THE IMPACT OF MONETARY POLICY ON THE ECONOMY OF THE UNITED KINGDOM: A VECTOR ERROR CORRECTION MODEL (VECM)

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Abstract

The paper investigates empirically the impact of monetary policy on economic growth in the United Kingdom. The study uses time-series data over a study period spanning from 1940-2012. The impacts of each of the endogenous variables are investigated using the Vector Error Correction Model (VECM). The study shows that a long run relationship exists among the monetary variables. Specifically, it finds that the inflationary rate and money supply are significant monetary policy instruments that drive growth in the United Kingdom. It therefore recommends that the UK policy makers focus on boosting macroeconomic performance by ensuring that growth in money supply is proportional to the growth in real Gross Domestic Product.

Keywords: Money supply, Economic Growth, Vector Error Correction Model

Introduction

Monetary policy is a combination of measures designed to regulate the value, supply and cost of money in an economy, in consonance with the expected level of economic activity (Osinubi, 2006). A sound monetary policy aims to achieve price stability, maintenance of balance of payments equilibrium, reduction in unemployment, economic growth and sustainable development. These objectives are essential to the attainment of internal and external balance of the economy, as well as the promotion of long-run economic growth and stability.

The relationship between monetary policy and economic performance has been the subject of much research for a long time. This interest stems from early dissension amongst economists on the impact of money supply on economic growth. While some economists (McKinnon (1973); Shaw (1973); Matheson (1980) and Levine (1997)) agree that the

most vital determinant of economic growth is the stock of money available in an economy at any given time. Others (Robinson (1952) and Fry (1997)) believe that other factors, depending on the economy play more significant roles and are skeptical about the role of money supply.

Evidence from the monetary statistics of the United Kingdom has shown that since the 1940's some relationship exist between the existing stock of money, interest rate and economic growth. The monetary regimes of the UK based on the data set (1940-2012) can be classified into three periods. First is the Bretton Woods regime which began on 18 December 1946 up to the floating of the pound vis-à-vis the US dollar, on 23 June 1972. The second period starts from 23 June 1972 to the introduction of inflation targeting, on 8 October 1992. And the third period is the inflation-targeting regime which spans from 8 October 1992 to the present.[1]

Against this background, the main thrust of the paper is to evaluate the effectiveness of the Bank of England's monetary policy over these years. The approach of the paper is to analyse the impact of monetary variables on the UK economic growth using the major objectives of monetary policy as a yardstick. Consequently, the selected macroeconomic data include the real GDP, money supply, inflation, bank rate, consumer price level, the real effective exchange rate and the current account deficit between the periods of 1940 to 2012.

A Vector Autoregressive (VAR) model would be developed to test the relationship and measure the magnitude of such impacts. This paper is divided into five sections; following this introduction is section two which discusses the theoretical and empirical issues in literature. Section three focuses on the data and methodology. Section four would present the analysis of VAR while the final section would conclude the paper.

The United Kingdom Experience

The end of World War II led to two significant changes in the monetary system of the UK. The first change occurred on 1 March 1946 with the transfer of the ownership of the Bank of England to the Treasury.

[1]"The aftermath of the Second World War led to the beginning of Bretton Woods, with the declaration of the par values vis-à-visthe US dollar on the part of 32 member countries. Full convertibility of sterling, at the rate of $4.03 to the pound, was introduced on 15 July 1947 in accord with Clause 8 of the Anglo-American Loan Agreement of December 1945. The period between 23 June 1972 and the introduction of inflation targeting, on 8 October 1992, was characterised by a succession of different monetary arrangements and measures. After 23 June 1972, UK membership of the 'snake'—a system of currency bands created by the six founding members of the On 18 September 1949 sterling devalued from $4.03 to $2.80. Sterling's devaluation was followed by similar devaluations by about 30 other countries"(Benati, 2006)

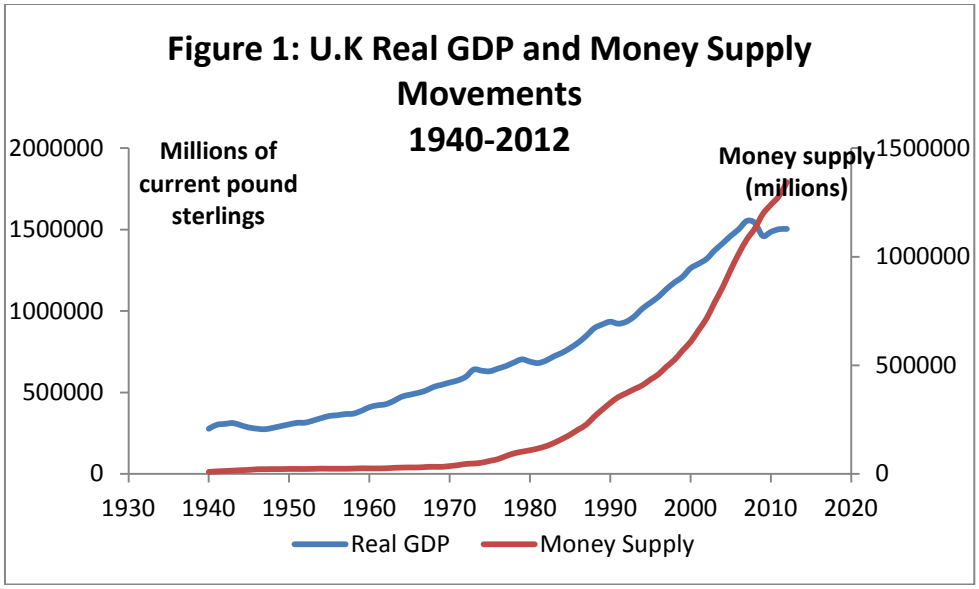
The second change was the introduction of the Bretton Woods system on 18 December 1946. The anchor of the system was the agreement between 32 member countries to par values with the US dollar. On 15 July 1947, the U.K introduced full convertibility of the sterling, at the rate of $4.03 to the pound, but this arrangement was cancelled on 20 August 1947 because of massive capital outflows. Full external convertibility of sterling began on 27 December 1958, and this formally marked the fully functioning Bretton Woods regime.(Benati, 2004)

