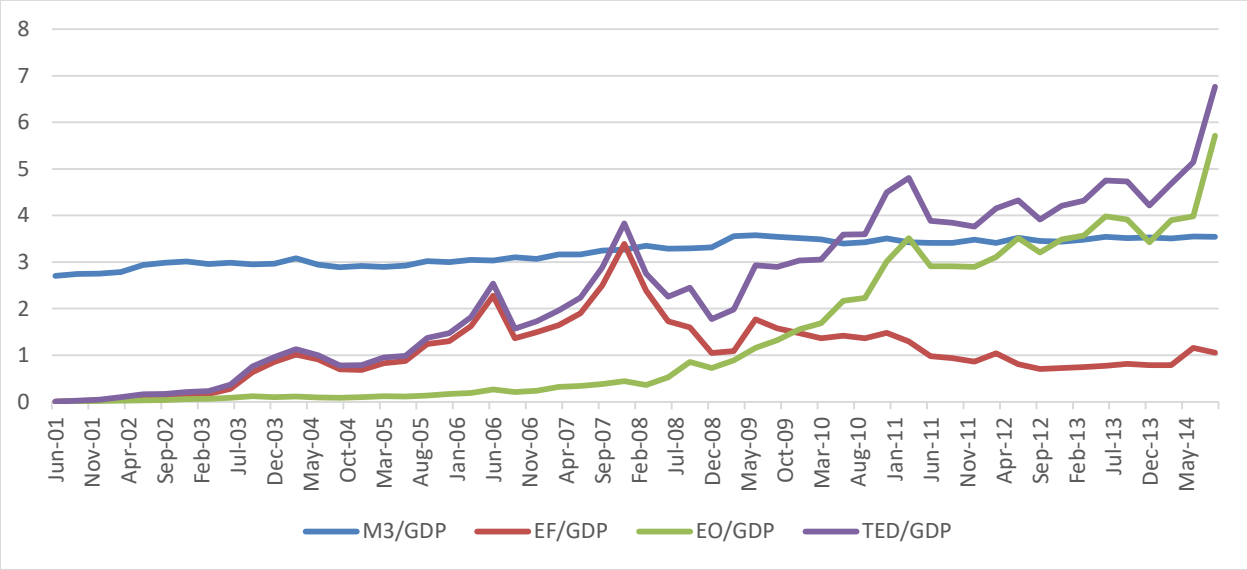


Table 3.1: Descriptive Statistics

Description	M3	GDP	CM	VRI	EF	EO	TED
Mean	10.48	9.37	6.50	82.48	9.03	8.52	9.72
Std. Dev.	0.61	0.54	2.10	159.62	1.64	2.48	1.97

The ADF and PP unit root tests have been conducted to check the orders of integration of the variables used in the money demand estimations. Since the orders of integration are found to be different for different variables, the ARDL bounds test is applied and the results are reported in Table 3.2 below.

Table 3.2: Unit Root Test Results

	ADF Test Statistic With Intercept		ADF Test Statistic With Intercept and Trend		PP Test Statistic With Intercept		PP Test Statistic With Intercept and Trend	
Variable Name	Level	Ist Diff	Level	Ist Diff	Level	Ist Diff	Level	Ist Diff
LRM3	-0.07	-6.17***	-1.80	-6.10***	-0.01	-6.43***	-2.07	-6.33***
LRGDP	-0.53	-6.65***	-2.83	6.59***	-0.47	-6.65***	-2.88	-6.59***
VRI	-1.98	-12.87***	-1.99	-12.73***	-5.45***		-5.46***	
CM	-4.24***		-4.71***		-4.27***		-4.73***	
LEDFU	-8.12***		-6.39***		-7.73***		-5.98***	
LEDOP	-4.22***		-10.59***		-3.74***		-7.79***	
LED	-6.66***		-8.32***		-5.80***		-7.87***	

Note: ***, **,* indicates 1,5,10 percent level of significance

Table 3.3: ARDL Bounds Test

Models	Model 1	Model2	Model3	Model 4
Calculated F-Statistic	9.907***	9.321***	9.683***	9.008***

Note: *** indicates 1 percent level of significance at upper bound critical value

The calculated F-statistic for all the models are found to be greater than its upper bound critical value at 1 percent level of significance. Hence, a long-run relationship between money demand and other variables in all the four models is confirmed. Having confirmed the long run relationship, in the next step the long run coefficients and short run error correction models are

estimated. For estimation of long run coefficients, the SIC criterion has selected lags (3,2,0,2) for model 1 and (3,2,0,2,0) for models 2 to4. The results are reported in the following table.

Table 3.4: Long- run coefficients and Short-run dynamics

Panel-A (Long-run Coefficients)				
Variables	Model 1	Model 2	Model 3	Model 4
GDP	1.116***	1.089***	0.994***	1.052***
CM	-0.001	-0.0008	-0.0004	-0.0003
VRI	0.0002***	0.0002***	0.0001***	0.0002***
EF		0.017*		
EO			0.030**	
TED				0.023*
Intercept	0.075	0.212*	0.958**	0.476*
Panel-A (Short-run dynamics)				
EC(-1)	-0.642***	-0.584***	-0.694***	-0.598***

Note: ***, **,* indicates 1,5,10 percent level of significance

The long-run income elasticity for model 1 is 1.116. For models 2 to 4 this elasticity takes the values of 1.089, 0.994, and 1.052 respectively. The elasticity is significantly greater than zero and close to one in all the models. However, in models with one of the derivatives as proxy of financial innovation the income elasticity is lower than the standard money demand specification as given in model 1. The underlying reason may be availability of alternative financial assets for more substitutes of money in portfolios of the households in the wake of financial innovations (see for

example Baharumshah et al 2009). The VRI coefficients for models1 to 4 vary in the range of 0.0001-0.00002. They are positive and significant. But the magnitudes of the VRI coefficients are very low implying low response of demand for real money balance to variability in inflation rate in all the specifications with or without derivatives. This is in line with the precautionary motive of money demand (see Blejer, 1979). The Call Money (CM) coefficients for models 1 to 4 lie between -0.0008 to -0.001and are statistically insignificant.

The coefficients of all the derivative variables i.e. EF, EO, and TED bear positive sign and they are statistically significant at 1% level. The magnitudes of these coefficients lying between 0.017 to 0.030 confirm the presence of wealth effect.

The short-run dynamics results (Table 3.4 Panel-B) presents the error correction coefficients EC (-1) for models-1 to 4. The error coefficient EC(-1) in model-1 is -0.642, which is negative and significant at 1 percent level of significance, meaning that fluctuations in the real balances of money demand is corrected up to 64% per period (one-quarter). In models 2 to 4 with different derivative variables the EC term ranges between -0.598 and -0.694. The magnitudes of EC terms in these models are both higher and variable signifying the importance of these new financial innovations. Therefore, it is important to include financial assets like, equity futures, equity options, and equity derivatives while evaluating the money demand functions for in India.

It is argued that structural break in the ARDL model can be one of the reasons for biased estimation of the long-run analysis. Therefore, Andrews/ Quandt (1993) and Bi-Perron (2003) tests are employed to study the possibility of parameter stability in the ARDL models. These two tests allow for an endogenous determination of structural break in the models.

Table 3.5: Quandt-Andrews test

	Model 1	Model 2	Model 3	Model 4
Maximum LR F-statistic	4.296 (0.33)	2.836 (0.58)	1.329 (0.94)	3.05 (0.54)
Exp. LR F-statistic	0.339 (0.59)	0.149 (0.89)	0.107 (1.0)	0.161 (0.87)
Avg. LR F-statistic	0.414 (0.721)	0.208 (0.93)	0.195 (0.94)	0.214 (0.92)

The Quandt-Andrews test result is reported in above table. Here, one can't reject null of no structural break in the model as the p-value is greater than 10 per cent in all cases. The Maximum LR F-stat, Exp. LR F-stat and Avg. LR F-stat show that the calculated statistics is not significant as the p-value is not below 10 percent. Hence, all the four models are found to be stable.

Table 3.6: Bai-Perron Test

	Model 1	Model 2	Model 3	Model 4
F-statistic	4.296	2.836	1.329	3.05
Critical value	8.58	8.58	8.58	8.58
Break Test	0 vs. 1	0 vs. 1	0 vs. 1	0 vs. 1

The Bi-Perron test results are presented in table 3.6. The calculated value is smaller than the critical value (8.58) leading to acceptance of null hypothesis. Therefore, there is no significant structural break in four models. All the four models are found to be stable. Further, a battery of diagnostic tests is conducted to check for serial correlation, normality, heteroscedasticity, and model specification. The results are reported in the following table.

Table 3.7. Diagnostic tests

Breusch-Godfrey Serial Correlation LM test				
	Model-1	Model-2	Model-3	Model-4
F-Statistic	0.15	0.05	0.13	0.05
P- Value	0.85	0.94	0.87	0.94
Heteroskedasticity test: Breusch-Pagan-Godfrey				
F-Statistic	1.64	1.13	1.27	1.01
P- Value	0.12	0.36	0.27	0.45
Ramsey RESET test				
F-Statistic	2.28	0.21	0.82	0.30
P- Value	0.14	0.64	0.36	0.58
Normality Test (Jarque –Bera)				
Jarque –Bera	1.05	0.46	1.24	0.41
P- Value	0.58	0.79	0.53	0.81

In all the four tests the test-statistics for normality, serial correlation, heteroscedasticity etc. are insignificant. Hence, the models do not suffer from serial correlation, heteroscedasticity and model specification.

3.6 Conclusion

To sum up, this paper revisits demand for money in the Indian context accounting for the role of financial innovation in terms of introduction equity derivatives in the Indian financial market after the year 2000. In the advent of financial innovations in different dimensions such as new products, new services, etc. in the emerging market economies, the demand for money functions have been re-estimated by some authors by employing variables such as stock prices as proxy for financial

innovation. In this paper an attempt is made to estimate money demand by taking variables such as equity futures, equity options, and total equity derivatives in a set of money demand functions.

The ARDL bounds test approach to cointegration is employed and a long run relationship is found in money demand models including equity futures, equity options, and total equity derivatives. The coefficients of all the derivative variables bear positive signs indicating the presence of wealth effect. The income elasticity coefficients are lower with inclusion of derivatives compared to the standard specification without derivatives. The short term interest rate as an opportunity cost variable is found insignificant in all cases though it carries an expected negative sign. The variability of inflation carries a positive sign and is statistically significant in all cases implying precautionary motive of demand for real money balances. The error correction terms indicate higher speeds of adjustment in case of money demand functions with derivatives. The magnitudes vary across types of derivatives employed i.e. EF, EO, TED. The derivative variable EO has the highest speed of adjustment coefficient among all three derivatives. The results of Quandt-Andrews and Bai-Perron do not yield presence of any structural break in the four money demand specifications considered in the study. To conclude, derivatives assume crucial importance in money demand functions in explaining the stability of the function as well as the short run deviation from long run equilibrium values.

Chapter-IV

Revisiting the role of Asset Prices in Monetary Transmission Mechanism in India

4.1 Introduction

The most recent global financial crisis had a devastating effect on the asset prices, which ultimately transmitted into the real economy culminating in severe recession around the world. The central banks of most of the countries in general and in emerging market economies like India have a mandate to conduct monetary policy by incorporating both internal and external macroeconomic factors. Of late, the debate on the role that asset prices play in monetary policy has attracted attention to researchers and policy makers. The differing views/theoretical conjectures on this issue have been articulated differently such as conventional approach, leaning against wind, direct targeting of asset prices, pricking asset prices, and wait and watch. In view of the growing market size of different financial assets both in the spot and derivative markets, this chapter makes a fresh attempt to examine the role of asset prices in monetary transmission mechanism and monetary policy formulation.

The sub - prime crisis of in the USA market rapidly spread to other financial markets of different markets. Since the financial markets of different countries have been more integrated in the last few decades. Different studies have shown how domestic policies are interfered due to

developments in foreign financial markets. The sentiment and confidence prevailing in this markets have also been found to be contagious.

The said crisis occurred despite a period of enviable stability in prices and the overall macroeconomic environment. This means financial stability cannot automatically be guaranteed by stability in prices and the countries macroeconomic environment. The crisis that started in developed economies did affect some of the emerging market economies proving that stability in the national and international markets is an interlinked phenomenon.

In an economy, when there is a combination of rapid expansion of economic activities (economic growth), with expansionary monetary policy (low interest rates), it leads to expansion of income levels. This changes investment pattern, demand for assets (equities, housing).It then leads to a gradual increase in the asset prices . Over a period in asset market there arises a possibility of formation of asset price misalignment (known as asset price bubbles). At certain point of time, both lenders & borrowers become cautious about changes in the economy. Any policy action, internal or external shocks leads to asset prices plummeting from its peak**.** It leads to persistent longer period recessions in the economy and the economy becomes weak. In the globalised environment, there may be spill-over to the other economies.

In the light of the above, the context of India, this chapter analyses empirically how monetary policy action is influenced by asset prices and how asset prices are influenced by monetary policy decisions. The following section provides various transmission briefly.

The rest of the chapter is organized as follows: section 4.2 presents an overview of different monetary transmission channels. In section 4.3 a select review of the relevant literature is presented. Section 4.4 presents the dynamics of Indian monetary policy instruments and asset

prices. The details of methodology and model selection are presented in section 4.5. Section 4.6 discusses the empirical results and the last section concludes.

4.2 Monetary transmission channels: An overview

Monetary policy has assumes crucial role in stabilizing output and price level in the economy. This is usually studied through different monetary transmission channels. Understanding different transmission channels helps in designing appropriate monetary policy. Mishkin (1995, 1996) presents an excellent summary of monetary transmission channels. The channels discussed in Mishkin's work are the following.

a) Traditional interest rate channel

The interest channel is the standard channel of Keynesian model which can be depicted as the following.

- $M\uparrow \dashrightarrow i_r \downarrow \dashrightarrow I \uparrow \dashrightarrow Y \uparrow$

An expansion in money supply leads to decline in the real interest rates ($i_r \downarrow$), leading to reduction in the cost of borrowing in the market. This is supposed to raise investment ($I \uparrow$), and therefore expansion of economic activity. Then income ($Y \uparrow$) expands. In addition to this Keynesian channel later empirical research found transmission through investment in household's residential housing and durable goods consumption expenditure ($I \uparrow$). Further, when nominal interest rate is zero, the interest rate channel takes the following form.

- $M\uparrow \dashrightarrow P^e \uparrow \dashrightarrow \pi^e \uparrow \dashrightarrow i_r \downarrow \dashrightarrow I\uparrow \dashrightarrow Y \uparrow$

When interest rate nears zero, the expansionary policy leads to increase in expected price level and expected inflation. Real interest rates fall and this reduced real interest rate transmits to long term

interest rates. Finally, one sees increase in aggregate demand, capital formation, housing demand, and consumer durable sales.

Taylor (1995) advocates that interest rate channel is important in influencing the consumer and business investment expenditure, which in turn transmits to economy. Bernanke and Gertler (1995) yield empirical evidence suggesting other alternative channels such as credit channel to be more effective than interest rate.

b) Asset price

In the monetary transmission channel literature the most happening one is asset prices. The assets discussed in the literature are exchange rate, equity price, housing and land price.

i) Exchange rate channel: With ever increasing trade of goods and service around world with flexible exchange rate mechanism, this channel has invited interest of researchers and policy makers. The exchange rate channel can be given as the following.

M↑ ---> i_r ↓---> E ↓--->NX ↑ ---> Y ↑

When monetary expansion leads to change in the nominal interest rate, the real short interest rate (i_r) falls. This fall in short term interest rates results in depreciation of exchange rate (E ↓). This depreciated currency makes domestic goods cheaper in the international market and as a result net exports increase. With increase in net exports, there is expansion of the aggregate output in the economy.

ii) Equity price: Equity price works via i.e., Tobin's *q* theory and wealth effect. Tobin's *q*: Tobin's q is defined as the ratio of market value of firm to replacement of value of capital. Tobin's

q channel works through changes in valuations of equity. With higher Tobin's *q*, the market price of firms become higher than the replacement cost of capital. Thus the new plant and equipment are cheaply available compared to the firm's market value. This makes easy for the firms to issue equity at a higher price. Thus investment spending rises since firms can buy more investment goods with lesser issue of equity now. Thus one sees increase in capital expenditure of new firms and expansion of their existing plant capacity. On the other hand if Tobin's *q* is low investments fall. Coming to the effect of monetary policy on equity prices one finds the following channel. .

M↑ ---> $\mathbf{P_e}$ ↑ ---> Tobin's *q* ↑ ---> **I** ↑ ---> **Y** ↑

An expansionary monetary policy resulting in more money supply leaves more money in hands of the public than the public desires to hold. The public reduces its money holdings by spending more on equities in the stock market. This leads to increase in demand for equity in the stock market and then equity prices increase. A similar Keynesian argument says that, with expansionary monetary policy interest rates fall making bonds less attractive compared to equities. Therefore, one sees increased demand for equities in the stock market. This raises the prices of equity.

iii) Wealth effect: Another dimension of asset price channel can be attributed to Franco Modigliani and Milton Friedman. This channel performs through financial wealth, human wealth, and real capital as life time resources of consumers affecting consumption spending. This channel can be presented as the following.

M↑ ---> $\mathbf{P_{equity}}$ ↑ --->**Wealth** ↑ ---> Consumption expenditure ↑ ---> **I** ↑ ---> **Y** ↑

Expansionary monetary policy leads to increase in equity prices as discussed earlier and with increase in stock prices overall financial wealth increases triggering the consumption cycle in market. This leads to increase in demand for goods, and investment.