The United Kingdom experienced another devaluation of sterling on 19 November 1967, from $2.80 to $2.40 (Cappie and Webber, 1985).The introduction of inflation-targeting policies began on 8 October 1992(Crafts and Mills, 1994). Between 23 June 1972 and the inflation-targeting period, different monetary agreements were introduced and replaced (Cappie and Collins, 1983). During this period, the UK also adopted a fully floating rate and began setting targets for M3 growth (Eichengreen, 1992) "However, this was a failure because not only did British policy makers lack the constraint imposed by an exchange rate commitment, but they failed to develop another reliable means of orientation. Sterling M3 turned out to be unworkable: controlling it was too difficult; the link to inflation was too loose." (Benati, 2006)

Narrow money (M0) did not function better (Sargent, 1983).Volatility in the nominal exchange rates further compounded the problems with policy targeting. This led to the United Kingdomjoining the exchange rate mechanism (ERM) of the European Monetary System (Cairncross and Eichengreen, 2003). According to Benanti (2006) the monetary regimes or historical periods of the UK for the purpose of the study are classified as follows[2]:

(i) Bretton Woods' regime: from 18 December 1946 up to the floating of the pound with the US dollar, on 23 June 1972.
(ii) From 23 June 1972 to the introduction of inflation targeting, on 8 October 1992.
(iii) Inflation-targeting regime: from 8 October 1992 to the present.

[2] Luca Benati (2006) UK Monetary Regimes and Macroeconomic Stylised Facts.



Theoretical Issues in Literature

Transmission Mechanisms

There are different transmission channels through which monetary policy impacts economic performance and these channels are classified by Dimitrijevic et.al (2001) under the Pigouvian, Friedman (monetarist) and Keynesian schools of thought.

The Pigouvian sequence focuses on the impact of price elasticity and asserts that a reduction in price levels results in real wages shooting up during recessionary periods which ultimately results in an increase in consumption, employment, aggregate demand and real GDP. A major assertion of the Pigouvian school of thought is that although increases in the quantity of money in circulation suppresses prices in the market, money does not play an active role in an economy with a self-balancing mechanism.

The Friedman sequence on the other hand is a slight variant of the Pigouvian school of thought. Like the Pigouvian sequence, it believes in liberal economic policies but differs in terms of the impact of money supply on the growth of nominal GDP in the short run. The summary of the Friedman sequence is that "money infused into the economy at a constant rate (velocity), results in the reduction of both nominal and real interest rates, and real GDP growth, as long as the money supply in the long-run is adjusted to the real GDP growth" (Friedman, 1974). According to Friedman and Schwartz (1963), an expansionary open market operation, increases the money in circulation in an economy, commercial bank reserves and ability to create credit through the multiplier effect.

The Keynesian sequence proposes an increase in money supply during recessionary periods to decrease the interest rate and thereby stimulate investments and aggregate demand. The Keynesians assert that a change in the money stock encourages activities in the financial sector which impact on key macroeconomic variables such as interest rates, investment, output and employment. (Modigliani, 1963) agrees with this view but also introduced the concept of capital rationing and concluded that the willingness of banks to lend affects the monetary policy transmission.

Demand for Money

Monetary policy originates form Irving fisher (Fisher, 1912) who laid the foundation of the quantity theory of money in his famous equation of exchange. The Quantity Theory of Money comes in two basic forms:

$$Mv = py \quad (2.1)$$

$$M = kpy \quad (2.2)$$

The first equation is known as the income version, where: *M* is money supply; *v* is the velocity of money; *p* is the general price level, and *y* is the real value of aggregate output (gross domestic product). The Quantity Theory of Money is based on the assumptions that in the short term, *v* and *y* are constant and dependable on real factors and causation runs from money to prices.

Equation (2) is the Cambridge version, and states that real demand for money (money with constant purchasing power $\frac{M}{P}$), is proportional to the real Gross Domestic Product expressed by coefficient *k*, and equal to the reciprocal value of income velocity of money (k=$\frac{1}{v}$).

Taking the logarithmic transformation and differentiating according to time, the following equations are derived below:[3]

$$\pi = m^s - y_r \quad (2.3)$$

$$\frac{Ms}{P} = \frac{Md}{P} \quad (2.4)$$

The equations above express all the parameters as growth rates, and take into account the equality in balance of supply and demand for money. This gives the Friedman's Monetary Rule that inflationary rate is equal to the difference between growth rate of the money supply (which is equal to the growth rate of money demand) and the growth rate of the physical volume of production. This means that, if $ms = yr \rightarrow$ p=0, i.e. if the growth rate of the money supply rises in the same proportion as the growth rate of the physical volume of production, such an economy would experience no price increase.

[3] Dimitrijevic B., Lovre I. (2012) Essay on Monetary Policy and Economic Growth: Journal of Central Banking Theory and Practice

But if money supply is rising faster than the growth rate of production, then prices would rise and inflation would consequently set in.

Empirical Issues in Literature

A large number of studies have explored the relationship between monetary policy and economic performance since the beginning of the 1950s. Similar studies that have found a strong support for a positive relationship between money supply and growth include Cagan (1956), Sims (1972), Friedman et al. (1963), Greenwood and Jovanovic (1990), Kevine and Levine (1993), Acemoglu and Zilibotti (1997) and recently Mansor (2005). Very few studies have studied the impact of monetary policy on the UK particularly after the global economic meltdown of 2008. This paper would add to the literature on the role of monetary effectiveness on the United Kingdom by considering a time period spanning from the Bretton Woods Regime in 1946 to the present inflationary targeting regime which started in 1992 by employing the Vector Error Correction Model.

The empirical literature shows that in middle-income countries, monetary policy shocks have moderate impacts on economic indicators. Ganev *et al.* (2002) investigated the relationship between monetary shocks and economic parameters in ten Central and Eastern European (CEE) countries and finds that changes in interest rates do not affect output, but have significant impacts on changes in the real exchange rate.

In developed economies, such as the United States (U.S) and the United Kingdom, there is substantial evidence of the effectiveness of monetary policy innovations on real economic parameters (Mishkin (2002); Christiano *et al.* (1999); Rafiq and Mallick (2008) and Bernanke *et al.* (2005).

Numerous empirical studies also analyze the relationship between the behavior of inflation and the rate of economic growth (Fischer, 1991). According to Levine and Renelt (1992), countries that experienced faster growth than average had an inflation of 12.34 percent per year over the period, while countries that experienced slower growth than average had an inflation rate of 31.13 percent per year. Similar results are reported in Easterly et al. 1994. Here “fast growers” are found to have had an average inflation rate of 8.42 percent per year. In contrast “slow growers” had an average inflation rate of 16.51 percent per year.

Data Sources and Methodology

The aim of this paper is to investigate the relationship between the monetary variables and growth rate between the periods of 1940 to 2012. The paper therefore employs 7 key macroeconomic variables in the empirical

analysis of the UK aggregate economy which is summarized in the table below.

TABLE 1: Raw Data Series

S/N	Variables	Formal Name	Unit of Measurement	Source
1	RGDP	Real Gross Domestic Product	Millions of 2006 Pound Sterling	Bank of England: http://www.bankofengland.co.uk/publications/Documents/quarterlybulletin/threecenturiesofdata.xls
2	MS	Money Supply	Millions	Bank of England: http://www.bankofengland.co.uk/publications/Documents/quarterlybulletin/threecenturiesofdata.xls
3	INF	Implied GDP Deflator	Percentage	Bank of England: http://www.bankofengland.co.uk/publications/Documents/quarterlybulletin/threecenturiesofdata.xls
4	PRICE	Consumer Price Level	Pounds	Bank of England: http://www.bankofengland.co.uk/publications/Documents/quarterlybulletin/threecenturiesofdata.xls
5	Bank	Bank Rate	Percentage	Bank of England: http://www.bankofengland.co.uk/publications/Documents/quarterlybulletin/threecenturiesofdata.xls
6	REXRT	Real Effective Exchange Rate	Dollar/Pound($/£)	Bank of England: http://www.bankofengland.co.uk/publications/Documents/quarterlybulletin/threecenturiesofdata.xls
7	CAD	Current Account Deficit	Millions of 2006 Pounds	Bank of England: http://www.bankofengland.co.uk/publications/Documents/quarterlybulletin/threecenturiesofdata.xls

- GDP is the market value of goods and services produced by labour and property in the United Kingdom.
- Real GDP is the market value of goods and services produced by labour and property in the United Kingdom, adjusted for the effects of inflation.
- Money supply is the total amount of monetary assets available at the time.
- The implied GDP deflator is a measure of inflation and captures rise in the general price level of goods and services over a period.
- The bank rate is the rate at which Central Bank charges on loans and advances to commercial banks.

Following Sims' (1980) pioneering paper, the vector auto regression (VAR) model has become one of the leading approaches employed in the analysis of dynamic economic interactions, particularly in the analysis of monetary policy and macroeconomics. The central feature of the VAR technique is that it possesses a less restrictive structural modelling as it does not impose a priori division of variables into endogenous or exogenous variables.[4]

Thus, we consider a VAR model of order K;

$Y_t = C_0 + \sum_{i=1}^{k} \phi_i Y_{t-I} + \varepsilon_t$ (3.1)

Where:

$Y_i : (Y_{1t}, Y_{2t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots Y_{nt})$

Y_t : Corresponding lag term for order i

C: Intercept vector of the VAR model

ε_t:$(\varepsilon_{1t}, \varepsilon_{2t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots \varepsilon_{nt})$

The unrestricted VAR model is estimated as follows;

$Y_t = m + A_1 Y_{t-1} + A_2 Y_{t-2} \ldots\ldots\ldots A_k Y_{t-k} + \varepsilon t$ (3.2)

Equation (3.2) specifies VAR (P) process where:

Y=(n+1) vector of variables

m=VAR intercept vector

A_i= i^{th} matrix of autoregressive coefficients

Et= generalization of unobservable zero-mean white noise process.

Assuming k=2 and p=1, this gives:

$$\begin{bmatrix} Y_{1t} \\ Y_{2t} \end{bmatrix} = \begin{bmatrix} m_1 \\ m_2 \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} Y_{1,t-1} \\ Y_{2,t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}$$

Explicitly, this can be rewritten as follows;

$$Y_{1t} = m_1 + a_{11} Y_{1,t-1} + a_{12} Y_{2,t-1} + \varepsilon_{1t} \quad (3.3)$$

$$Y_{2t} = m_2 + a_{21} Y_{1,t-1} + a_{22} Y_{2,t-1} + \varepsilon_{2t} \quad (3.4)$$

In this study, Vector Y comprises of seven variables discussed above. The vector of endogenous variables is specified as:

$$Y_t = [CAD, RGDP, MS, INF, PRICE, BANK, REXRT] \quad (3.5)$$

In a more explicit and a linear form, the empirical model can be expressed as:

$$Y_t = a_0 + a_1 CAD + a_2 RGDP + a_3 MS + a_4 INF + a_5 PRICE + a_6 BANK + a_7 REXRT \quad (3.6)$$

Taking the natural logarithm of the equation and assuming linearity among the variables, the above equation in semi log-linear form gives:

[4] Johansen 1991

$$Y_t = a_0 + a_1 CAD + a_2 LogRGDP + a_3 LogMS + a_4 LogINF + a_5 LogPRICE + LogBANK + a_7 REXRT \quad (3.7)$$

Empirical Results and Discussion

Unit Root Test

It is imperative to first conduct preliminary diagnostics on the time series properties of the variables before further evaluationbecause the efficacy of the VAR model rest on the establishment of the assumption of stationarity of the variables (Wooldridge, 2006). Hence, the first step is to ascertain the order of integration of the variables by testing for the presence of unit-roots. The most popular approach is the augmented Dickey-Fuller (ADF) test by Dickey and Fuller (1979, 1981) and the Phillips Peron test by Phillips and Perron (1988). They were proposed originally by Dickey and Fuller under the assumption that the error terms follow an Autoregressive process of known order.