Land and housing prices channels work in similar fashion as that of equity. Land and housing play significant role as wealth holding in the economy. The logic of Tobin's *q* can be fitted to housing as equity. Further, rise in housing and land prices increase household and therefore consumption demand increases. Monetary expansion resulting in increase in housing and land prices thus lead to higher aggregate demand in the economy.

c) The Credit view

The general dissatisfaction with traditional transmission channels in the empirical literature led to development of bank lending and balance sheet channels to explain monetary transmission better under the credit view.

Bernanke and Gertler (1995) highlight the role of asymmetric information in the credit market. Banks are important to modern financial system since they address well asymmetric information in the credit market. Banks also play roles to bridge gaps between the lenders and borrowers in the economy with their expertise.

The banking lending channel works in in following way. An expansionary monetary policy (M↑) boosts bank reserves and deposits giving scope to banks to lend more in market. This increased quantity of loans positively impacts investment by private business and household consumption expenditure. Finally, output grows. Further, the credit view implies that monetary policy impacts the smaller firms' expenditure more than the bigger firms since smaller firms are dependent on bank loans more than the bigger firms.

M↑ ---> Bank deposits ↑ ---> Bank loans ↑ ---> I ↑ ---> Y ↑

Balance sheet channel: Bernanke and Gertler (1995) highlight the balance sheet channel, which works through net worth of business firms. The low/high net worth of firms has a bearing on the adverse selection and moral hazards problems in the credit market. In case of lower net worth firms the adverse selection and moral hazard problems are likely to be severe in lending to these firms. Lower net worth and higher net worth imply lower and higher collateral with lenders respectively. Therefore in case of lower net worth losses from adverse selection are supposed to be higher. A decline in net worth this leads to reduced lending to finance investment spending. Firms' balance sheet can be affected by monetary policy in different ways. Under the balance sheet channel. An expansionary monetary policy (M↑) leading to rise in equity price (P_e ↑) raises the net worth of the firms and as a result investment spending increases. The underlying reason is an increase in net worth of business firms due to reduced adverse selection and moral hazard in the credit market. **M↑ ---> P_e ↑ ---> ↓ in adverse selection and moral hazard in credit market---> ↑ in lending ---> I ↑ ---> Y ↑.**

Another dimension of the balance sheet channel is cash flow to business firms. A fall in nominal interest rates due to expansionary monetary policy increases firms' cash flows resulting in reduced moral hazard and adverse selection problems. The important feature of this transmission channel lies in the role of nominal rather than real interest rates in influencing the investment expenditure of the economy. This is because interest payments on the short term debt rather than long term debt impacts investment through changes in cash flow of firms. **M↑ ---> i ↓ --->cash flow to**

firms ↑ --->adverse selection problem and moral hazard in credit market ↓ ---> lending↑ --> I ↑ ---> Y ↑.

The balance sheet channel also works through the general price level. It can be described as follows.

M↑ ---> unexpected P ↑ --->cash flow to firms ↑ --->adverse selection problem and moral hazard in credit market ↓ ---> lending↑ ---> I ↑ ---> Y ↑

An unanticipated rise in general price level due to an expansionary monetary lower firm's liabilities in real terms resulting in lower debt burden of the firms. This is because most of the debt are contractual and fixed in nominal terms. This situation increases firms' net worth and reduces adverse selection and moral hazard problems. Thus lending activity picks up and investment increases in the economy finally leading to an increase in output. **Household Balance sheet effects:** Though the focus in the literature has been balance sheet effects of firms, household balance sheets do play a role since household expenditure has an impact on the aggregate expenditure and output in the economy. **M↑ ---> P_e ↑ ---> Household's financial assets ↑ ---> Household's spending on durable goods and housing ↑---> I ↑ ---> Y ↑**

An increased money supply increases equity prices (**P_e**) leading to an improved financial assets position of households over their liabilities and this helps households purchase of durables and housing. This in turn revives the investment cycle and expansion of aggregate output. This is another transmission link between money and equity prices. The other ways in which transmission takes place include for instance a contractionary monetary policy reducing bank lending and

thereby reducing household spending, an increased interest rate affecting household cash flows etc.

Overall the empirical literature is of the view that traditional interest channel operates through cost of borrowing of capital. In the recent past interest rate channel's ineffectiveness has been established and other channels like credit and asset prices have gained importance in the monetary policy formulation.

4.3 Review of Major Past Studies

To quote Kent and Lowe (1997), "Suppose that the real asset price is above, and moving further away, from some fundamental level – that is, that there is an asset-price bubble. As the asset price rises, it is likely to put some upward pressure on goods and services price inflation by increasing aggregate demand and expectations of inflation. When the bubble eventually bursts, these inflationary pressures will abate, but we argue that there will be an additional contractionary effect on inflation arising from the adverse effect that falling asset prices have on collateral values, financial system stability and the provision of intermediated finance".

The conventional view in the literature is that monetary policy should not respond to the changes in asset prices, it has to respond in times of changes in the inflation expectations and changes in future output level only. Monetary policy reacts only after the collapse of asset prices, which means (1) central banks should not target asset prices; (2) central banks should not crack to jab asset bubble; and (3) central banks should follow a "mop up" strategy after the burst of a bubble, i.e. implanting enough liquidity to avoid a macroeconomic cataclysm (Issing, 2009).

Another view is due to Alan Greenspan as chairman of the Federal Reserve Board, "where he argues that monetary policy need not lean against asset-price bubbles, rather it should clean up things after they burst . The notion that a timely incremental tightening could have prevented the late 1990's bubble is almost surely an illusion. Instead, one needs to focus on policies to mitigate the fallout when it arises" (Greenspan, 2002). This view seems to be strongly for a policy of not responding to asset prices. The opposite view is that monetary authorities should respond to changes in asset prices or incorporate the asset price changes into monetary policy. This is popularly known as 'lean against wind". This view is advocated by Cecchetti (2000) in the report titled "Report on world economy". A central bank or top regulator of banking system of that country, pursuing an inflation target will not achieve optimum performance in terms of its inflation objective by setting its interest rate singularly in response to deviation from its inflation outlook and reacting to nothing else. Overall, they suggest that asset prices have strong effect on future inflation, although the impact surely differs across countries and may shift over time.

In the Indian context, Aleem (2010) analyses the asset price channel using vector author regression model, using quarterly data for the period of 1996 to 2007. The model consists of the variables GDP, WPI, Call money rate, and BSE-30 (Sensex). The results indicate that asset price channel of monetary transmission is not so important. In another paper, Singh & Pattanaik (2010) analyse in the Indian context, if monetary policy should respond to asset prices. Their empirical results indicate that interest rate changes cause changes in stock price, but the reverse causality does not hold. This implies that monetary policy in India does not respond to asset prices, though the asset price channel of monetary policy transmission does exist. The evidence indicates a significant bi-directional causality between credit growth and asset price. But the role of credit in asset price bubbles is not unambiguous. This might be due to the role played by a common factor; i.e. strong

GDP growth coinciding with high credit growth, and the former driving the asset prices up. Sengupta (2014) studies Indian asset prices monetary transmission channel, using VAR methodology, for the period preceding liquidity adjustment facility (i.e. 1993 to 2000) period and 2000 to 2012. The variables in the model consists of index of industrial production (as proxy of output), wholesale price index (WPI) as proxy for price level, call money rate, M3 measure of money supply, BSE Sensex as asset price. The results indicate a weak asset price channel of monetary transmission before the liquidity adjustment facility and a bit stronger after the liquidity adjustment facility.

To sum up, in the past decade and a half financial innovation caused significant changes in monetary policy functioning, dismantling administrative control on interest rates, credit rationing, and introduction of new financial instruments financial markets. The liquidity adjustment facility has been influencing the monetary transmission as well as reducing volatility in the overnight call money market in money markets in India. This chapter focuses on monetary policy and asset prices interactions under liquidity adjustment policy regime. The questions raised are (1) Does monetary policy respond to asset prices changes? or (2) Do asset prices changes influence monetary policy action. To answer these questions an attempt is made to examine causality among a set of interest rates, bank credit and stock prices for the period spanning the liquidity adjustment regime. The following section presents causality results. Further, a structural vector auto regression (SVAR) model is estimated to examine the monetary policy and asset price interactions. The SVAR results are presented in section 4.5.

4.4 Interest rates, Bank Credit and Asset Prices: Causality results

As discussed earlier monetary policy transmission is traditionally seen to be working via the interest rate channel, whereas after opening up of the Indian economy channels like asset prices,

exchange rate have assumed significance. To capture the dynamic interrelationship between interest rate, bank credit to private sector and stock prices, granger causality test is employed for the period of April 2001 to September 2014. The variables used are Call Money, Stock Prices, 91 day Treasury bill, 10 Year Bond, Bank credit. This period refers to the liquidity adjustment facility regime of monetary policy in India.

The results presented in table 4.1 reveals that, a short term interest rate like call money rate causes stock price, whereas stock price does not granger cause call money. Another proxy of short term interest rates, the 91 day Treasury Bill Rate (TB) shows bi-directional causality with stock price during this period. The proxy of long term rates, the 10 year bond yield and 91 TB rate as proxy of short term interest rate show bidirectional causality with stock price. This result is different from the results obtained by Singh & Pattanaik (2010), where they found uni-directional causality. In case of bank credit we find causality running from stock price to bank credit and not the *vice versa*.

Table 4.1. Interest rates, Bank Credit and Stock price: Causality Results

Null Hypothesis	F-Statistic	Prob.
Call Money does not ⟶ Stock Prices	3.15	0.04
Stock Prices does not ⟶ Call Money	1.69	0.18
91 day Treasury Bill does not ⟶ Stock Price	3.27	0.04
Stock Price does not ⟶ 91 day treasury Bill	4.77	0.009
10 Year Bond does not ⟶ stock Price	2.07	0.09
Stock Price does not ⟶ 10 year Bond	3.33	0.03
Bank credit does not ⟶ stock Price	0.70	0.49
Stock Price does not ⟶ bank credit	7.47	0.0008

Note - ⟶ denotes "Granger Cause"

4.5 Asset Prices and Monetary Transmission: Some SVAR Results

In this section some SVAR results are discussed on role of asset prices in monetary transmission in India. The basic objective is to investigate the relationship and dynamic interaction between monetary policy and different asset prices. Accordingly, following the most recent empirical literature, the variables selected are GDP for income, Inflation (based on WPI), Call money rate for interest rate, and Nonfood bank credit (cr) for credit demand, NSE Nifty index for stock price, and REER for exchange rate. The model and variables are chosen broadly following the works of Singh & Pattanaik (2010) and Sengupta (2014) in the Indian context. All the variables in the model are taken in terms of their respective growth rates.

The data on GDP, WPI, Call money rate, and Nonfood bank credit, real exchange rate (36- country currency index) are collected from the RBI-Handbook of Statistics on Indian Economy. The data on stock prices are collected from SEBI and NSE.

The period of study is selected in line with Woodford (2001) i.e. to study monetary policy transmission effectiveness, the time period selection should be based on the monetary policy regime adopted by the country under consideration. The current study have selected the time period post introduction to liquidity adjustment facility (LAF). The period of the study is 2001Q1 to 2014Q2.

4.5.1. Methodology

The SVAR model uses short-run restrictions, on the basis of economic theory, to identify different structural shocks.

$A_0 y_t = B(L) y_{t-I} + \varepsilon$,with i=1,…….,n (4.1)

$$\begin{pmatrix} e_y \\ e_p \\ e_r \\ e_{cr} \\ e_{sp} \\ e_{ex} \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ b_{21} & 1 & 0 & 0 & 0 & 0 \\ 0 & b_{32} & 1 & 0 & 0 & 0 \\ b_{41} & b_{42} & b_{43} & 1 & 0 & 0 \\ b_{51} & b_{52} & b_{53} & b_{54} & 1 & 0 \\ b_{61} & b_{62} & b_{63} & b_{64} & b_{65} & 1 \end{pmatrix} = \begin{pmatrix} \varepsilon_y \\ \varepsilon_p \\ \varepsilon_r \\ \varepsilon_{cr} \\ \varepsilon_{sp} \\ \varepsilon_{ex} \end{pmatrix}$$

The SVAR model has the following theoretical assumptions that, before we assumed GDP as demand shock, Inflation or prices as supply shock, interest rate as monetary shock, Nonfood bank credit as credit shock, stock price as asset price shock, and exchange rate as exchange rate shock.

Singh & Pattanaik (2010) are of the view that "Aggregate demand shocks are most exogenous and are not instantaneously affected by other macroeconomic aggregates in the model, therefore, all coefficients in the matrix are restricted to zero". Inflation is influenced by aggregate demand shocks simultaneously, but no other variable is impacted in the SVAR structure. Similarly, at the time of monetary policy decisions data on aggregate demand is usually not available. The information on aggregate demand becomes available to the central banks at a time lag. Thus the interest rate function does not respond simultaneously to aggregate demand, but supply shock information, being available to monetary authority, is used in the monetary policy function. Next, nonfood bank credit is simultaneously affected by aggregate demand shock, supply shock, and

monetary shocks. Asset price i.e. stock price, is affected by all shocks in the model, except exchange rate. The literature suggests that, asset price misalignment (in the form of asset price bubbles) is a result of monetary and credit market shocks. . Finally, in the standard empirical literature, the exchange rate is placed at the end of the order. Therefore, exchange rate is affected by all the shocks in the model.

Before going for SVAR estimation unit root tests by using ADF and PP tests are employed to confirm the stationarity properties of the variables considered in the model. After confirming the stationarity property, the lag order for the model are determined. Based on earlier empirical literature transmission channels are assessed by the impulse response function (IRFs) and variance decomposition. Some diagnostics test is employed to test the model stability. IRFs trace out the response of the variables in the model to one standard deviation shock given to one variable in the model. Similarly, the forecast error variance decomposition (FEVD) explains the percentage of forecast error variance in each endogenous variable that is determined by the other variables in the model. Historical variance decomposition analyses the contribution of the different accumulated structural shocks to each observed variable. The results obtained from the SVAR estimation is discussed in the next section.

4.6 Results and discussion

4.6.1 Unit root result

The results of unit root tests (Augmented Dickey Fuller (ADF), Phillips-Perron (PP) are presented in Table 4.2. All the variables are tested for unit roots with intercept and with intercept and trend. (NFBC),GDP, INF,SP,REER are found to be non-stationary at level in all the tests and stationary at the first difference with trend and intercept in ADF and PP tests at 1 percent level of significance. WPI inflation (INF) is found to be stationary at level in all the tests and

stationary at the first difference with trend and intercept in ADF, whereas PP test is found to be non-stationary at level in all the tests and stationary at the first difference with trend and intercept. CM is found to be stationary at level trend and intercept in ADF and PP tests at 1 percent level of significance. For estimating the models, based on unit test results, the study employed the first difference values of variables in the model to adhering to norm of stationary of variables.

Table 4.2: Unit root tests

	ADF Test Statistic With Intercept		ADF Test Statistic With Intercept and Trend		PP Test Statistic With Intercept		PP Test Statistic With Intercept and Trend	
Variable Name	Level	Ist Diff	Level	Ist Diff	Level	Ist Diff	Level	Ist Diff
GDP	-2.56	-7.08***	-2.36	-5.63***	-2.64*	-7.08***	-2.45	-7.06***
INF	-5.21***		-5.33***	-6.37***	-2.22	-3.71***	-2.05	-4.03***
CM	-4.28***		-4.81		-4.31***		-4.82***	
NFBC	-2.36	-6.14***	-2.98	-6.20***	-2.36	-6.10***	-3.06	-6.11***
SP	-2.34	-7.19***	-3.01	-7.14***	-3.10**	-5.56***	-3.15	-5.52***
REER	-2.87*	-6.09***	-2.83	-6.01***	-3.26**	-6.93***	-3.21*	-6.89***

Note: ***, **,* indicates 1,5,10 percent level of significance

4.6.2 Lag length selection

Table 4.3. Provides the optimum lag order is found to be 3 by following AIC information criteria for the SVAR models. Results are in appendix Table – 4.3.VAR- lag order selection.