Table 2: Augmented Dickey Fuller (ADF)

Variable	Without Trend			With Trend			Conclusion
	Level	1st difference	2nd difference	Level	1st difference	2nd difference	
RGDP	-0.042	-5.404***	-	2.067	-5.39***	-	I(1)
MS	0.862	-4.396***	-	-0.735	-4.58***	-	I(1)
INF	-1.521	-9.243***	-	-0.681	-9.14***	-	I(1)
BANK	-0.642	-7.503***	-	-0.328	-7.90***	-	I(1)
PRICE	-1.592	-2.815*	-7.74***	0.269	-2.794	-7.67***	I(1), I(2)
CAD	-1.772	-5.945***	-	-2.686	-5.89***	-	I(1)
REXRT	-1.034	-5.227***	-	-1.193	-5.22***	-	I(1)

Note that ***, **, * indicates significance at 1%, 5% and 10% respectively

Table 3: Phillips-Perron (PP) Test

Variable	Without Trend			With Trend			Conclusion
	Level	1st difference	2nd difference	Level	1st difference	2nd difference	
RGDP	-0.135	-5.511***	-	-2.545	-5.50***	-	I(1)
MS	0.392	-4.356***	-	-1.119	-4.52***	-	I(1)
INF	-1.441	-9.027***	-	-0.874	-8.95***	-	I(1)
BANK	-0.712	-7.456***	-	-0.028	-7.92***	-	I(1)
PRICE	-1.073	-2.781*	-7.89***	-0.679	-2.76	-7.80***	I(1) , I(2)
CAD	-1.890	-5.669***	-	-2.897	-5.60***	-	I(1)
REXRT	-1.106	-5.204***	-	-1.551	-5.18***	-	I(1)

Note that ***, **, *indicates significance at 1%, 5% and 10% respectively

As the analysis is based on time series data, the estimation therefore begins by conducting stationarity test to ascertain the stationarity or otherwise of the variables and the appropriateness of the VAR specification.

Thus, both the Augmented Dickey and Fuller (1979) and the Phillips and Perron (1988) tests are employed. The ADF- tests and PP-tests are reported in Table below. Both the Augmented Dickey Fuller (ADF) and the Phillip Perron (PP) analysis above confirm that the same set of variables became stationary after first differencing, while only price become stationary only after second differencing implying that it is integrated of order two. This is a necessary condition for the application of the VAR and cointegration analysis. Since all the series are non-stationary at levels and integrated of either order one or two, this suggests the possibility of the presence of cointegrating relations among the variables. Therefore, test is conducted for the existence of at least two cointegrating vectors.

Cointegration Analysis

H_0: there is no cointegrating relationship among the variables

H_1: there is a cointegrating relationship among the variables

Table 4: Johansen Cointegration Test

Null Hypothesis	Alternative Hypothesis	Test Statistics	Critical-value
Trace Test			
None	R=<1	253.2240	124.24
At most 1	R=<2	177.0143	94.15
At most 2	R=<3	113.3230	68.52
At most 3	R=<4	67.2591	47.21
At most 4*	R=<5	28.1242*	29.68
At most 5	R=<6	12.7095	15.41
At most 6	R=<7	0.8184	3.76
Maximum Eigenvalue Test			
None	R=1	76.2097	45.28
At most 1	R=2	63.6913	39.37
At most 2	R=3	46.0639	33.46
At most 3	R=4	39.1349	27.07
At most 4	R=5	15.4147	20.97
At most 5	R=6	11.8912	14.07
At most 6	R=7	0.8184	3.76

Trace Test indicates 4 cointegrating eqn(s) at the 0.05 level. Trace Max Eigenvalue test indicates 4 cointegrating eqns at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level.

The results the Trace Tests indicate the presence of at least four cointegrating vectors. Thus, the null hypothesis of no cointegration amongst the variables is rejected. This infers the existence of a long run relationship between Real GDP, inflation, real exchange rate, current account deficit, bank rate, consumer price index and money supply. Moreover, the result of the Maximum Eigenvalue Test also confirms the result at the 0.05 level. Consequently, we resort to the application of the Vector Error Correction

Model (VECM). The application of the VECM will identify the long run relationship amongst these variables of interest and tie it to deviations that may occur in the short run (Lorde et al. 2009).

Optimal Lag Length Selection

Table 5: VAR Lag Order Selection Test VAR (1) to VAR (4)

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	-2297.96		7.5e+29	88.6522	88.7529	88.9149
1	-1718.21	1159.5	1.0e+21	68.2387	69.0443	70.34*
2	-1635.16	166.09	3.1e+20	66.9294	68.4399	70.8694
3	-1548.74	172.85	9.7e+19*	65.49	67.7054*	71.2687
4	-1494.87	107.74*	1.5e+20	65.3027*	68.223	72.92

Note: * indicates lag order selected by the criterion.

The optimal lag length is utilized in the estimation procedure of the VECM to ensure that the parameters are consistent. The results from the lag order selection criteria: Likelihood Ratio (LR); Final Prediction Error (FPE); Akaike Information Criterion (AIC); Schwarz Information Criterion (SBIC) and Hannan-Quinn Information Criterion (HQIC) show a tie in the selection. The FPE and HQIC criterions specify a period of 3 while the LR and AIC select a 4-period lag. Gonzalo (1994) illustrates that under specification of lag number in a VECM can lead to finite-sample bias and serial correlation. Therefore, for the sake of the study, a 4-period lag is utilized.

Vector Error Correction Estimates

The table above shows the results of the VECM estimates. Each column shows the equation for each endogenous variable in the model. For example, the only statistically significant determinant of the current account deficit is the lagged value of the current account deficit [CAD (–1)]. This means that this year's current account deficit can be duly estimated by our knowledge of the deficit in the previous year. On the other hand, the real GDP is determined money supply and the lagged values of money supply [LMS (–1) & LMS (–3)]. Similarly, the money supply is affected by the real GDP (lnRGDP), its lagged value [LMS (-1)], the lagged values of inflationary rate [LINF (–1) & LINF (–3)] and the lagged value of consumer price indexes [LPRICE (–1) & (–3)].