4.6.3 The Dynamic relationship: Impulse Response Analysis

Figure 4.1: Impulse responses of asset prices (stock prices) to various shocks

Figure 4.1.1

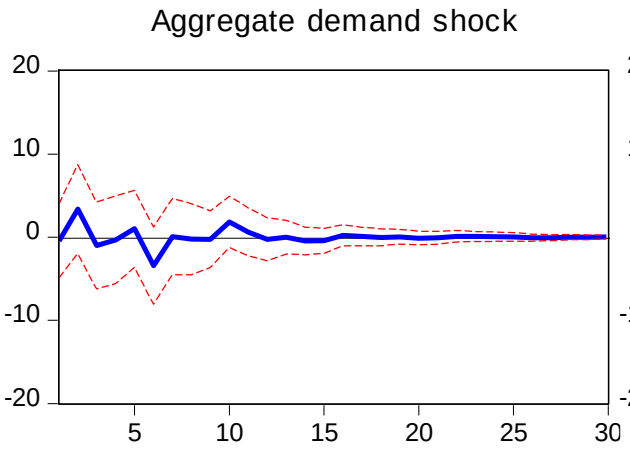


Figure 4.1.2

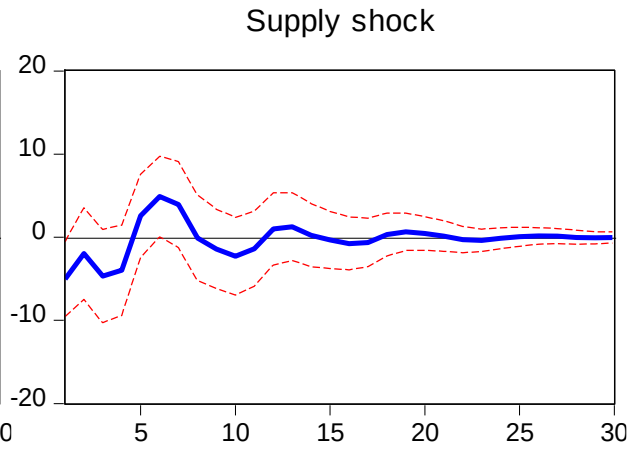


Figure 4.1.3

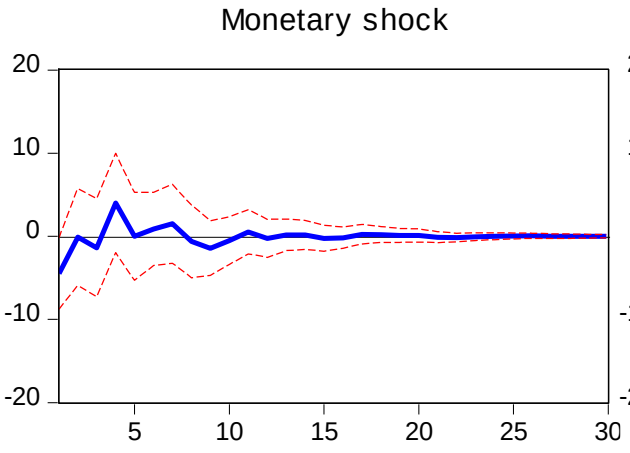


Figure 4.1.4

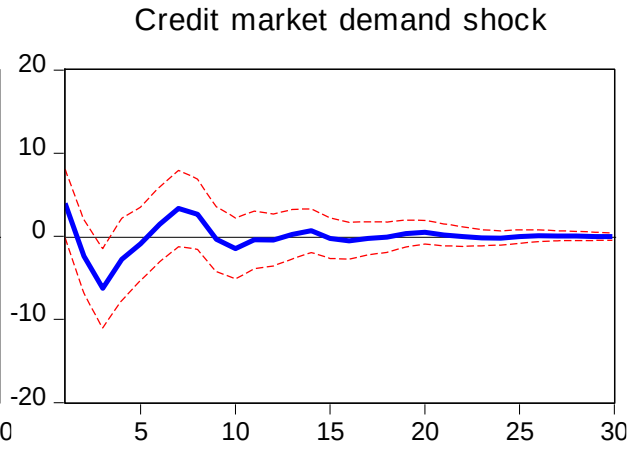


Figure 4.1.5

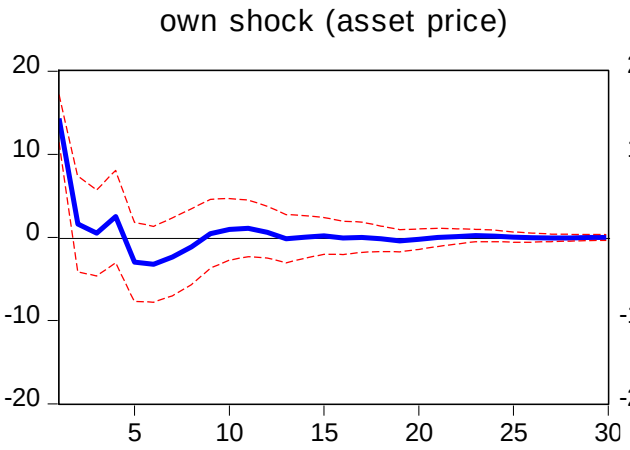
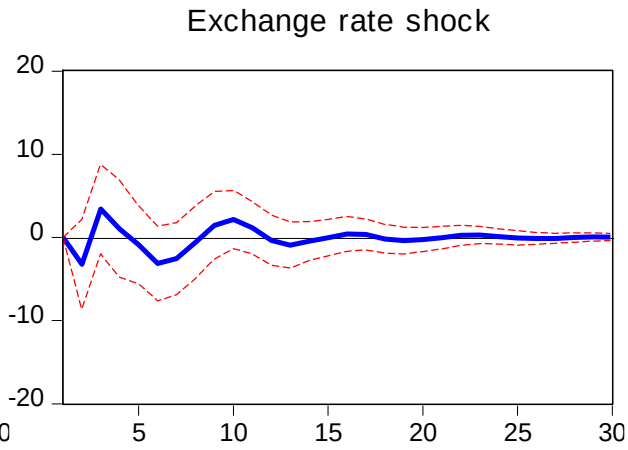


Figure 4.1.6



The results of IRFs presented in figure 4.1 trace the dynamic relationship between asset prices and interest rate. It's evident from figure 4.1.1 that a shock to aggregate demand (positive shock) leads to 3 % rises in asset price before the response dies out. This positive shock probably shows that, economic growth changes the household, business firm's wealth, and therefore change in the expectations of asset prices returns. In figure 4.1.2 an unexpected supply shock changes general prices, this increase in general price level leads to 5% decline in stock prices. This response fizzles out in medium to long run. This inflation shock is found to be strong in the asset prices channel. Further in figure 4. 1.3. a positive shock i.e. Increase in interest rate causes 4% decline in the stock prices from the 3rd quarter onwards before reverting to zero. Monetary shock shows significant impact on asset price channel, through decline in stock prices, moderation asset prices, reduction in consumption of households, business firms, due to decline in wealth. Figure 4.1.4 shows that the positive credit shock leads to increase in the stock price from the 5th quarter and these shocks die out beginning the 11th quarter. Finally figure 4.1.5 shows the own shock of the stock prices to be positive as desired from theory and figure 4.1.6 shows the response of

stock price to exchange rate shock to be negative from 3rd quarter onwards before becoming zero. The appreciation of exchange rate makes external trade less competitive in international markets and reduction in returns from stock prices. This dampens the economic growth rate and stock prices.

Asset price shocks to other variables in the model

Figure 4.2: Impulse responses of other variables in the model to asset price shocks

Figure 4.2.1

Response of aggregate demand to asset price shock

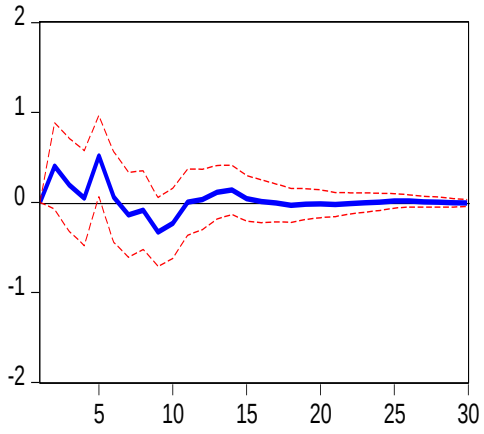


Figure 4.2.2

Response of supply(inflation) to asset price shock

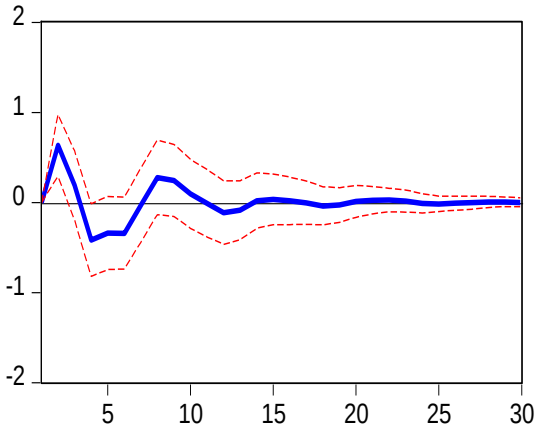


Figure 4.2.3.

Response of Monetary (interest rate) to asset price shock

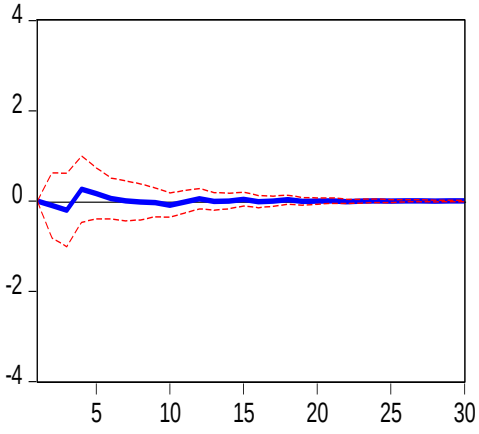


Figure 4.2.4

Response of credit market to asset price shock

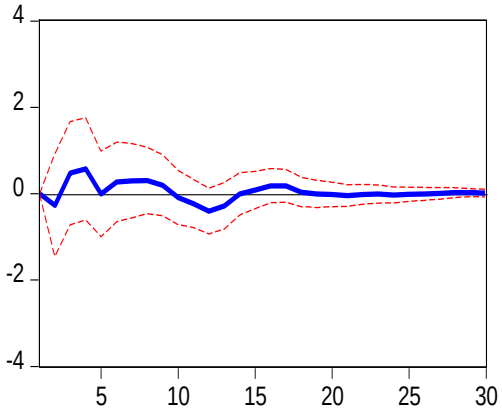
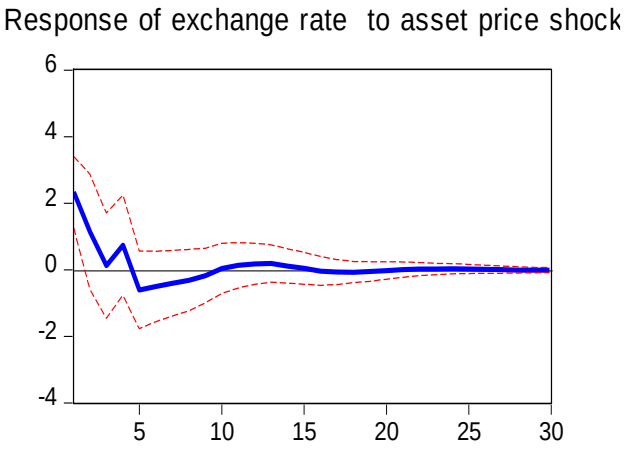


Figure 4.2.5



Another critical issue for monetary policy formulation is the effect of asset price shocks on the economy in terms of its effect on aggregate demand, supply, interest rates, credit market, and exchange rate. This is analysed through the impulse responses presented in the figure 4.2.1. The response of GDP is positive which can be attributed to wealth effect. This wealth effect further gets transmitted through the balance sheet channel changing investment and consumption.. In the other panels of the figure one finds response of general rice level to be positive. The response of interest rate is negligible, which confirms that monetary policy doesn't respond to stock prices (i.e. asset prices).The credit market response is positive meaning that stock prices tend to increase the demand for credit in the economy. The asset price shock fizzles out in 14 quarters. The figure 4.2.5. The response of exchange rate is positive from the second quarter. The positive shock on asset prices changes stock returns, which attracts capital inflows from foreign investors, resulting in increased investment in the country. The exchange rate appreciates in the process in short run, and then medium to long run this shock dies out.

4.6.4 Variance decomposition results

The variance decomposition separates out the variation in an endogenous variable into the shocks of different of the VAR. In other words it answers the question, "what portion of the variance of the forecast error in predicting the variable of our interest is due to the structural shock? It basically provides information on how each innovation is important relative to another in affecting the variable(s). Accordingly, the results of variance decomposition are presented and discussed below.

In this section asset price channel is assessed through the forecast error variance decomposition analysis. It's clear from the table 4.4 above that asset price's own shock explains the largest variation in asset prices. This is followed by supply and credit market shocks. This establishes the credit market and stock prices relation. The monetary and output shock establishes that, monetary policy works through the credit and supply markets as they respond first. The exchange rate also explains significant variation in asset prices. Another aspect how asset prices shock explains the variations other variables.

Table 4.4: Variance decomposition of asset prices

Period in quarters	Aggregate demand	Supply	Interest rate	Credit	Asset price	Exchange rate
1	0.07	9.52	7.54	5.88	76.96	0.00
2	3.87	9.72	6.69	7.12	69.12	3.45
5	3.11	16.68	8.64	15.65	50.51	5.39
6	5.06	19.50	7.78	14.23	46.67	6.73
10	5.03	20.97	7.66	15.98	42.09	8.23
15	5.08	21.38	7.59	15.84	41.57	8.50
20	5.07	21.54	7.57	15.87	41.37	8.55

The table 4.5. Reveal that, variance decomposition of aggregate demand, supply explained by asset prices is low in short run, whereas medium to long run significant. The asset prices does not explain the variation in the monetary policy. The largest variation in exchange rate explained by asset prices.

Table 4.5: Variance decomposition explained by asset prices

Period in quarters	**Aggregate demand**	**Supply**	**Interest**	**Credit market**	**Asset price**	**Exchange rate**
Variance decomposition of Aggregate demand						
1	100.00	0.00	0.00	0.00	0.00	0.00
2	81.52	10.27	0.25	0.41	5.93	1.59
5	56.91	24.26	3.79	1.40	10.59	3.03
6	53.37	23.90	3.71	6.28	9.85	2.86
10	45.61	26.28	4.78	7.26	11.52	4.52
15	44.33	26.37	4.89	7.54	11.71	5.13
20	44.27	26.37	4.89	7.53	11.71	5.21
Variance decomposition of supply (price level)						
1	5.32	94.67	0.00	0.00	0.00	0.00
2	9.14	67.14	0.05	18.01	0.01	5.62
5	5.95	58.72	3.25	17.99	6.03	8.02
6	5.80	57.19	3.34	19.89	5.82	7.93
10	5.31	54.01	3.94	19.10	7.43	10.18
15	5.35	53.56	3.90	18.68	7.48	10.99
20	5.35	53.54	3.90	18.67	7.47	11.02
Variance decomposition of monetary (interest rate)						
1	0.19	3.39	96.41	0.001	0.00	0.00
2	0.69	2.62	90.87	4.68	0.14	0.97
5	1.11	5.14	82.94	7.35	1.97	1.46
6	1.13	5.01	82.05	8.35	1.95	1.48

10	1.86	5.50	79.41	9.52	2.01	1.68
15	2.09	5.74	78.63	9.75	2.04	1.72
20	2.11	5.78	78.53	9.76	2.05	1.73
Variance decomposition of credit market						
1	0.51	9.93	2.15	87.39	0.00	0.00
2	11.47	14.18	2.06	71.75	0.47	0.05
5	13.75	17.52	2.96	57.19	3.07	5.49
6	13.80	19.50	3.47	54.42	3.25	5.53
10	13.08	21.82	3.77	51.98	3.87	5.44
15	12.51	23.06	3.85	49.57	4.78	6.20
20	12.41	23.29	3.81	49.02	4.97	6.47
Variance decomposition of exchange rate						
1	1.00	18.09	9.48	0.41	22.77	48.24
2	1.06	18.80	8.95	5.60	23.73	41.82
5	3.52	18.89	9.69	6.04	22.65	39.18
6	3.88	18.61	9.62	5.97	23.05	38.84
10	3.90	18.31	10.59	6.27	23.18	37.72
15	3.90	18.32	10.59	6.35	23.28	37.53
20	3.91	18.31	10.58	6.36	23.29	37.51

4.6.5 Historical variance decomposition (HVD)

The historical decomposition tells what portion of the deviation of y_{it} from its unconditional mean is due to the shock e_j. The structural shocks push the variables away from their equilibrium values. Thus, HVD is an alternative method of innovation accounting, which decomposes the observed series into the components corresponding to each structural shock. Burbridge and Harrison(1985) proposed transforming observed residual to structural residuals and then for each observation

beyond some points in the estimation sample, computing the contribution of the different accumulated structural shocks to each observed variable.

The contribution of different shocks to asset price in India over a time period could be gathered from the historical decomposition results. It is evident from Fig. 4.3.1 to 4.3.6 that shocks in asset prices since the 2007-2008 were explained by genuine credit, supply shocks and its own asset price shock. The monetary shock does influence asset price variability, but its impact is transmitted *via* credit market, and supply shocks. This result is also seen in the IRFs result presented earlier. The own shocks of asset prices emanate from information due to sudden changes in market sentiment and other capital market related information.