Independent Variable	**Dependent Variable**						
	lnRGDP	**LMS**	**LINF**	**LBANK**	**LPRICE**	**REXRT**	**CAD**
lnRGDP (-1)	0.163	0.776*	0.305	2.793	-0.281	91.42	-89349
lnRGDP (-3)	-0.002	-0.050	1.047*	-2.096	0.330	86.29	-19195
LMS(-1)	0.427*	0.358*	-0.165	2.562	-0.293*	-90.61*	-46821
LMS (-3)	-0.193*	-0.128	0.055	-3.738	0.111	7.52	-37906
LINF (-1)	-0.089	1.208*	0.169	-1.528	-0.099	46.89	72310

LINF (-3)	-0.207	0.468*	0.159	-3.987	0.0991	75.75	-18290
LBANK(-1)	0.015	-0.027	0.039	-0.093	0.0199	-10.73*	5344.85
LBANK(-3)	0.013	-0.008	-0.011	0.2830	-0.026	-4.51	1199.33
LPRICE(-1)	-0.214	-1.158*	0.489	7.139	0.9532*	-121.70	-56417
LPRICE (-3)	0.157	-0.974*	-0.132	6.008	0.0765	-76.96	51528
REXRT(-1)	0.000	0.0001	-0.002*	0.012	-0.001*	0.4283*	-130.93
REXRT(-3)	0.001	-0.0005	-0.000	0.004	-0.0003	-0.2758	24.93
CAD(-1)	-4.21e-07	9.60e-07	2.7e-06*	-0.0001	-1.13e-06	-0.0001	0.516*
CAD (-3)	1.16e-06*	6.02e-07	2.4e-06*	0.0002	-5.35e-07	0.00003	-0.094
R-Squared	0.8903	0.9476	0.9263	0.5555	0.9612	0.5127	0.5347
Chi2	235.32	524.66	364.47	36.24	717.84	30.51	33.33
P>chi2	0.0000	0.0000	0.0000	0.0390	0.0000	0.1354	0.0755

Note: * indicates statistical significance at the conventional rates

Variance Decomposition Analysis (VDC)

The VDC analysis aids in the determination of the relative importance of the dependent variables to changes in the endogenous variables. The result of the VDC over a 10-quarter time period is presented in the figures below. In each table, SE refers to forecast error and each column shows how much in percentage of the forecast error is explained by each variable in the VAR.

Table 7 below shows that the one-period ahead forecast error in the real GDP is due to variations in real GDP. Moreover, a two-period ahead forecast error is 74.76 per cent due to variations in real GDP, 21.91 per cent due to variations in money supply, 0.18 per cent due to variations in inflationary rate, 0.033 per cent due to variations in consumer price levels, 1.86 due to variations in the bank rate, 0.89 per cent due to variations in the current account deficit and 0.34 per cent due to variations in real exchange rate. As for the other forecast horizons, variations in the money supply and the bank rate are the most significant factors while the inflationary rate, and consumer price levels have moderate impacts. The real exchange rate, real GDP and current account deficit show a slight effect. For example, the five-period forecast error in the real GDP is 36.28 per cent due to variations in real GDP, 27.28 per cent due to variations in the bank rate, 2.74 per cent due to price variations, 1.62 per cent due to variations in inflation and 1.45 per cent due to variations in the real exchange rate.

Table 6: Variance Decomposition

Variance Decomposition of LOG RGDP

Period	S.E.	RGDP	MS	INF	PRICE	BANK	CAD	REXRT
1	12745.95	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	20150.19	74.76669	21.91827	0.179614	0.033452	1.860776	0.891634	0.349570
3	27345.08	50.29926	34.95940	0.242220	2.148304	11.39262	0.541396	0.416800
4	33505.09	42.02489	30.59290	0.164277	2.669140	21.11614	3.037736	0.394908
5	37656.23	36.28421	25.88096	1.627892	2.748154	27.28873	4.714632	1.455431
6	41163.93	31.57382	22.29935	4.177577	3.744350	30.32069	4.404700	3.479516
7	44080.31	28.38727	19.46010	4.524751	4.091296	30.88781	4.242553	8.406229
8	45696.82	26.62001	18.48074	4.498632	3.828618	30.76930	4.121779	11.68092
9	46552.52	25.91884	18.58994	5.077754	3.953859	30.63547	3.979518	11.84462
10	47747.46	25.66719	18.18814	6.047576	4.922064	30.02263	3.820597	11.33181

Variance Decomposition of LOGMS

Period	S.E.	RGDP	MS	INF	PRICE	BANK	CAD	REXRT
1	6066.945	0.000220	99.99978	0.000000	0.000000	0.000000	0.000000	0.000000
2	10855.58	0.137778	93.04649	0.768491	3.124520	2.857461	0.002798	0.062460
3	17328.61	2.830034	88.50903	0.503996	2.940335	4.722093	0.349928	0.144584
4	24128.92	2.586831	83.94269	0.408613	5.051281	6.749019	0.517884	0.743681
5	31292.70	2.292501	77.39137	0.366393	7.961988	9.776142	0.882261	1.329344
6	37540.34	1.874488	71.01232	0.380125	10.10310	12.32281	1.746211	2.560944
7	42742.10	1.449369	64.64307	0.599508	12.12213	14.67891	2.779550	3.727452
8	47052.31	1.225839	58.49691	0.951832	13.76081	16.79709	3.849341	4.918174
9	50407.36	1.176452	53.42998	1.241446	14.89255	18.32598	4.804361	6.129233
10	52816.35	1.255279	49.82055	1.419996	15.93143	19.30150	5.385355	6.885885