Figure 4.3: Historical variance decomposition

Figure 4.3.1

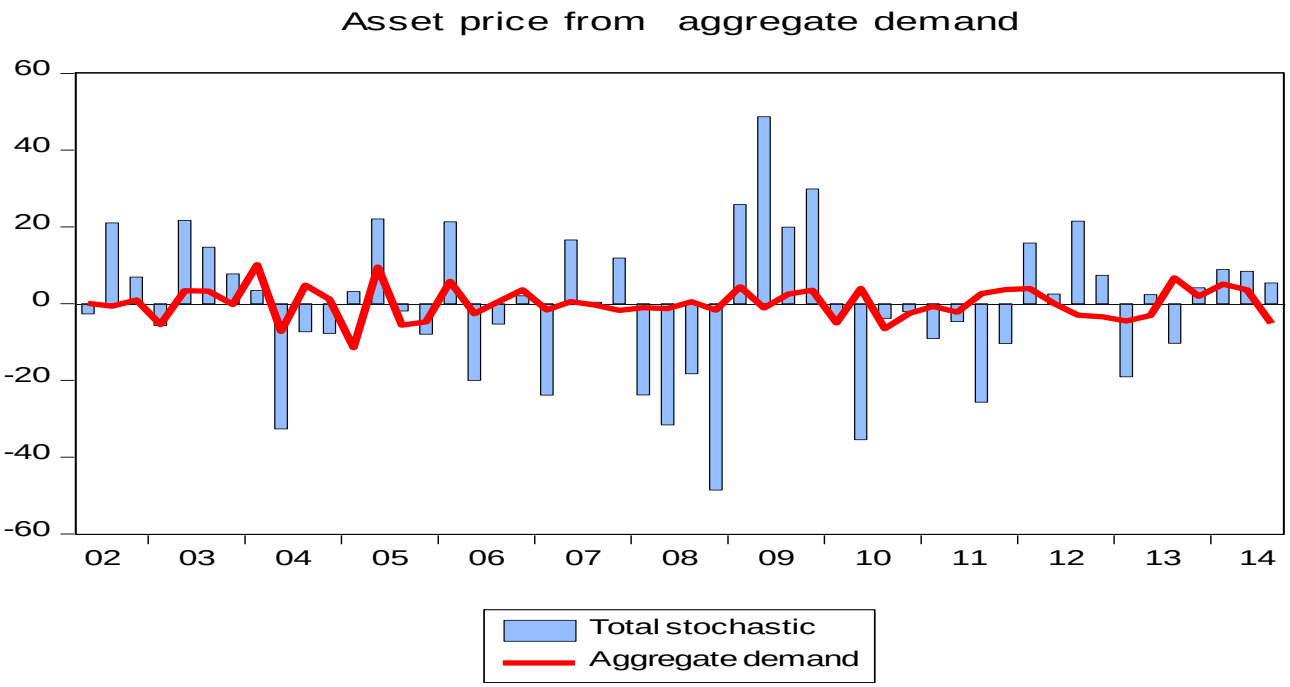


Figure 4.3.2

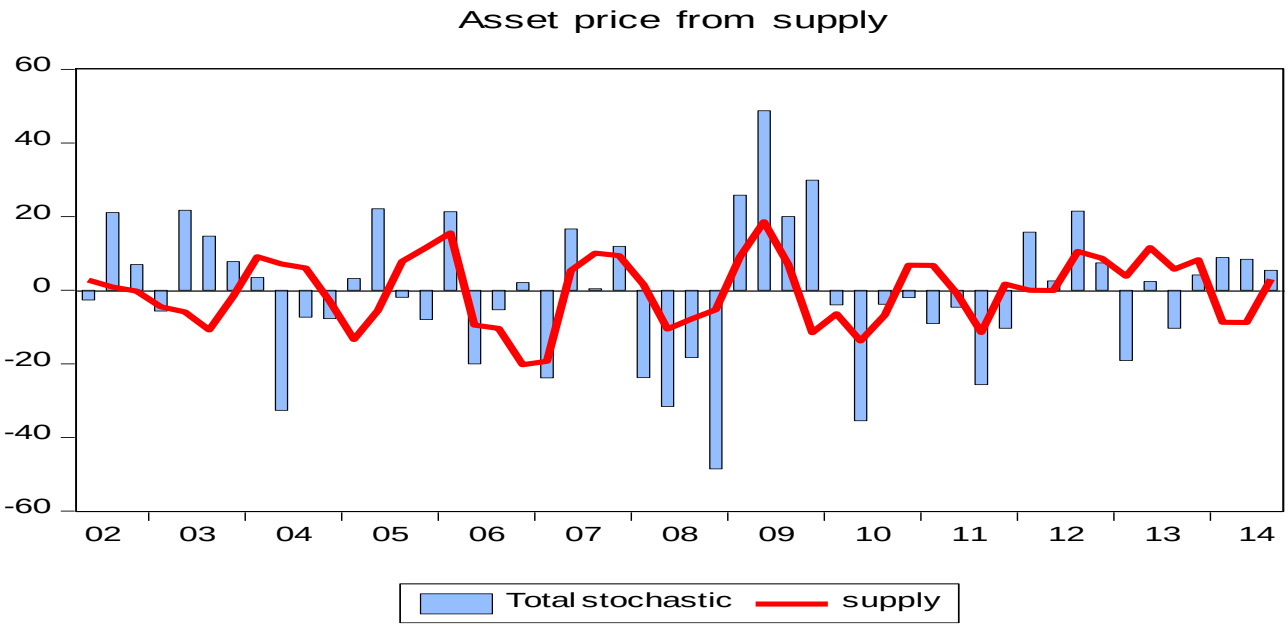


Figure 4.3.3

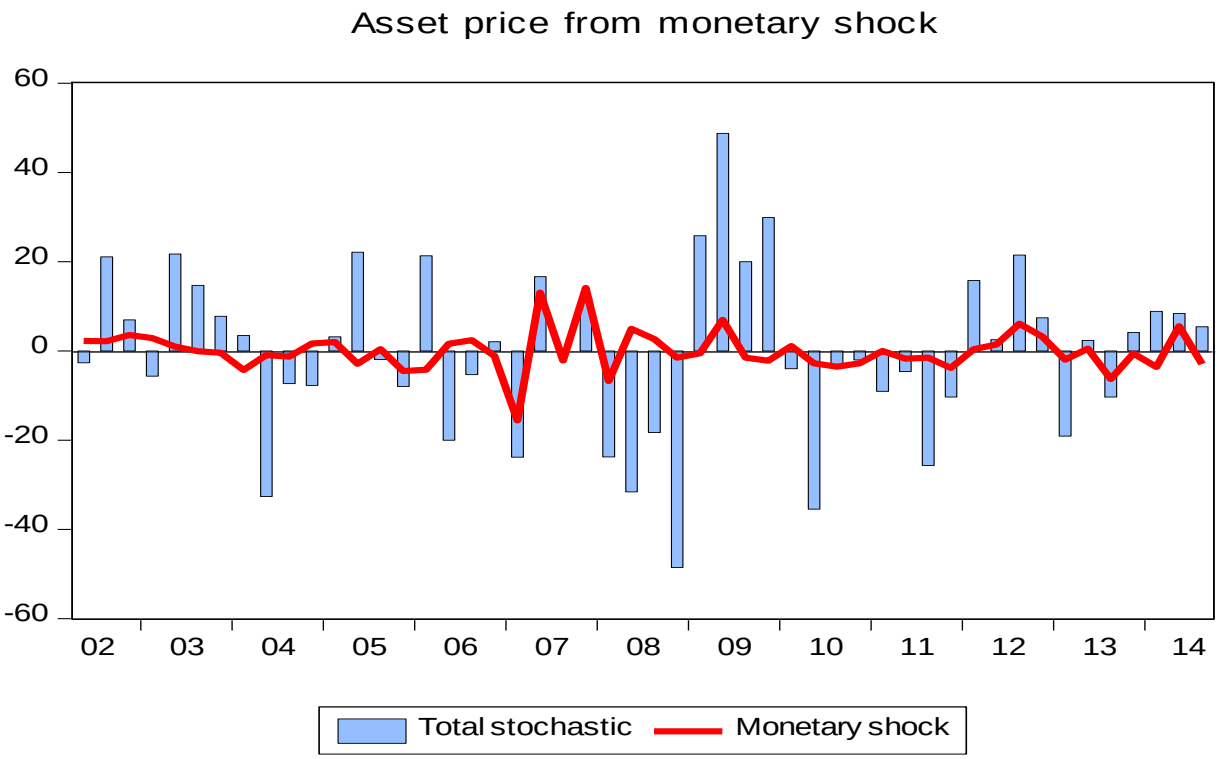


Figure 4.3.4

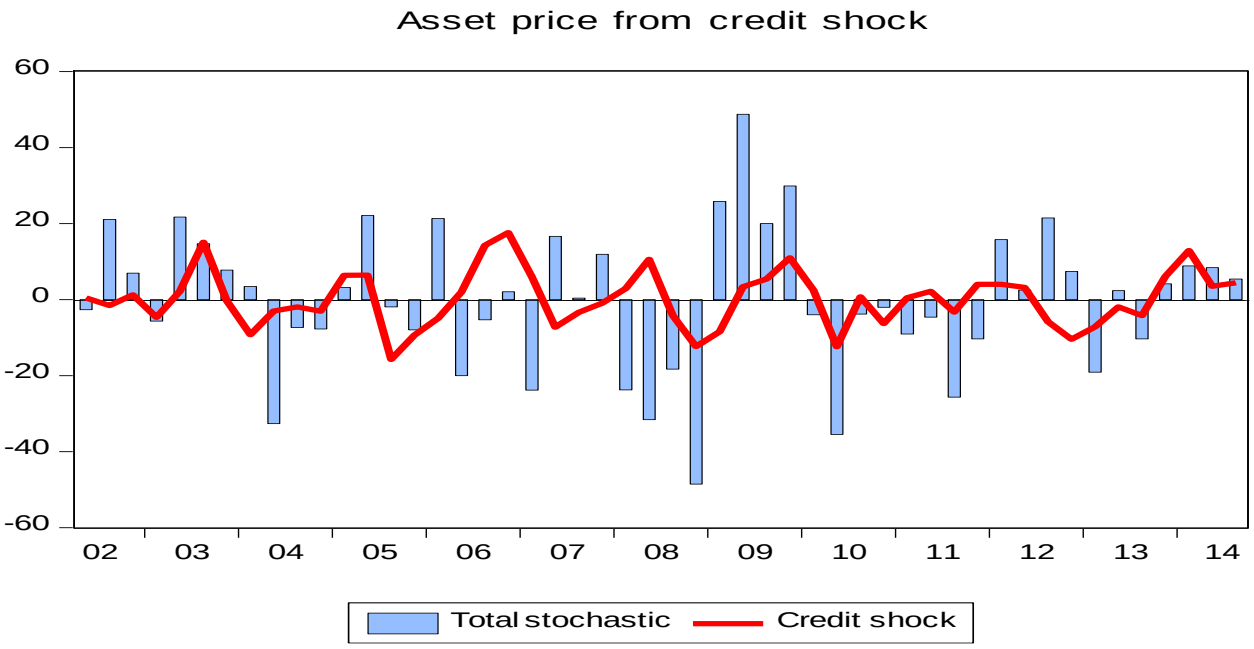


Figure 4.3.5

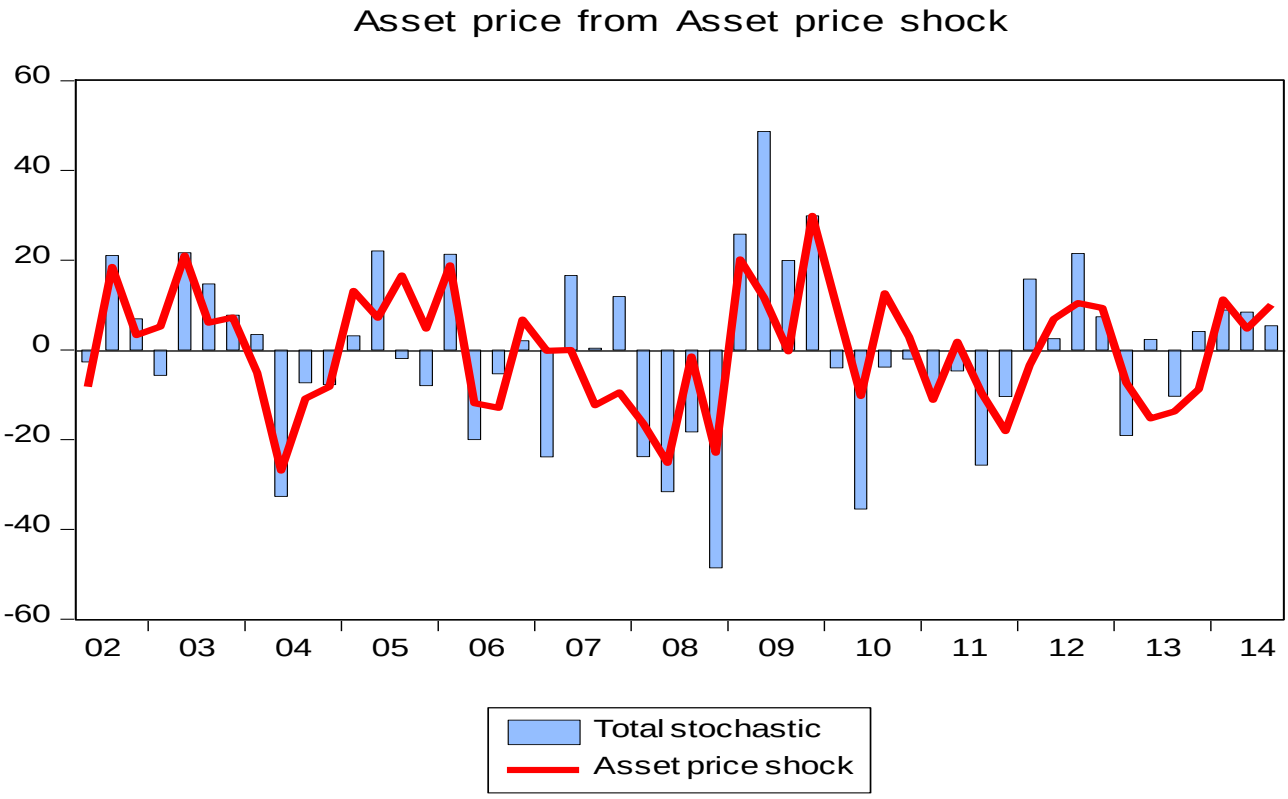


Figure 4.3.6

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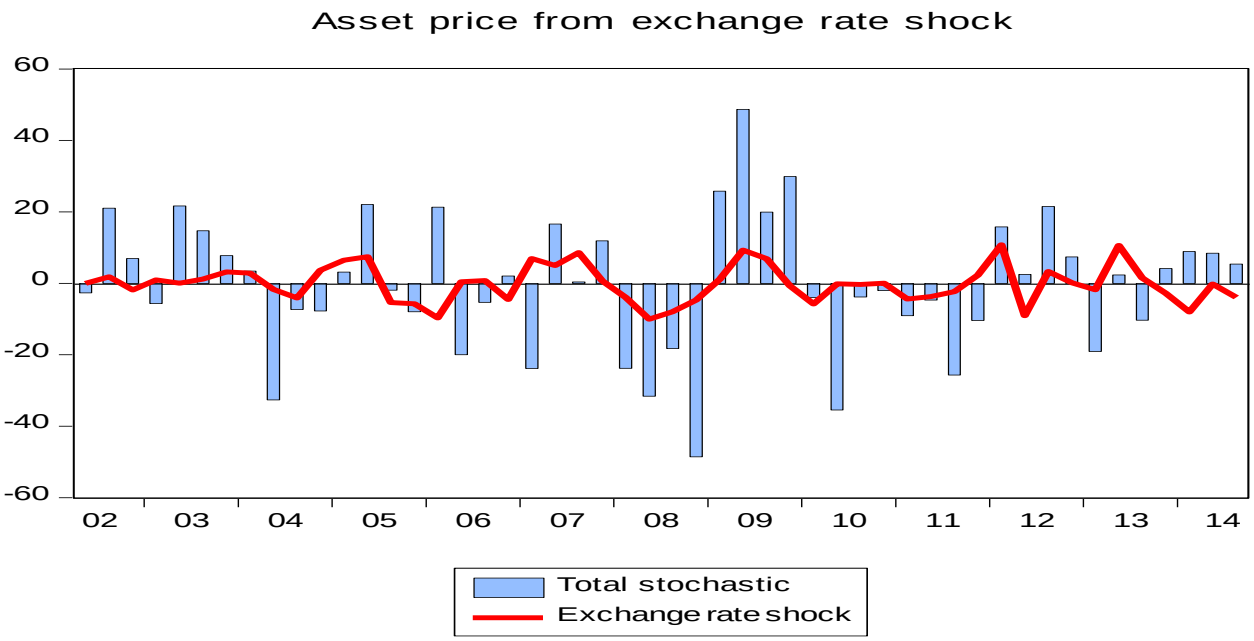


4.6.6 Some diagnostic tests

The relevant diagnostic test results due to serial correlation, heteroscedasticity and AR root test for SVAR model are presented in the appendix. In two tests the test-statistics for, serial correlation, heteroscedasticity are found to be insignificant. Hence, the models do not have any issues of serial correlation and heteroscedasticity. The Fig.4.4. AR root test also confirms that the models do not suffer from the unit root problem. (See the tables and figure in chapter - 4 appendix).

4.7 Conclusion

The objective this chapter was to assess the role played by asset prices in the monetary transmission channel. The empirical analysis revealed the following results. The asset price proxy

was equity prices here. It is found that the positive aggregate demand shock leads to economic growth rate changes and in turn changes in the household and business firm's wealth. This change results in change in asset prices. A supply shock that changes the general prices, leads to fall in equity prices. This response fizzles out in medium to long run. The inflation shock is found to be strong in the asset price channel. A positive monetary policy shock i.e. increase in interest rate causes decline in the equity prices. Monetary shock shows significant impact on asset price channel, through decline in equity prices reduction in consumption of households, and business firms, due to decline in wealth. The positive credit shock leads to an increase in the equity price initially before the shock dies out. The response of equity price from positive exchange rate shock leads to decline by equity prices. The appreciation of exchange rate makes external trade less competitive in international markets and reduction in returns from equity prices. This dampens the economic growth rate and equity prices.

The next set of results show how aggregate demand, supply, monetary, credit market, exchange rate respond to shock from asset price (equity price).The response of GDP is positive , which can be attributed to wealth effect. This is further transmitted through the balance sheet channel finally impacting the investment and consumption pattern. The response of general price level is positive in line with theoretical expectations. The response of interest rate is negligible, confirming that monetary policy doesn't respond to equity prices (asset prices).The credit market response is positive. The asset price shock fizzles out in medium term to long run. The positive shock on asset prices, results in changes in equity returns, attracting capital inflows from foreign investor and finally resulting in higher investment in the economy. The exchange rate appreciates in the process in short run, and then in the medium to long run this shock dies out.