Variance Decomposition of LOGINF

Period	S.E.	RGDP	MS	INF	PRICE	BANK	CAD	REXRT
1	0.004939	3.440849	2.473338	94.08581	0.000000	0.000000	0.000000	0.000000
2	0.008005	1.358834	7.211213	76.98543	2.751557	10.81363	0.366618	0.512724
3	0.010326	0.890566	10.72893	57.72507	9.231127	18.49067	2.621092	0.312540
4	0.013631	2.384392	18.51797	33.76412	9.829485	20.80740	7.748028	6.948611
5	0.018359	4.995768	19.59429	18.63516	9.749467	18.76201	7.681128	20.58217
6	0.022948	7.605126	17.79069	11.97481	11.51856	14.73686	5.554719	30.81923
7	0.027084	9.224946	15.26339	8.599140	14.43056	12.10965	4.239412	36.13290
8	0.031189	9.572013	12.29735	6.493510	19.53180	11.05926	3.578790	37.46727
9	0.035263	9.052284	9.625127	5.305845	25.05255	11.19725	3.140687	36.62626
10	0.039514	7.914469	8.270650	4.783124	27.54929	12.33058	2.733675	36.41822

Variance Decomposition of LOG PRICE

Period	S.E.	RGDP	MS	INF	PRICE	BANK	CAD	REXRT
1	0.463391	1.336255	0.351780	42.44844	55.86352	0.000000	0.000000	0.000000
2	0.869631	2.008925	7.091134	31.80730	36.48611	22.37315	0.191128	0.042251
3	1.390764	4.277233	7.823965	19.31358	21.42993	37.71863	3.128193	6.308470
4	1.911433	2.304130	5.457465	11.00819	13.55026	41.19001	5.395540	21.09441
5	2.505790	2.857514	3.273686	6.524314	8.890175	38.97147	5.581124	33.90171
6	3.215960	4.610002	2.101405	4.503288	7.734606	32.84113	5.687879	42.52169
7	3.973032	6.193737	1.759935	3.727959	9.226552	27.46831	5.575499	46.04800
8	4.676466	6.699210	1.441341	3.594593	11.70334	24.61217	5.046759	46.90259
9	5.317923	6.427657	1.117102	3.513995	14.26235	23.09892	4.381641	47.19834
10	5.913218	6.012540	1.159223	3.385543	16.26713	22.20738	3.740315	47.22786

Variance Decomposition of LOGBANK

Period	S.E.	RGDP	MS	INF	PRICE	BANK	CAD	REXRT
1	1.695674	2.244666	17.84177	4.233497	0.091472	75.58860	0.000000	0.000000
2	1.859021	2.450877	14.86939	5.569482	3.547115	68.04904	3.522019	1.992086
3	2.076290	4.874847	18.14373	8.532805	4.706539	54.55302	3.331819	5.857237
4	2.297252	8.071612	15.35751	11.72661	3.873296	44.92842	2.988539	13.05401
5	2.532659	9.638059	12.63575	10.16678	8.843282	38.22460	2.512099	17.97942
6	2.614840	9.781118	12.02913	9.799059	11.46349	36.04315	2.367247	18.51681
7	2.752702	9.417943	15.00630	9.159393	13.76014	33.47686	2.136380	17.04299
8	2.975537	8.859005	23.64338	8.099954	12.96936	29.75808	1.945898	14.72432
9	3.205963	8.067775	30.66744	7.114526	11.38510	27.89539	1.681501	13.18828
10	3.401167	7.310682	33.38592	6.420799	10.41294	27.25379	1.584788	13.63108

Variance Decomposition of CAD

Period	S.E.	RGDP	MS	INF	PRICE	BANK	CAD	REXRT
1	3301.925	1.671505	14.15472	4.509236	2.325375	19.78819	57.55098	0.000000
2	4550.410	3.569310	25.38730	5.872143	1.327562	23.31216	39.85229	0.679231
3	5019.219	3.281430	34.20662	6.201595	2.312395	19.27856	34.14277	0.576638
4	5768.090	3.174403	35.33170	7.755940	3.734795	19.34803	29.89319	0.761947
5	6828.589	4.609378	37.01661	10.35003	2.948476	20.69128	22.88863	1.495597
6	8039.913	3.887799	33.83077	7.766153	7.373386	21.41313	16.99797	8.730794
7	8751.022	3.511673	29.73367	6.918589	11.45148	20.54730	14.38390	13.45339
8	9000.194	5.288072	29.00796	6.586059	12.31891	19.57243	13.69582	13.53075
9	9481.501	7.037603	31.86913	6.519707	11.17848	17.65937	13.54368	12.19202
10	10109.45	7.205311	34.93042	7.168467	11.25097	15.57249	13.14771	10.72463

Variance Decomposition of REXRT

Period	S.E.	RGDP	MS	INF	PRICE	BANK	CAD	REXRT
1	6.014695	3.688387	0.496764	3.590071	1.054795	0.857543	3.068487	87.24395
2	9.163336	6.651433	2.541047	3.690651	2.125597	2.933549	3.288570	78.76915
3	11.09860	6.862807	3.610402	4.015910	2.491463	4.178091	3.883875	74.95745
4	12.69917	6.758801	4.736570	4.513937	3.051795	9.024803	5.068656	66.84544
5	14.03620	6.616012	5.788212	4.779003	3.634058	14.15073	5.542131	59.48985
6	14.94538	6.585731	6.053693	5.092462	3.494427	17.35783	5.485865	55.92999
7	15.60129	6.774574	5.974373	5.102210	3.283326	18.48405	5.135936	55.24553
8	16.08772	7.535888	5.800327	5.019429	3.364737	18.02671	4.835944	55.41696
9	16.49005	8.333298	5.642588	5.062643	4.111720	17.25033	4.613164	54.98626
10	16.93514	8.465935	5.656899	5.320013	5.856349	16.47078	4.390237	53.83979