The results obtained from variance decomposition imply that the own shock in case of equity price accounts for the largest variation in the equity prices. This is followed by the supply and credit market shocks. This establishes the credit market and equity price relation. The monetary and output shocks establish that, monetary policy works through the credit variable as it seems to be responding first. The exchange rate also explains significant variation in asset prices.

To sum up one finds from the above results that monetary policy doesn't respond directly to asset prices (equity prices). But there is indirect presence of asset price channel, which transmits to other macro variables. The results also confirm that monetary policy impacts stock price returns.

4.8 Appendix

Figure 4.4: AR root test

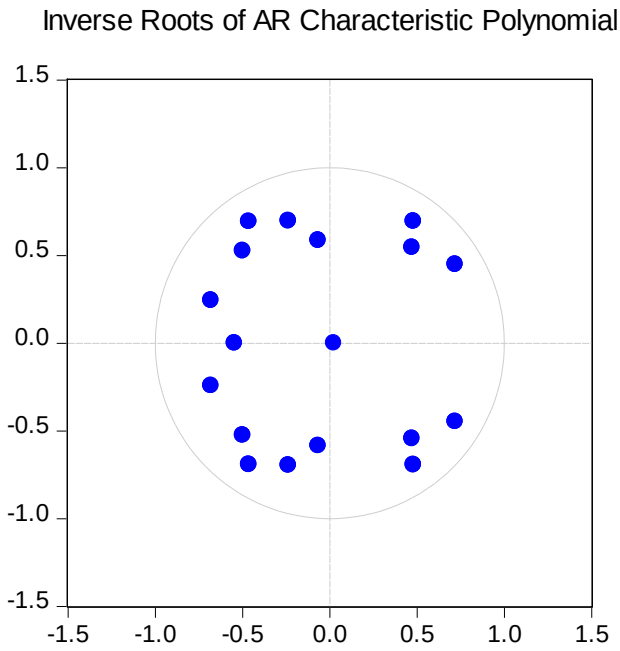


Table 4.3: Lag order selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-787.8961	NA	2492046.	31.75584	31.98529*	31.84322*
1	-741.5587	79.70033	1666429.	31.34235	32.94845	31.95396
2	-698.9870	63.00612*	1363437.*	31.07948	34.06224	32.21533
3	-662.1173	45.71844	1556804.	31.04469*	35.40410	32.70478
* indicates lag order selected by the criterion						

Table 4.6: LM Tests for Serial Correlation

SVAR Model	
Lags	LM-Stat
1	43.62 (0.17)
2	44.23 (0.16)
3	44.52 (0.15)

Table 4.7: Heteroskedasticity Tests

SVAR Model	
Joint Test	
df	Chi-sq (Prob.)
756	745.9 (0.59)

Chapter-V

Equity derivatives and monetary transmission in India: Some Evidence

5.1 Introduction

After the economic reforms beginning with 1991in the Indian economy, in the wake of the Indian BOP crisis, Indian Financial system's structure, shape and direction changed considerably. The role of capital markets assumed greater significance in the Indian financial system which was primarily bank led earlier. The role of financial assets such as equities and derivatives assumed further importance in monetary policy transmission. Integration of the economy with the rest of the world in general and of the financial markets in particular has led to higher asset prices volatility. This has also played key role in the financial stability of the economy. To manage this uncertainty and enable different stakeholders in the financial markets to manage their risks, Indian policy makers had introduced derivative products in the Indian financial system in a phased manner. The details of its evolution have been discussed in Chapter-II.

Of late use of Derivatives has grown significantly, but in the last two decades, it's got a prominent role in the financial markets operations. This can be seen from the magnitude of the notional amount of turnover in trading exchanges and OTC markets. Derivatives fulfil some specific economic functions that can influence the way individual, institutional and economic agents respond to monetary and fiscal policy actions and changes in the macroeconomic environment.

One example to highlight the importance of derivatives in the present day Indian economy is the twin balance sheet[1] problem mentioned in the economic survey 2016 "Firms that borrowed domestically suffered when the RBI increased interest rates to quell double digit inflation. And firms that had borrowed abroad when the rupee was trading around Rs 40/dollar were hit hard when the rupee depreciated, forcing them to repay their debts at exchange rates closer to Rs 60-70/ dollar". This led to higher financing costs, reduced revenues to corporations, and this also forced companies into higher costs of debt servicing. The problems of balance sheet of companies translated in turn to banking sector balance sheet problem. In this case companies probably had not t hedged against foreign exchange rate risk. This is where derivatives play key role in providing risk mitigating solutions.

The rise and growth of equity derivatives has been discussed in chapter 2.This chapter attempts to analyse the role of equity derivatives in monetary transmission to investigate the possibility of derivatives affecting monetary transmission in India in recent days.

The rest of the chapter 5 is organized as follows. Section 5.2 presents the economic function of derivatives. In section 5.3. On the possible effect of financial derivatives on monetary transmission channel is discussed. Section 5.4. Reviews select relevant literature relating to the theme of this study. The details of model selection and methodology are discussed in section 5.5 and empirical results are discussed in section 5.6. .Finally, section 5.7.offers some concluding remarks.

5.2 Economic Function of Derivative Instruments

The economic function of derivatives is presented in detail in the BIS (1994) report. A brief understanding of such economic functions from the review of the BIS report is the following. The

economic functions may be broadly divided as into four; i) Risk unbundling and its transfer ii) larger trading opportunities iii) Price discovery iv)Asset substitutability.

i) Risk unbundling and its transfer: The basic premise of the derivatives market is that, transferring the risk of underlying assets like exchange rates, interest rates, equity, and other assets. Diamond (1984) demonstrates that, "hedging interest rate risk through the derivatives markets lowers the probability of bank failure. Because bank loans are illiquid and monitoring loan contracts are costly, banks have incentives to use a variety of means to increase the net cost advantage of intermediation". With the help of interest rate derivatives risks due to discrepancies in the bank's variety of maturity period of assets can be unbundled.

ii) Larger trading opportunities: This economic function explains the completeness of markets. Derivatives create leverage of trading and hedging for the underlying assets without purchasing the actual assets. For example, if a trader wants to purchase all the stocks in BSE SENSEX it is very expensive to purchase. Instead, the trader can buy the index options or index futures with lower cost. This enables the trader to leverage better the increasing trading opportunities in the market.

iii) Efficiency and price discovery: The underlying contract prices can discover and improve the efficiency. Prabha et al (2014) say, "Price discovery refers to the use of derivative prices to predict future cash market prices, information that can be applied by policymakers and central banks in decision-making as well as companies and banks in managing their risks". To explain with an example, based on the future stock, index contract prices, the spot market price information can be inferred. Markets do not have full information always and therefore, the futures and options markets help gain the most valued information with least cost possible. The recent studies such as Reichsfeld and Roache (2011) and Mizrach and Neely (2007) confirm the price discovery process.

iv) Asset substitutability: The above functions of risk transfer, price discovery and increased trading options make the investor switch from one asset to another in the financial system. Gupta (2004) explains that "Derivatives make arbitrage between two different assets or two similar assets denominated in different currencies much easier. The extra trading caused by arbitrage transactions increase liquidity and improves market efficiency". This enhances the arbitrage and hedging opportunities for domestic players in international markets. But there is always a danger perceived if the investor opts for speculative activity.

5.3 Effect of Financial derivatives on Monetary Transmission

The monetary transmission channels explained earlier in section 4.2 covered basic transmission channels without financial derivatives. The role of asset price channel was discussed limiting it to equities/stock prices only. Of late, the possible role of derivatives in monetary transmission has invited attention of researchers. But the empirical literature to prove this role is very scanty. To quote Chakrabarti (2016) in his discussion on effects of financial development on monetary transmission, " ……(i) Indian financial markets have experienced significant deepening as the proportion of market capitalization to GDP has risen markedly over the years; (ii) derivatives have emerged as key elements of the financial system; (iii) the vulnerability of the exchange rate and the asset markets to the ebb and flow of international capital has increased and will continue to stay high;…..". Further says Chakrabarti (2016), "The rise of derivatives, in general, is also a positive development for strengthening monetary transmission as derivatives help to complete markets and aid arbitrage, therefore possibly circumventing institutional delays or reluctance on the part of banks in transmitting policy rate changes to alterations in effective lending rates. There are, of course, the concomitant fears of derivatives leading to hyper leveraging and overconcentration of risks to a few entities with possible destabilizing effects of the financial

system itself, but with the highly conservative regulatory stance of the Indian financial system as well as the post-global-financial-crisis institution of stability report, this risk seems to be a remote one. The extent to which the strengthening of transmission has actually been happening in India is something that only future research can say, however". This observation implies that derivatives may speed up transmission or possibly impede. This skepticism on actual working of the transmission post financial innovation in India in various dimensions in India including the derivatives' growth is due to the following.

As financial markets deepen one would usually expect strengthening of the transmission channel. But the question is whether the deepening is due to sheer rising asset values in the market with very less participation of the population. To partially quote Chakrabarti (2016)" ….For instance direct equity market participation for the Indian population is below 5 % and even by taking into account indirect participation through mutual funds, it still remains below 15 %. Further, the glaring rural–urban divide is seen with the 5 metros accounting for almost three-quarters of the entire asset under management for the mutual fund industry. Therefore, a coexistence of increasing deepening *via* asset price increases in the formal sector with informality in the last mile for the majority of savers and businesses is the reality".

In the wake of increased use of derivatives as one of the dimensions of financial innovation the transmission channels discussed earlier in chapter-4 may be revisited as the following.

The interest rate channel: The interest rate is a traditional channel of monetary transmission. The use of derivatives cannot reduce the ability of central banks changing the interest rates. The regular substitution effect does not change due to derivatives' usage. But derivatives intensify the transmission speed through substitutability between various financial assets due to leverage and

low cost. Thus they can influence the investors to hedge their portfolio and that surplus cash flow helps to improve their wealth distribution.

Derivatives have the following possible impact on credit channel. Hypothetically derivatives can add to broadening firms different sources of finances, either by reducing the issues related to asymmetric information or by empowering borrowers and in addition borrowers and lenders had the overcome risks by using the credit derivatives.

Coming to the exchange rate channel, the relationship between the exchange rate channel and interest rate channel is about the substitutability of assets and speed of transmission. In exchange rate channel, derivatives' impact can be assessed through as the following. How do domestic as well as foreign assets of different maturity get substituted using different derivatives. This substitution mechanism helps the transmission of monetary policy on changes in yields' of different maturities of different currency denominated assets. This process helps to promote the international monetary transmission linking with different countries. Derivatives may not directly drive the force of channel, but through speeding up of the process.

Research on different channels of monetary transmission has been voluminous, directly or indirectly impacting the employment, output, prices, financial markets and overall economic agents. Mishkin, F. (1996) had classified the channels broadly as follows, a) traditional interest rate channel b) bank lending and balance sheet channels, c) exchange rate channel, d) asset Price Channel. Here, we cover largely impact of derivatives on these transmission channels with and without the presence of derivatives. In other words we try to examine these channels controlling for derivatives.

5.4 Select Review of Literature

Financial derivatives give opportunity to market participant to plan investment gaps between different market segments .This indicates that an increase in the substitutability of financial assets across a wide range of market segments and a broader scope of arbitrage possibilities between markets (Deutsche Bundesbank, 1994). It will reduce the price volatility in domestic market because of spillover of the asset in different markets.

Large scale derivatives usage has the following underlying economic intuition like hedging, leveraging, and substitutability of assets. In terms of impact on the macroeconomy, the more preferable risk distribution of hedging with combined marginal cost of capital allowing market participants and economic agents to ameliorate unique strengths, resulting in large sustainable growth. An IMF (1997) study by Vrolijk used structural vector autoregression model to study the derivative effect of monetary policy transmission in UK. The model consists of four variables: the real gross domestic product, proxy of notional turnover in derivatives, prices, overnight nominal interest rate, mainly focusing on the United Kingdom. The empirical results show that changes in financial market asset prices will be more rapid following monetary policy actions with derivatives. However, impact on output and inflation remain ambiguous.

Growth of financial derivatives might alter the direction of monetary transmission channel. When central banks change monetary policy instruments like policy interest rate of that country, derivatives enable asset substitutability in market by absorbing the new information in the market and it changes monetary transmission process in the financial markets. Cohen (1996) supports this assumption empirically i.e. derivatives quickly imbibe the new information inflow in asset prices. The study formulated three hypotheses to understand this phenomenon by using Variance ratio test

methodology for USA and Germany economies. The hypothesis is that, use of derivative markets can create fluctuations in its underlying asset price market, which are not related to the price discovery mechanism. Empirical evidence shows that the variance in changes in the asset price are bigger after the introduction of derivatives than before. Thus, it suspects the assumption that derivatives make underlying asset prices more stable. It is suggested that presence of derivative market, changes the direction and path of monetary transmission channels.

Visco (2007) analyses how financial deepening impacts the monetary policy and its transmission mechanism in to real sectors, since the last two decades witnessed enormous growth of development of financial derivatives deepening financial market portfolio. This dramatically altered roles of banking and other financial institutions. The emergence of a new set of investors and diversification of portfolios made difficult the task of tracking events for the central banks for the developed and developing countries, and its risk on financial system. The main arguments given are the following. The growth of financial assets made the credit channel weaker over time due to asset securitization and other derivatives market growth. The changing structure of households and financial asset portfolios made the wealth and substitution relevant in monetary transmission mechanism. With the increasing integration of financial markets around the world resulted in importance of exchange rate in the wealth effect. Further, financial derivatives as part of financial innovation in the financial system also led to weakening of the traditional monetary transmission channels.

Amamiya (2016) discusses about the robust financial architecture with especially financial derivatives market to deal with uncertainties, broader safety and transparent transaction system. These factors help monetary and macroeconomic performance given the situation in the developed and developing countries. Japan central bank experience of dealing of above factors as follows. In

most of the financial economics literature Risk –free interest rate is the most focal point of financial modelling, to reduce the uncertainty and eliminate the basis risk. To identify Japan central bank and ISDA established study group on Risk –free interest rate, they concluded Japan risk-free interest rate overnight call money rate uncollateralized. Similar exercises happened to USA, UK and countries, overnight call money rate is the most suitable instrument and through this we can trace out the financial derivatives uncertainties and its volatility.

Disyatat and Vongsinsirikul (2003) examine the monetary transmission mechanism in Thailand, to understand the gaps in policy transmission lag, which ultimately show how monetary policy shocks affect macroeconomic development in Thailand. The results show that interest rate pass-through is sticky in Thailand economy. Comparing the results with advanced countries, the authors find that interest rate pass-through is higher in the advanced countries than Thailand. Another interesting finding is that after the south Asian financial crisis of 1997, the responsiveness of interest rate became stickier compared to the period before 1997. This result of Thailand banking channel is important because historically Thailand's Investment depended on bank lending process. Further, results on role of asset prices in the monetary transmission had less importance in their study period. However, in the future investment in the Thailand economy is expected to be more dependent on capital market.. Belke & Beckmann (2015) in a cross country study find short run interest rate impact on stock prices in three out eight countries.

Fender (2000) argues that in the presence of hedging with derivative contracts the credit channel gets reduced to just the cost of capital effect. The underlying reason is that when firms facing interest rate risk can stabilize their cash flows in a given period, they are in a position to predict their need for external funding. Thus they take decisions based on the expected cash flow, which is entirely independent of the interest rate movements. Therefore, the investment spending ought

to be less responsive to interest rate changes with hedging. In other words reduction in hedging ought to magnify investment spending changes as a result of interest rate changes.

Let us see what happens to the asset price i.e. equity price channel in the presence of derivatives. Firms can use derivatives to hedge against possible changes in their net worth due to equity price changes. This can happen in a number of ways making their investment and spending decisions less sensitive to equity prices. For instance, firms can purchase derivative contracts, the value of which changes according to the general level of equity prices in the market. This in turn makes the firm's spending and investment decisions less sensitive to changes in equity prices. For instance, when a firm's equity investment decreases in value, but its derivative hedge increases in value proportionally, net worth won't change due to equity prices changes. The firm won't , change its spending decisions in such a case. This reasoning can be placed in the context of interest rate changes due to expansionary/contractionary monetary policy leading to certain change in equity prices and therefore in investment and output, but without derivatives. This can happen through the Tobin's *q* discussed earlier. But with derivatives and hedging firms' spending decisions turn less sensitive to changes in equity prices via the Tobin's *q* mechanism. This is precisely the reason why one should revisit the equity price channel in the presence of derivatives.

In the Indian study Singh & Pattanaik (2012) show that, role of asset prices in the monetary transmission is weakly present and it's not clear if the central bank responds to asset prices in their monetary policy decisions. Another study by Sengupta (2014), however, finds that the asset price channel has strong presence in the post liquidity adjustment facility regime in India. These studies primarily look at equity prices. There is no study that looks at derivatives.

5.5 The present study: methodology and some SVAR results

5.5.1 Choice of Model and Variables selection

In light of the above discussion and review, in this chapter two Structural Vector Autoregression (SVAR) models are investigated to examine the dynamic relationship between monetary policy and equity derivatives. This two Structural Vector Autoregression (SVAR) models have been set up. The variables used are GDP, Inflation (WPI), Call money rate, and Money Supply (M3), volume of Equity derivatives spanning over quarterly period of 2001Q2 to 2014Q2. The model and variables are selected based on Vrolijk (1997), Singh & Pattanaik (2012) and Sengupta (2014). GDP, M3 and derivatives are in terms their growth rates.

SVAR-1 Model-without equity derivatives

$Y_t = [GDP_{t,} WPI_t, CM_{t,} M3_t]^T$

SVAR-2 Model- with equity derivatives

$Y_t = [GDP_{t,} WPI_t, CM_{t,} M3_t, Equity\ Derivatives]^T$

5.5.2 Data Sources and study period

Data on GDP, Inflation (WPI), call money rate, and money Supply (M3) are collected from RBI-the Handbook of Statistics on Indian Economy. The data on equity derivatives are collected from SEBI.

5.5.3 Methodology

To study monetary policy transmission with and without equity derivatives, the two SVAR models are estimated using the following variables: GDP (y), Inflation (p), Call money rate (r), Money Supply (M3), Equity derivatives (e).

The SVAR model incorporates the restrictions, which are deployed to identify various structural shocks. The model takes the following form.

$A_0 y_t = B(L) y_{t-I} + \varepsilon$,with i=1,…….,n (1)

SVAR-1

$$\begin{pmatrix} e_y \\ e_p \\ e_r \\ e_{m3} \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ 0 & a_{32} & 1 & 0 \\ a_{41} & a_{43} & a_{43} & 1 \end{pmatrix} = \begin{pmatrix} \varepsilon_y \\ \varepsilon_p \\ \varepsilon_r \\ \varepsilon_{m3} \end{pmatrix}$$

SVAR-2

$$\begin{pmatrix} e_y \\ e_p \\ e_r \\ e_{m3} \\ e_e \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ 0 & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{pmatrix} = \begin{pmatrix} \varepsilon_y \\ \varepsilon_p \\ \varepsilon_r \\ \varepsilon_{m3} \\ \varepsilon_e \end{pmatrix}$$

The SVAR-1, and 2 models have the following theoretical assumptions. GDP shocks being exogenous are not instantaneously affected by other macroeconomic variables in the model. Therefore, all coefficients in the matrix have been restricted to zero. Whereas, Inflation is influenced by GDP shocks simultaneously, other variables do not impacted inflation in the

SVAR structure. With regard to the monetary policy variable is interest rate, the information being available to the central banks at a time lag on GDP data therefore the interest rate function does not respond simultaneously to GDP. But price information being available is used in the monetary policy function. Money supply is simultaneously affected by GDP, Inflation, and interest rates. In SVAR -1, there is no equity derivatives .Whereas in SVAR -2 model the equity derivatives variable simultaneously gets affected by GDP, prices, interest rate, and money supply shocks in the system.

5.6 Results and discussion

5.6.1 Unit root tests

The results of unit root tests (Augmented Dickey Fuller (ADF), Phillips-Perron (PP) are presented in Table 5.1. All the variables are tested for unit roots with intercept and with intercept and trend. Broad money (M3), is found to be non-stationary at level in all the tests and stationary at the first difference with trend and intercept in ADF and PP tests at 1 percent level of significance. WPI inflation (INF) is found to be stationary at level in all the tests and stationary at the first difference with trend and intercept in ADF, whereas PP test is found to be non-stationary at level in all the tests and stationary at the first difference with trend and intercept., Equity Derivatives(ED), in ADF test ,with intercept, it is found to be stationary at level and first difference; non-stationary at level and stationary at the first difference with trend and intercept,. But in the PP test it is found to be non-stationary at level and stationary at the first difference with trend and intercept. GDP is found to be non-stationary at level in all the tests and stationary at the first difference.. For estimating the models, based on unit test results, the study employed variables in their first difference the model.

Table 5.1: Unit root tests

	ADF Test Statistic With Intercept		ADF Test Statistic With Intercept and Trend		PP Test Statistic With Intercept		PP Test Statistic With Intercept and Trend	
Variable Name	Level	Ist Diff	Level	Ist Diff	Level	Ist Diff	Level	Ist Diff
GDP	-2.56	-7.08***	-2.36	-5.63***	-2.64*	-7.08***	-2.45	-7.06***
INF	-5.21***		-5.33***	-6.37***	-2.22	-3.71***	-2.05	-4.03***
CM	-4.28***		-4.81		-4.31***		-4.82***	
M3	-1.84	-8.22***	-1.86	-8.26***	-1.84	-8.54***	-1.80	-9.13***
EDFU	-3.20**	-8.48***	-1.65	-9.40***	-1.90	-5.99***	-1.79	-6.64***
LEDOP	-3.34**	-3.32**	-3.34*	-6.05***	-3.30**	-8.54***	-3.33*	-8.53***
ED	-3.68***		-2.51	-9.09***	-2.44	-6.16***	-1.84	-6.78***

Note: ***, **,* indicates 1,5,10 percent level of significance

5.6.2. Lag length:

Table 5.2. Provides the optimum lag order is found to be 3 by following AIC information criteria for the SVAR models. Results are in appendix Table - 5.2.VAR- lag order selection.

5.6.3. Impulse Response functions

The impulse response results of empirical SVAR-1, and 2 models basically show the impact of equity derivatives on monetary transmission mechanism. The response to monetary policy i.e. interest rate shocks are traced in the IRFs with or without presence of equity derivatives. The one S.D. positive shock in interest rate impacts GDP and inflation, faster in the presence of equity derivatives compared to the model without equity derivatives. The Figure 5.1, 5.2, 5.3 and 5.4

trace the IRFs with and without the presence of derivatives. To see the response of GDP, inflation when one S.D. shock is given to interest rate, it's evident from the IRFs that with introduction of derivatives transmission becomes different in nature. In case of GDP the IRFs shows faster decline in GDP without equity derivatives. Inflation hardly responds to interest shock in the presence of equity derivatives. It's is almost negligible for the first few quarters in the model with derivatives. The response of money supply to interest rate shock doesn't change much in the presence of derivatives. In both the models money supply declines in the first two quarters before reverting to zero in the 11^{th} quarters.

Then next shock is from money supply and response of GDP and inflation. The empirical results shown that, response of GDP, and inflation are positive in both the models but the transmission is faster with presence of derivatives than without derivatives as shown in the figure 5.7, 5.8, 5.9 and 5.10.

The overall finding from impulse response results show that, presence of derivatives fastens the monetary transmission process and its impact on the real variables like GDP, and Inflation in the Indian economy.

Figure 5.1: Response of GDP to Interest rate (without equity derivatives)

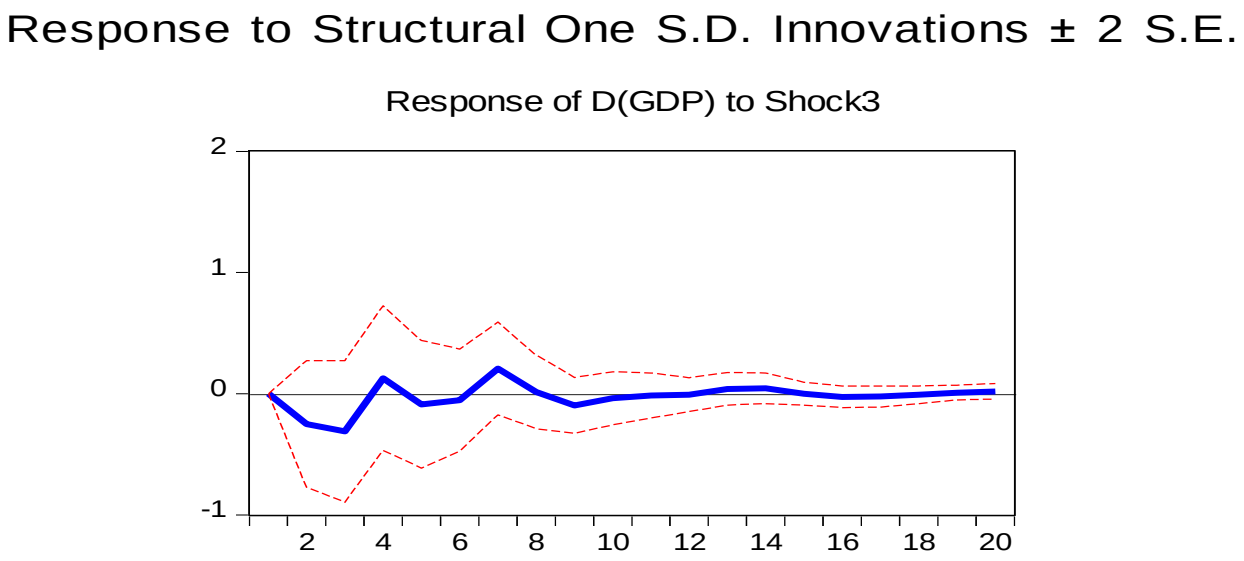


Figure 5.2: Response of GDP to Interest rate (with equity derivatives)

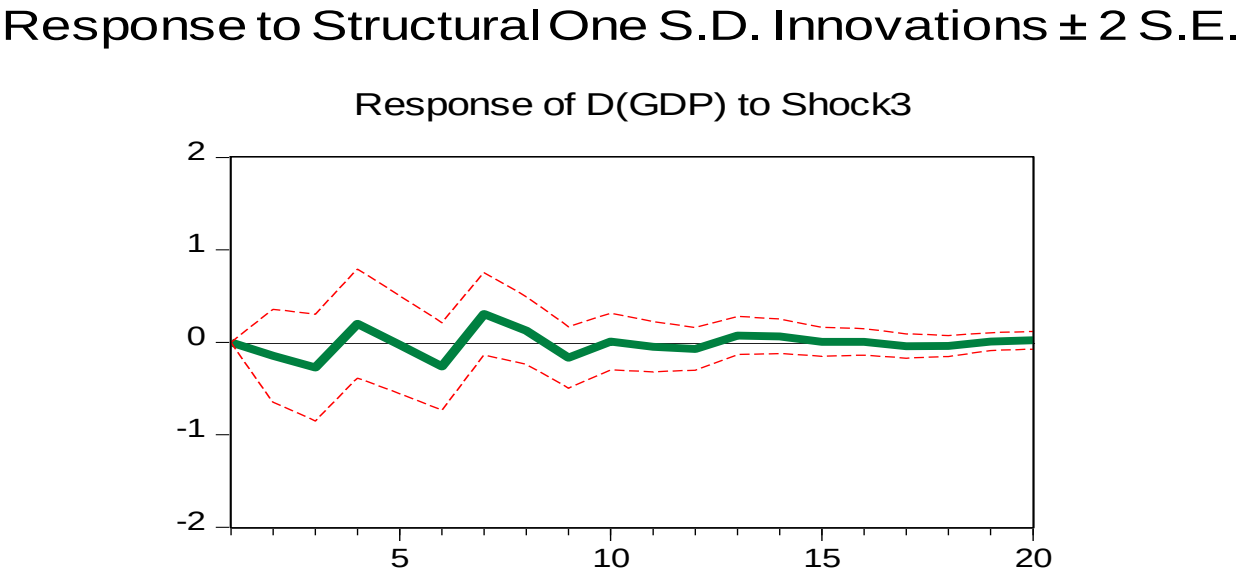


Figure 5.3: Response of Inflation to Interest rate (without equity derivatives)

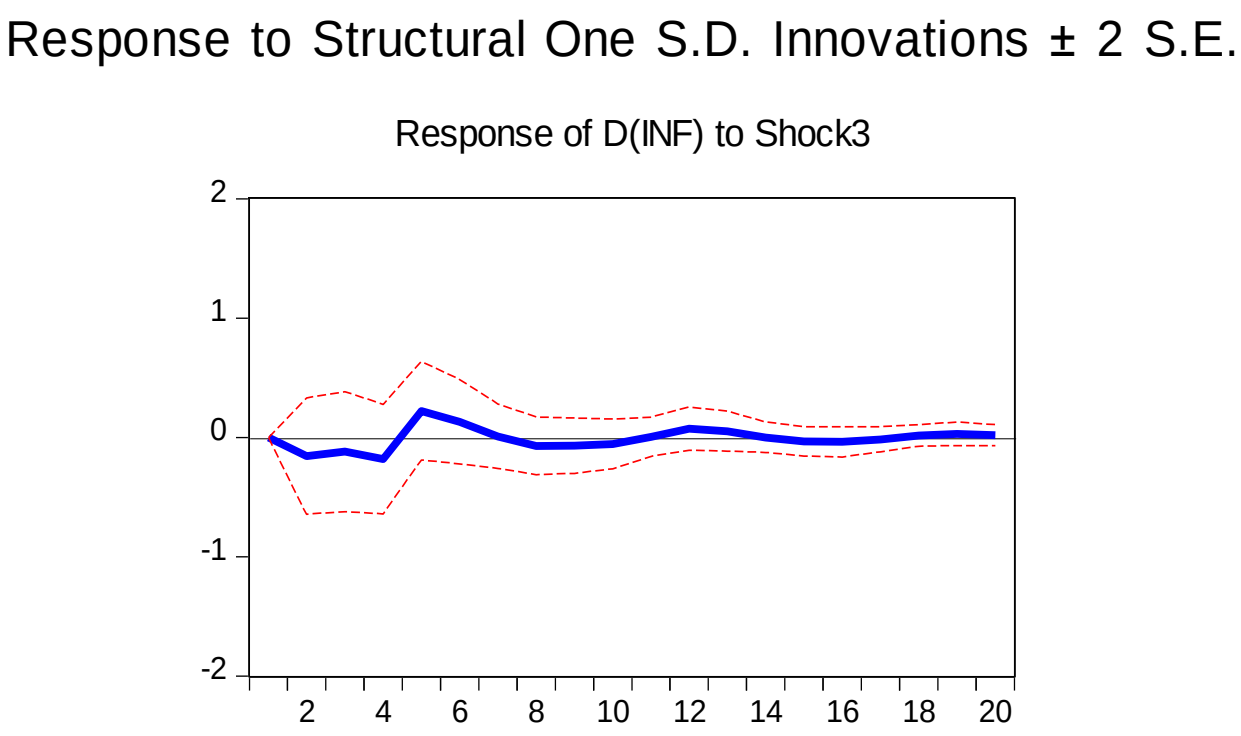


Figure 5.4: Response of Inflation to Interest rate (with equity derivatives)

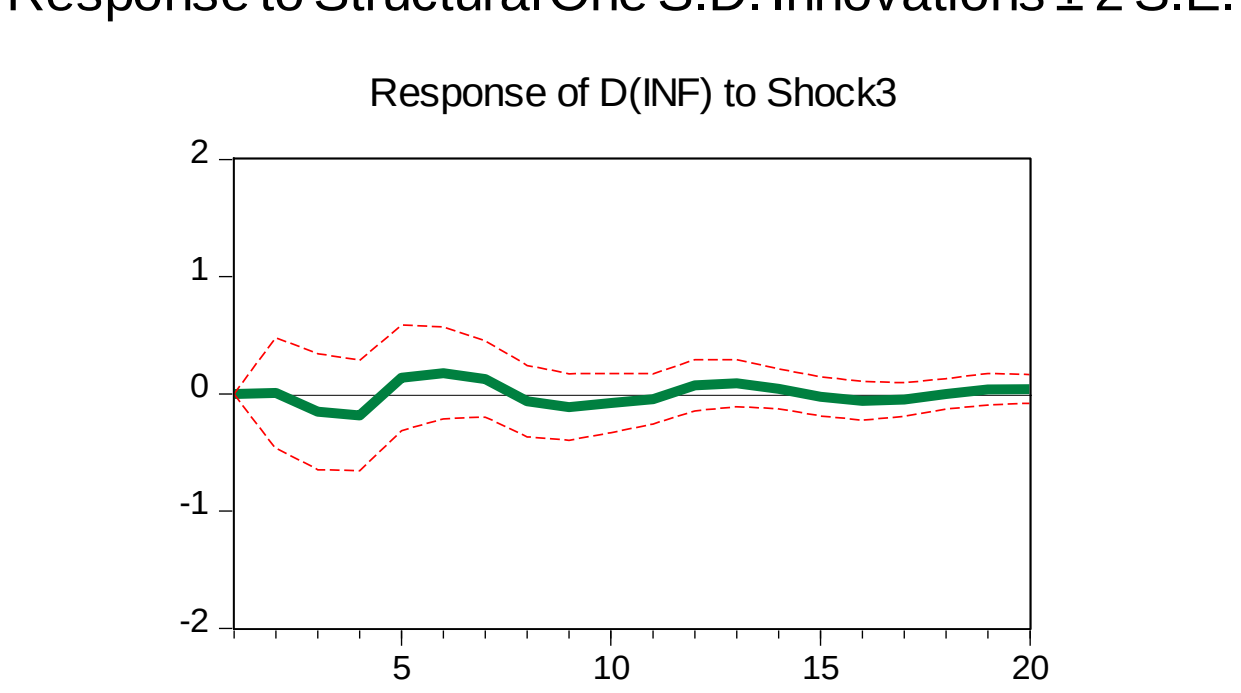


Figure 5.5: Response of money supply to Interest rate (without equity derivatives)