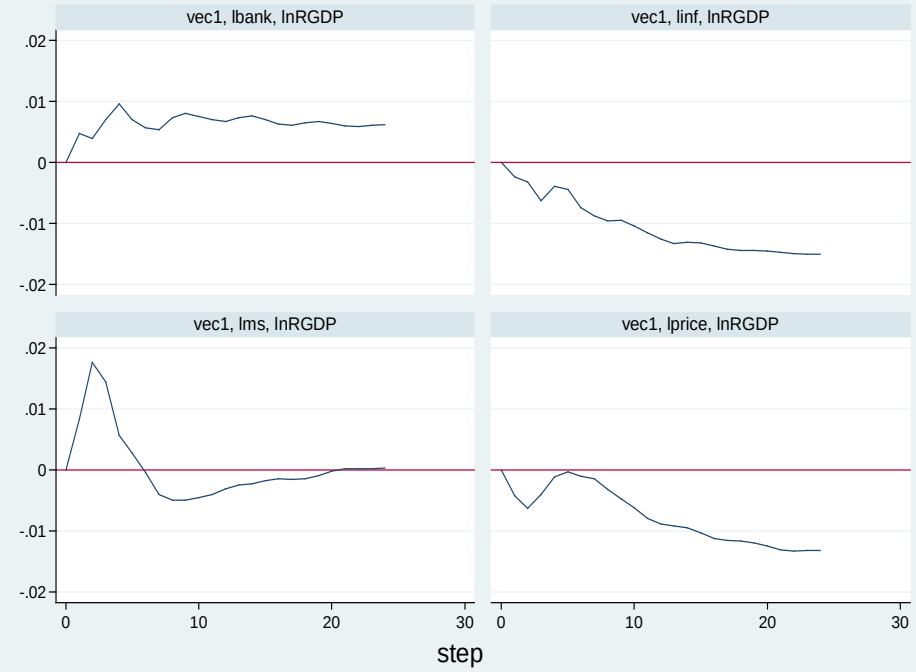
Cholesky Ordering: RGDP MS INF PRICE BANK CAD REXRT

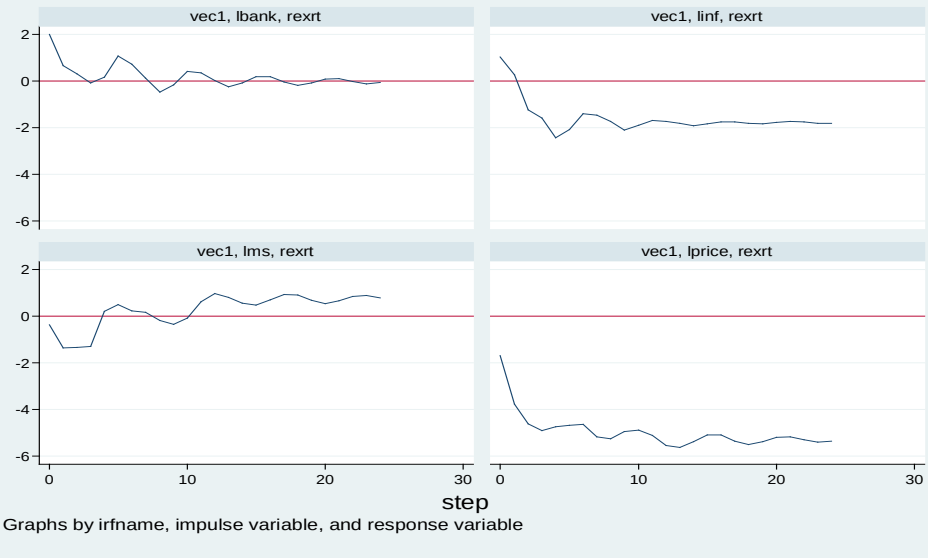
Forecast errors in money supply are due to variations in the money supply and the real GDP. Moreover, the tenth-period forecast error, we see that price and bank rate have more impact with 15.93 percent and 19.30 per cent respectively while the remnant is accounted for by the other variables. The implication of this result is that in the long run, the consumer price index and the bank rate begin to impact more on the money supply determined by the Central Bank.

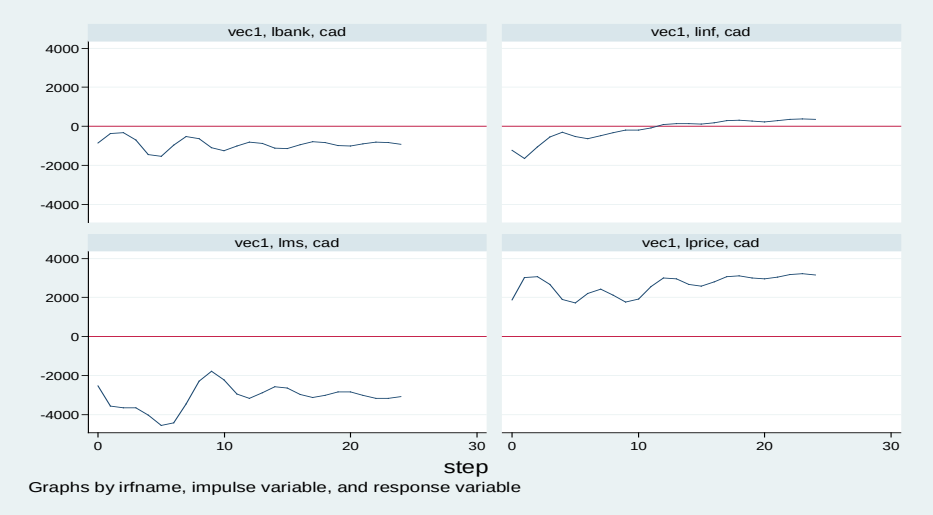
The variance decomposition of inflation shows that variations in money supply are significant in explaining variations in the inflationary rate. The one-period ahead forecast error in inflation is due to variations in the real GDP and the money supply. Similar results are obtained for the variance decomposition of the consumer price index, bank rate, current account deficit and real exchange rate. The table above shows that the one-period ahead forecast error in the consumer price index is due to variations in the money supply, inflation and real GDP.