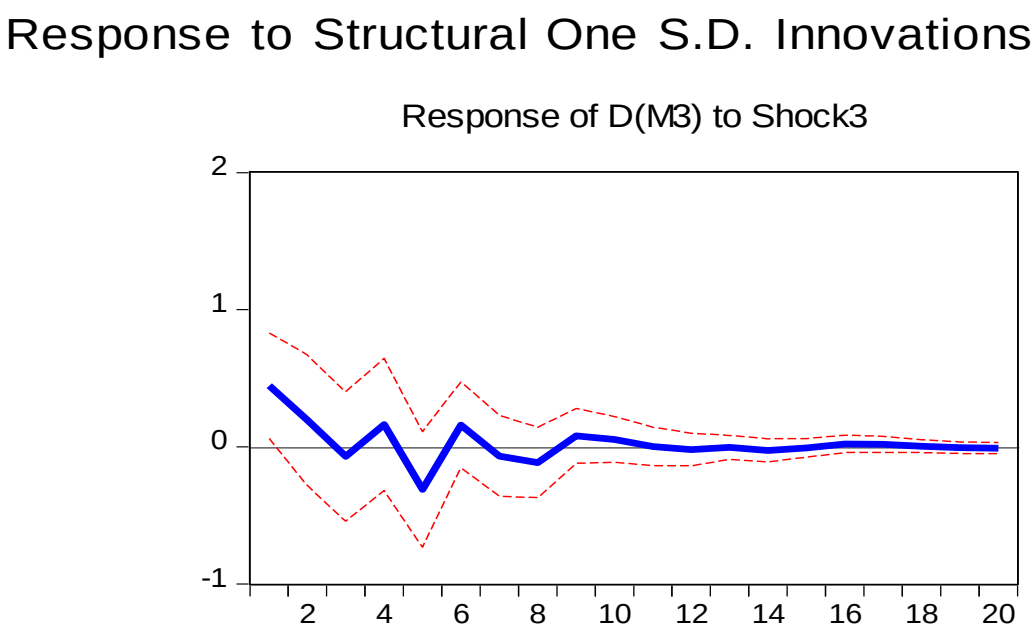


Figure 5.6: Response of money supply to Interest rate (with equity derivatives)

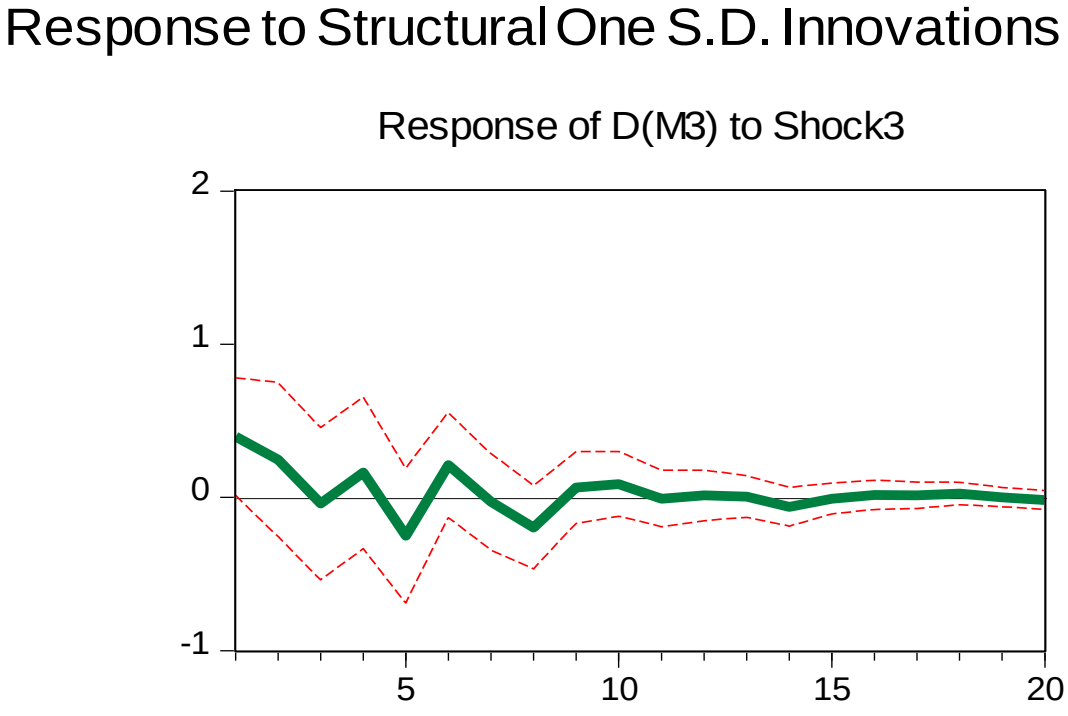


Figure 5.7: Response of GDP to money supply (without equity derivatives)

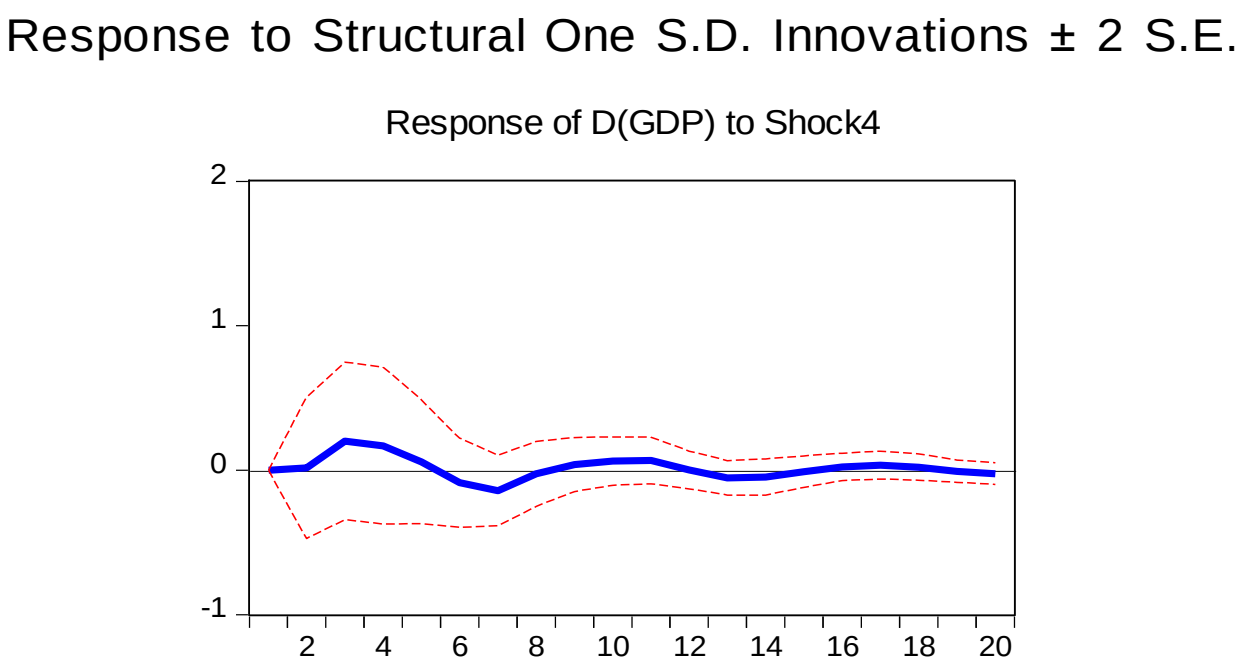


Figure 5.8: Response of GDP to money supply (with equity derivatives)

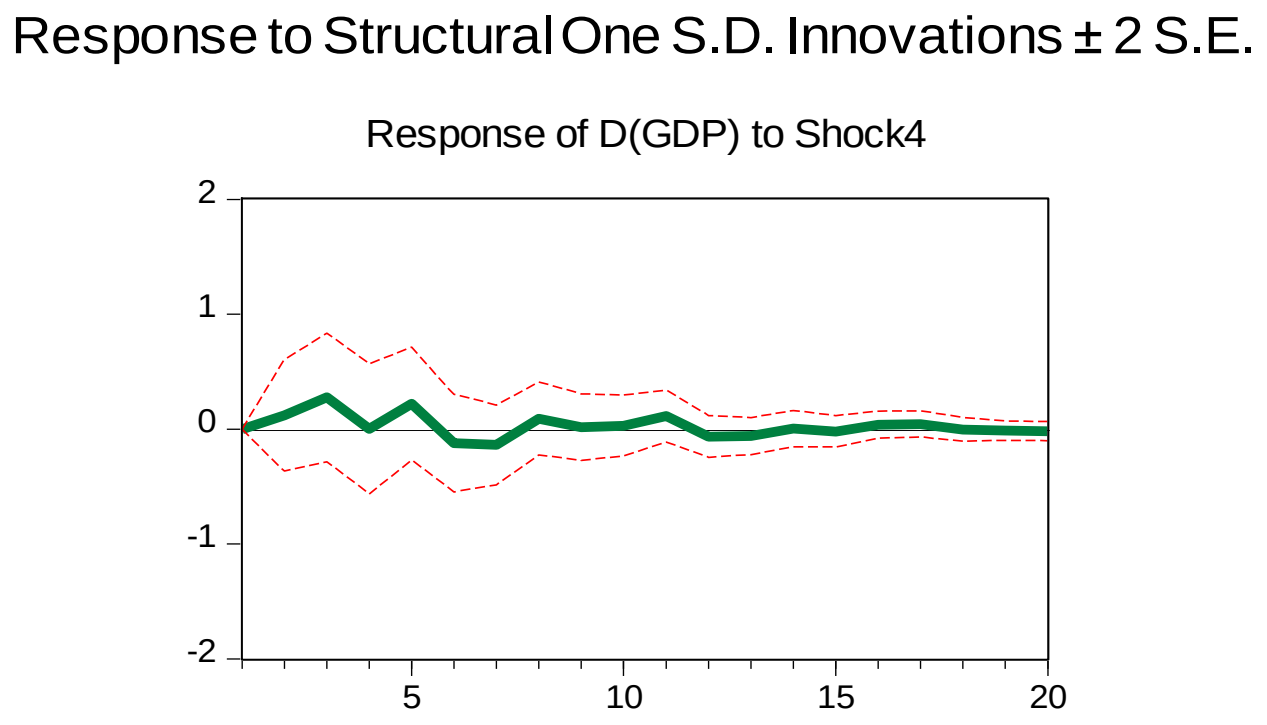


Figure 5.9: Response of Inflation to money supply (without equity derivatives)

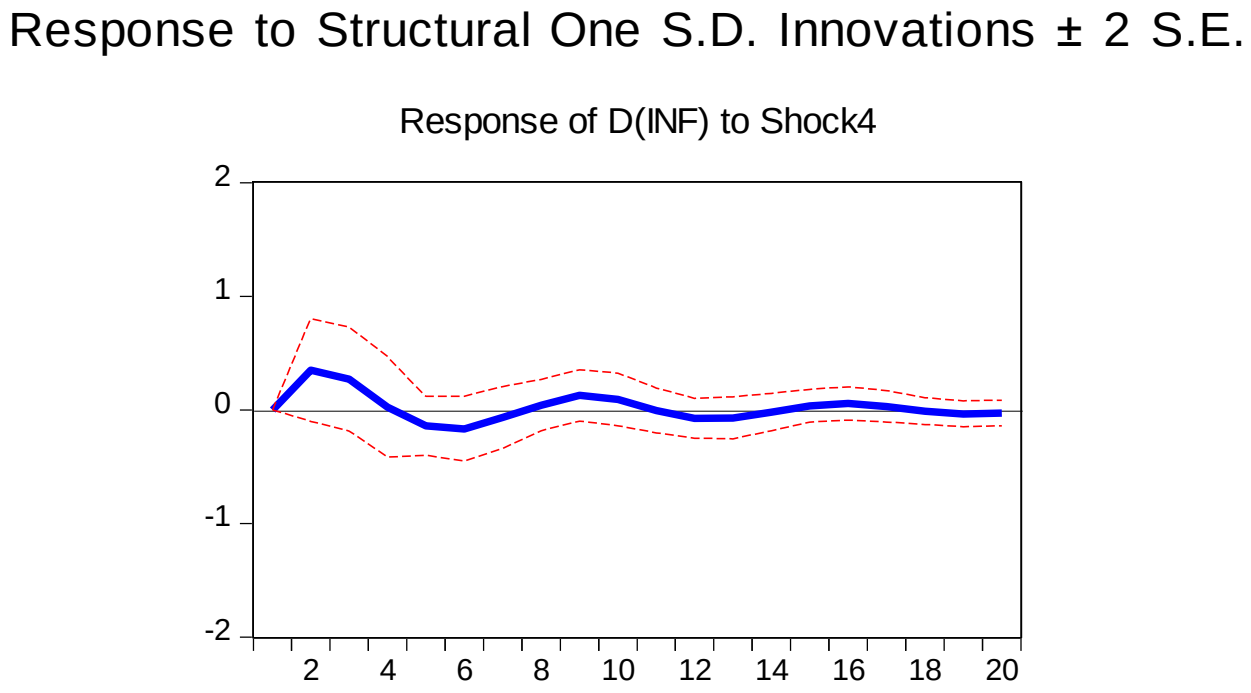
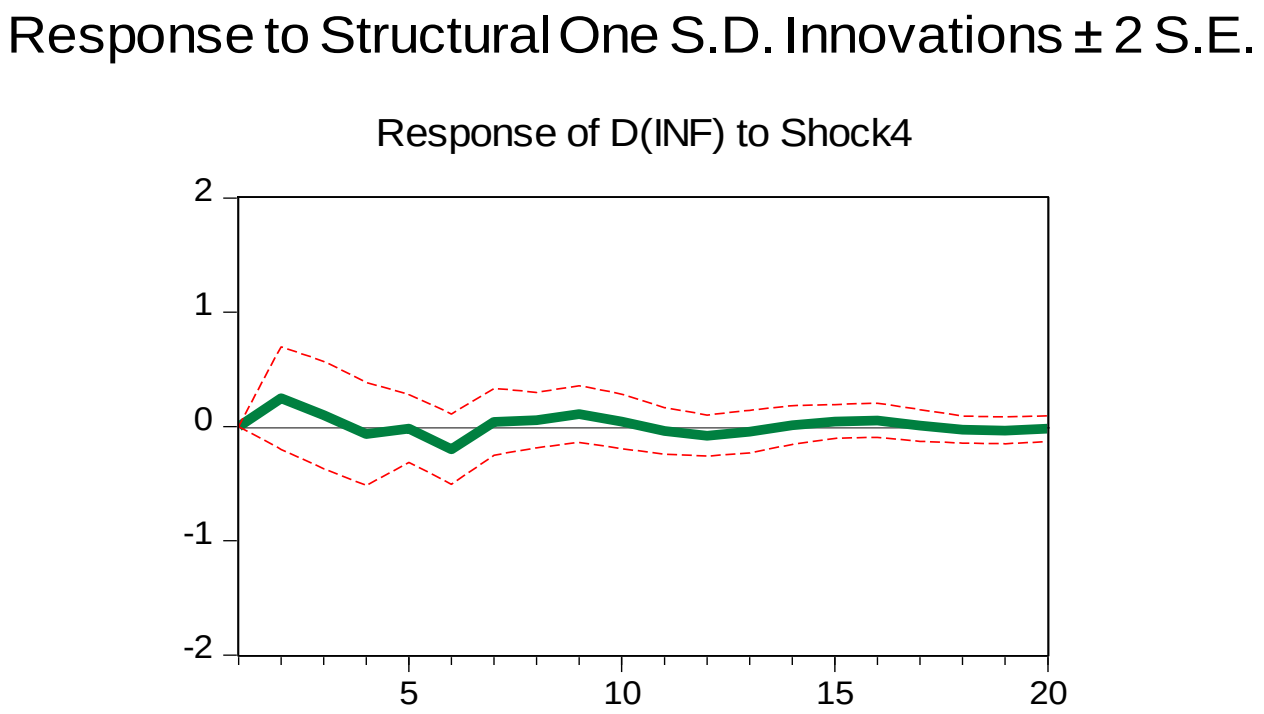


Figure 5.10: Response of Inflation to money supply (with equity derivatives)



5.6.4 Variance decomposition results analysis

The impulse response functions trace out the path of a shock to one endogenous variable on the other variables in the VAR. Variance decomposition adds to one's understanding by separating the variation in an endogenous variable into the component shocks to the VAR. Thus, the variance decomposition helps in giving the relative importance of each random innovation in affecting the variables in the VAR. Accordingly, the decomposition results from SVAR-1, 2 models are presented in the table 5.3 given below and discussed.

Table 5.3: Variance decomposition results SVAR-1, 2 models

Variance Decomposition D(GDP)									
	SVAR-1				SVAR-2				
Period	GDP	INF	Interest rate	M3	GDP	INF	Interest rate	M3	ED
1	100	0.00	0.00	0.00	100	0.00	0.00	0.00	0.00
2	80.9	17.19	1.89	0.007	69.43	20.23	0.72	0.48	9.10
3	69.82	25.01	4.10	1.05	55.81	24.87	2.54	2.36	14.48
4	69.90	24.19	4.22	1.66	55.25	25.51	3.38	2.22	13.62
5	67.74	26.38	4.20	1.66	53.81	25.98	3.12	3.15	13.91
10	62.04	30.74	5.00	2.21	47.14	27.55	6.82	3.62	14.85
15	60.78	31.87	4.97	2.36	45.60	27.96	6.90	3.90	15.61
20	60.32	32.29	4.97	2.40	45.07	28.29	6.89	3.92	15.84
Variance Decomposition D(INF)									
	SVAR-1				SVAR-2				
Period	GDP	INF	Interest rate	M3	GDP	INF	Interest rate	M3	ED
1	9.01	90.98	0.00	0.00	11.51	88.48	2.4E-30	1.74E-3	1.40E-29
2	7.52	87.08	0.90	4.48	17.80	79.14	0.001	2.45	0.59

3	8.33	83.48	1.36	6.81	17.39	77.89	0.92	2.76	1.05
4	7.37	84.58	2.18	5.86	14.64	74.35	1.87	2.39	6.75
5	6.59	84.40	3.25	5.74	13.83	74.72	2.20	2.16	7.07
10	5.98	84.01	3.57	6.42	12.04	70.23	3.54	3.20	10.98
15	5.71	84.35	3.58	6.35	11.18	68.68	3.63	3.20	13.29
20	5.66	84.29	3.61	6.42	11.04	68.16	3.76	3.25	13.77
Variance Decomposition D(CM)									
	SVAR-1				SVAR-2				
Period	GDP	INF	Interest rate	M3	GDP	INF	Interest rate	M3	ED
1	0.97	9.81	89.21	0.00	0.39	3.00	96.60	0.00	1.07E-3
2	0.71	6.81	91.27	1.19	4.11	2.31	93.19	0.21	0.15
3	0.74	6.81	91.14	1.23	9.25	2.13	86.99	0.70	0.91
4	1.24	7.30	90.14	1.30	11.21	2.60	78.41	0.68	7.08
5	1.25	9.35	87.61	1.77	10.73	5.53	75.24	1.52	6.95
10	1.45	9.84	86.65	2.04	11.03	5.83	72.44	3.63	7.05
15	1.47	10.11	86.34	2.06	11.04	6.09	71.96	3.62	7.25
20	1.47	10.18	86.26	2.07	11.03	6.17	71.85	3.63	7.30
Variance Decomposition D(M3)									
	SVAR-1				SVAR-2				
Period	GDP	INF	Interest rate	M3	GDP	INF	Interest rate	M3	ED
1	1.80	2.62	9.98	85.57	1.04	6.39	7.78	84.76	0.03
2	4.50	2.38	10.55	82.55	2.54	5.67	9.17	82.29	0.30
3	8.75	7.54	9.63	74.06	5.51	10.11	8.23	73.28	2.85
4	8.70	7.49	10.54	73.26	5.39	9.90	8.97	71.54	4.17
5	7.91	12.27	13.03	66.76	5.36	14.03	10.35	66.12	4.12
10	8.68	15.17	13.76	62.37	5.31	14.61	12.31	60.90	6.84
15	8.60	16.16	13.61	61.61	5.25	15.06	12.19	59.89	7.58
20	8.56	16.50	13.57	61.34	5.24	15.27	12.15	59.50	7.81

		SVAR-2 Variance Decomposition D(ED)				
Period		GDP	INF	Interest rate	M3	ED
1		6.03	0.03	6.21	0.52	87.18
2		6.58	5.89	7.88	0.48	79.15
3		5.82	7.36	8.01	8.33	70.46
4		9.86	6.92	9.06	9.21	64.92
5		9.10	7.49	8.71	8.46	66.22
10		9.11	9.42	8.97	8.59	63.89
15		9.07	9.92	8.87	8.50	63.57
20		9.03	10.25	8.85	8.47	63.37

GDP is explained by its own shock upto 62.37% without derivatives, whereas with derivatives its own shock explains only 47.14%. Similarly monetary shock explains GDP by 5% and 6.82% without and with derivatives respectively. Money supply shock is minimal in the both models while explaining the GDP. Inflation shock predominantly explains the GDP in both models. Equity derivatives shock accounting for 14.85%. Overall, in the presence of derivatives, GDP is explained less by its own shock and monetary shock explains GDP better. This shows impact of derivatives on monetary transmission in India.

The Inflation shocks are explained by its own shock to the extent of 84.01% and 70.23% without and with derivatives. Money supply shocks are explained by 6.42% and 3.42% without and with derivatives. Monetary shock is minimal in the both models. The monetary shock (interest rate) is explained by its own shock in both the models without and with derivatives. The money supply shock is explained by its own shock upto 62.37% and 60.90% without and with derivatives. GDP shock is explaining by money supply is minimal. The variation on money supply is explained by

its own shock upto 13%. But Inflation shock explain 15%, and equity derivatives explains upto 6.84%.

The equity derivatives shock is explained by its own shock upto 63.89%. Whereas GDP, inflation, monetary, money supply shocks explained by 9.03%, 10.25%, 8.85%, 8.47% respectively. The results show that, there is a role of derivatives and the macro, monetary shocks.

5.6.5 Diagnostic tests

The diagnostic tests such as, AR root test, VAR serial correlation, and VAR heteroscedasticity for two SVAR models are also presented for completeness. In these tests the test-statistics for, serial correlation, heteroscedasticity are insignificant. Hence, the models do not suffer from any issues of serial correlation, and heteroscedasticity. The AR root test confirms that the models do not suffer from the unit root problem.

5.7 Conclusion

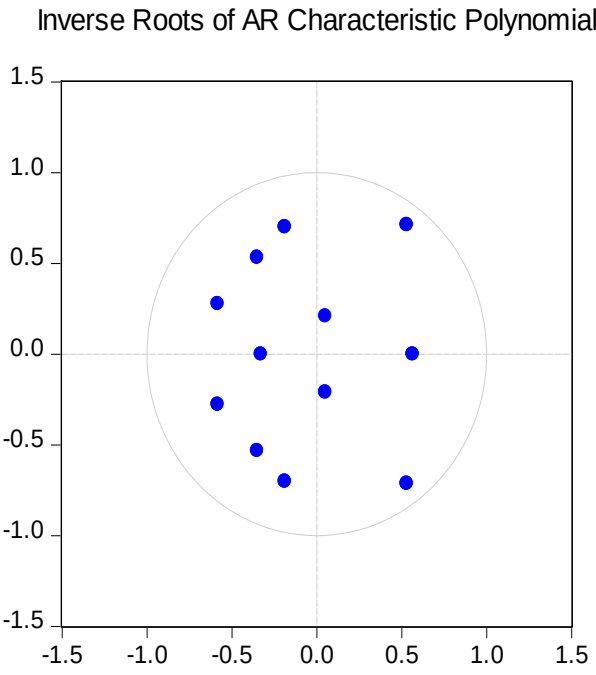
The main objective this chapter was to assess the role played by equity derivatives spurred by financial innovation in the monetary transmission channel. Derivatives including Futures and options have increased the opportunity for hedging and arbitrage between cash and derivative markets. Theoretically, the presence of derivatives markets is expected to speed up the transmission of monetary policy to the real economy by reducing market imperfections. The empirical analysis revealed the following results. The asset price proxy was equity derivatives here. The overall finding from impulse response results show that, presence of derivatives fastens the monetary transmission process and its impact on the real variables like GDP, and Inflation in the Indian economy. The results obtained from variance decomposition imply that in the presence of derivatives, GDP is explained less by its own shock and monetary shock explains GDP better.

This shows impact of derivatives on monetary transmission in India. The empirical results suggests that large scale derivatives trading does impact on monetary policy transmission by changing and at times speeding up the transmission process. But their impact on the real economy is still not unambiguous. Nevertheless, the results from this study tend to support the proposition that the impact of any interest rate shock on the overall economy starts earlier than would otherwise occur without derivatives markets.

5.8 Appendix

Figure 5.11: AR root test

SVAR-1



SVAR-2

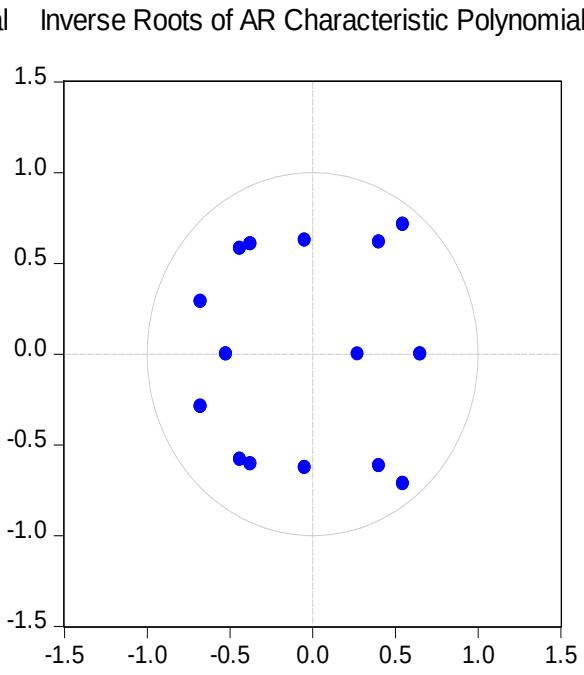


Table 5.2: Lag order selection

SVAR-1						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-387.4244	NA	102.0051	15.97651	16.13094*	16.03510
1	-363.3685	43.20253	73.62882	15.64769	16.41987	15.94065*
2	-345.9059	28.51044*	70.34082*	15.58799*	16.97790	16.11532
3	-332.1212	20.25493	79.75208	15.67842	17.68606	16.44012
SVAR-2						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-638.8596	NA	178193.4	26.27998	26.47302*	26.35322*
1	-606.1406	57.42512	130837.6	25.96492	27.12318	26.40436
2	-579.1093	41.92605*	124432.9	25.88201	28.00548	26.68766
3	-551.4622	37.23893	121622.4*	25.77397*	28.86266	26.94581
* indicates lag order selected by the criterion						

Table 5.4: LM Tests

SVAR Model-1		SVAR Model-2	
Lags	LM-Stat	Lags	LM-Stat
1	24.62 (0.08)	1	50.63 (0.08)
2	17.32 (0.36)	2	23.40 (0.55)
3	22.52 (0.12)	3	27.09 (0.35)

Table 5.5: VAR Residual Heteroskedasticity Tests

SVAR Model-1		SVAR Model-2	
Joint Test		Joint Test	
df	Chi-sq (Prob.)	df	Chi-sq (Prob.)
240	246.31 (0.37)	480	463.14 (0.32)

Chapter-VI

Summary, Conclusion and Scope for Future research

6.1 Introduction

The thesis set three major objectives to examine three main issues revolving around financial innovation driven use of derivatives and monetary policy transmission in India. Though, there are studies in the Indian context examining role of asset prices such as equities, housing etc. in monetary transmission, there is no study that considers the possible role of derivatives in changing different transmission channels and speeding up or impeding these transmissions. One finds very few studies that intuitively articulate possible change in monetary transmission with increased use of derivatives. One also finds very few studies with empirical evidence on derivatives and monetary policy transmission. In view of the above the thesis formulated three specific objectives. They are,

(a) to examine the role of equity derivatives in money demand function.

(b) to examine the role of equity prices as proxy of asset prices in the monetary transmission mechanism.

(c) the role of equity derivatives in monetary transmission mechanism.

Towards achieving these three objectives the thesis reviews literature relevant to each objective in the respective chapters. Data and method used for each of the objectives is also discussed in respective chapters. The data is of quarterly frequency and spans over the period 2001 to 2014. The time period is chosen to capture the possible changes that may have occurred due to use of derivatives and also consistent availability of data on all the variables used in the study. Before moving to the objectives in chapters 3, 4, and 5 an attempt is made to review the global and Indian trends in derivative markets.

6.2 Chapter wise summary and concluding remarks

6.2.1 Evolution of the Market for Derivatives: The Global and Indian Scenarios

This chapter presents the global and Indian scenarios of the derivatives market. It has also traced the historical evolution over a long period of time. The general trends of global derivatives from 1998 to 2014 in exchange traded and OTC markets in brief are as follows. The OTC market share was 71.98 in 1998 the same increased to 82.10 in 2014.The exchange traded derivatives market share was 28.02% in 1998 which gradually lost market share to OTC The % of global GDP to total global derivatives continually declined over a period of 1998 to 2014. In 1998 it was 14.71 and it steeply declined to 3.92 in 2007 and further to 4.8 in 2014. Interest rate derivatives enjoyed the major market share in both OTC and ET platforms followed by forex, equity, and other derivatives. The Indian financial derivatives market has been one of the fastest growing markets in the world in the last decade. In the last fifteen years, this market has introduced a variety of products such as equity, currency, and interest rate derivatives both in Exchange traded as well as OTC markets. The Indian Exchange traded market share is higher that the OTC markets. Looking at the market product wise, one finds equity market to have had more share than the interest rate derivatives markets as compared to the global markets. The above analysis reveals that, in India equity derivatives play a prominent role. Based on the above trends in the Indian derivative market, the present study attempts testing the impact of financial innovation (taking equity derivatives as proxy of financial innovation) on monetary policy transmission mechanism in India.

6.2.2 Financial Innovation and Stability of Money Demand Function in India: Role of Equity Derivatives.

To sum up, this chapter revisits demand for money in the Indian context accounting for the role of financial innovation in terms of introduction equity derivatives in the Indian financial market

after the year 2000. In the advent of financial innovations in different dimensions such as new products, new services, etc. in the emerging market economies, the demand for money functions have been re-estimated by some authors by employing variables such as stock prices as proxy for financial innovation. In this chapter, an attempt is made to estimate money demand by taking variables such as equity futures, equity options, and total equity derivatives in a set of money demand functions. The ARDL bounds test approach to cointegration is employed and a long run relationship is found in money demand models including equity futures, equity options, and total equity derivatives. The coefficients of all the derivative variables bear positive signs indicating the presence of wealth effect. The income elasticity coefficients are lower with inclusion of derivatives compared to the standard specification without derivatives. The short term interest rate as an opportunity cost variable is found insignificant in all cases though it carries an expected negative sign. The variability of inflation carries a positive sign and is statistically significant in all cases implying precautionary motive of demand for real money balances. The error correction terms indicate higher speeds of adjustment in case of money demand functions with derivatives. The magnitudes vary across types of derivatives employed i.e. EF, EO, TED. The derivative variable EO has the highest speed of adjustment coefficient among all three derivatives. The results of Quandt-Andrews and Bai-Perron do not yield presence of any structural break in the four money demand specifications considered in the study. To conclude, derivatives assume crucial importance in money demand functions in explaining the stability of the function as well as the short run deviation from long run equilibrium values.

6.2.3 Revisiting the role of Asset Prices in Monetary Transmission Mechanism in India

The objective this chapter was to assess the role played by asset prices in the monetary transmission channel. The empirical analysis revealed the following results. The asset price

proxy was equity prices here. It is found that the positive aggregate demand shock leads to economic growth rate changes and in turn changes in the household and business firm's wealth. This change results in change in asset prices. A supply shock that changes the general prices, leads to fall in equity prices. This response fizzles out in medium to long run. The inflation shock is found to be strong in the asset price channel. A positive monetary policy shock i.e. increase in interest rate causes decline in the equity prices. Monetary shock shows significant impact on asset price channel, through decline in equity prices reduction in consumption of households, and business firms, due to decline in wealth. The positive credit shock leads to an increase in the equity price initially before the shock dies out. The response of equity price from positive exchange rate shock leads to decline by equity prices. The appreciation of exchange rate makes external trade less competitive in international markets and reduction in returns from equity prices. This dampens the economic growth rate and equity prices.

The next set of results show how aggregate demand, supply, monetary, credit market, exchange rate respond to shock from asset price (equity price).The response of GDP is positive , which can be attributed to wealth effect. This is further transmitted through the balance sheet channel finally impacting the investment and consumption pattern. The response of general price level is positive in line with theoretical expectations. The response of interest rate is negligible, confirming that monetary policy doesn't respond to equity prices (asset prices).The credit market response is positive. The asset price shock fizzles out in medium term to long run. The positive shock on asset prices, results in changes in equity returns, attracting capital inflows from foreign investor and finally resulting in higher investment in the economy. The exchange rate appreciates in the process in short run, and then in the medium to long run this shock dies out.

The results obtained from variance decomposition imply that the own shock in case of equity price accounts for the largest variation in the equity prices. This is followed by the supply and credit market shocks. This establishes the credit market and equity price relation. The monetary and output shocks establish that, monetary policy works through the credit variable as it seems to be responding first. The exchange rate also explains significant variation in asset prices.

To sum up one finds from the above results that monetary policy doesn't respond directly to asset prices (equity prices). But there is indirect presence of asset price channel, which transmits to other macro variables. The results also confirm that monetary policy impacts stock price returns.

6.2.4 Equity derivatives and monetary transmission in India: Some Evidence

The main objective this chapter was to assess the role played by equity derivatives spurred by financial innovation in the monetary transmission channel. Futures and options have increased the opportunity for hedging and arbitrage between cash and derivative markets. Theoretically, the presence of derivatives markets is expected to speed up the transmission of monetary policy to the real economy by reducing market imperfections. The empirical analysis revealed the following results. The asset price proxy was equity derivatives here .The overall finding from impulse response results show that, presence of derivatives fastens the monetary transmission process and its impact on the real variables like GDP, and Inflation in the Indian economy. The results obtained from variance decomposition imply that in the presence of derivatives, GDP is explained less by its own shock and monetary shock explains GDP better. This shows impact of derivatives on monetary transmission in India. The empirical results suggests that large scale derivatives trading does impact on monetary policy transmission by speeding up the transmission process. But their impact on the real economy is still not unambiguous. Nevertheless, the results

from this study tend to support the proposition that the impact of any interest rate shock on the overall economy starts earlier than would otherwise occur without derivatives markets.

6.3 Policy Implications

The results obtained in this study are not unambiguous. But given such innovation driven use of derivatives on one hand and the informality in financial markets on the other, caution the policy makers on efficacy of monetary transmission in India. Each of the channels discussed for instance by Mishkin (1996, 2001) get affected in the presence of derivatives in the Indian market. Thus, the results obtained add to the existing bag of mixed evidence on role of asset prices in Indian monetary policy. There is a need to monitor increasing use of derivatives and track it impact on monetary transmission. This can be done by examining the role of different types of derivatives used in Indian markets and their specific roles in monetary policy transmission, if any. This warrants more studies in this direction to check definitive role of derivatives in monetary policy transmission.

6.4 Limitations and Scope for Future Research

The thesis is not without limitations. The role of derivatives is limited to equity derivatives only in the fifth chapter. This objective could be extended to examine the role of forwards in exchange rate market affecting the exchange rate channel of monetary transmission. Similarly, one could investigate the role of options in equity channel of monetary transmission. Further in line with Savona (2000) one could also examine reaction of short-term interest rates to derivative prices. For instance, Fung and Leung (1993) showed how the future price of euros traded in the LIFFE and IMM could foresee the behaviour of the euro deposit rate.

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