The table also shows that variations in the bank rate are due to variations in inflation, money supply, price and real GDP. Money supply contributes significantly to its variations in the immediate period by accounting for 17.84 per cent of the variations. The variance decomposition of the current account deficit also shows that in the immediate period also shows that money supply (14.15%) and the bank rate (19.78%) are making the most significant contributions to variations in the current account deficit. Variations in the real exchange rate are due to variations in the real exchange rate, real GDP, money supply, inflation, consumer price index, bank rate and the current account deficit. All the variables in the model contribute to its forecast error.

Impulse Response Function (IRF) Analysis







The graph of the Impulse response functions above show some interesting relationships. We see that the Bank rate is declining with increases in the Real GDP while GDP is falling with increasing inflation. An increase in the money supply leads to GDP shooting up initially but is followed by a sharp fall thereafter. The real exchange rate is observed to be fluctuating with changes in the bank rate and the quantity of money in circulation. However, an appreciation of the real exchange rate causes both the inflationary rate as well as the consumer price index to drop. This is consistent with literature. We also see that the current account deficit fluctuates in response to changes in the bank rate, inflation, money supply and consumer price index. Only with changes (increase) in the consumer price index, does it rise to a positive value.

Granger Casualty Analysis for short run impacts

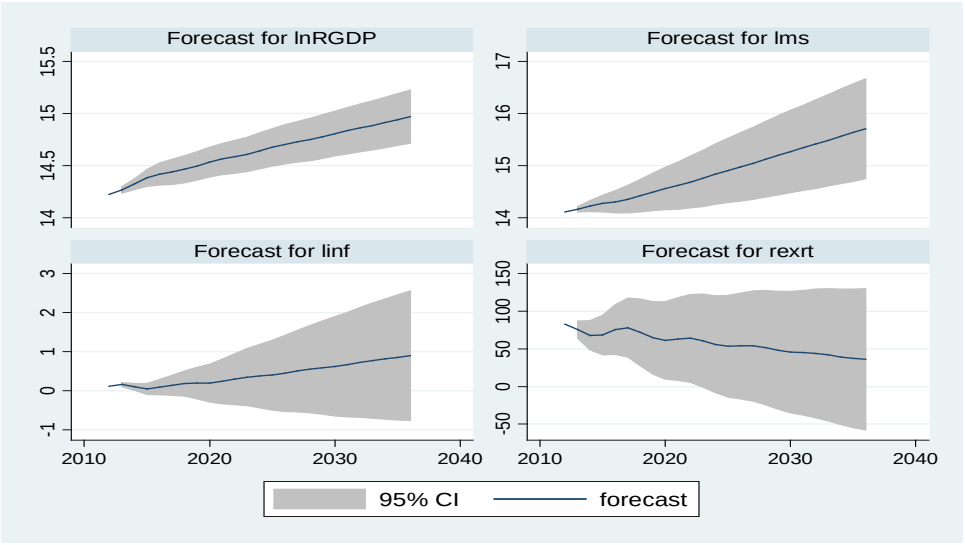
Null Hypothesis: Changes in Money Supply do not granger-cause:		
Variable	F-Statistics	P-Value
RGDP	4.13950	0.0202**
INF	1.83701	0.1673
PRICE	1.95799	0.1493
BANK	2.69155	0.0752*
CAD	24.7315	1.E-08***
REXRT	0.10657	0.8991

The Granger-casualty test is conducted to investigate whether a significant short-run relationship exists between oil prices and the selected macroeconomic variables. The results presented in the table above show that changes in the money supply granger-cause only three of the variables in the model, namely, Real GDP, bank rate and the current account deficit. This

means that these variables are affected by changes in the money supply in the short run. This is informed by an F-statistics of 4.13, 2.69 and 24.73 and p-values of 0.0202, 0.0752 and 1.E-08 respectively. However, for the other variables, the null hypothesis is accepted in their cases as money supply does not granger cause inflation, price and real exchange rate. The implication is that in the short run, changes in the money supply do not impact these variables.

Forecasting with the VECMs

The forecast of the VECMS shows that in the next 3 decades, the UK would experience growth in real GDP which will be achieved by similar growth rates in money supply, inflation and a depreciation of its real exchange rate.



Summary of findings

TEST

Variable	VDC (one-period forecast error)	VDC (Ten-period forecast error)	Vector Error Correction Model (VECM) estimates	Granger-casualty
RGDP	insignificant	significant	positive	significant
INF	significant	significant	positive	insignificant
BANK	significant	significant	negative	significant
PRICE	significant	significant	negative	insignificant
CAD	significant	significant	positive	significant
REXRT	significant	significant	positive	insignificant

Putting the results from the model together, the results reveal that changes in monetary policy, the main variable being money supply, are a very significant determinant of economic activity in the United Kingdom. The main policy implication emerging from these finding is that policy makers must emphasize the importance of effective control of the stock of money in circulation at any given time as a key determinant for macroeconomic policy formulations.

Summary and conclusion

The primary objective of this study is to evaluate the impact of monetary policies on the macro economy of the UK using selected macroeconomic indicators. The study employed the use of the Vector error correction model to estimate the impacts of changes in the money supply over the study period. Based on economic theory and literature, seven endogenous variables were selected to assess the impacts of monetary policy.

The econometric findings presented in this study prove that changes in the money supply have considerable effects on GDP, inflation rate, and consumer price index in the UK. The results of the Variance decomposition analysis show that money supply changes account for variations in other variables in the immediate period and its significance becomes more prominent in subsequent periods.

The impulse response functions from the model suggest that following a shock in the quantity of money supplied the real GDP increases within the second and fourth quarters and declines over the remaining periods. Furthermore, a monetary policy shock has considerable impacts on the current account deficit, as it increases dramatically between the sixth and eighth quarter.

The Granger-casualty test is also conducted to investigate whether any short-run relationship exists between monetary policy and macroeconomic activity in the UK. The results generated provide evidence of the existence of a short-run casualty to the bank rate, current account deficit and real GDP.There is a therefore, a dire need for policy makers to focus on policies that will strengthen the macroeconomic structure and boost the economic performance of the United Kingdom by ensuring effective control of the quantity of money in supply at any given time.

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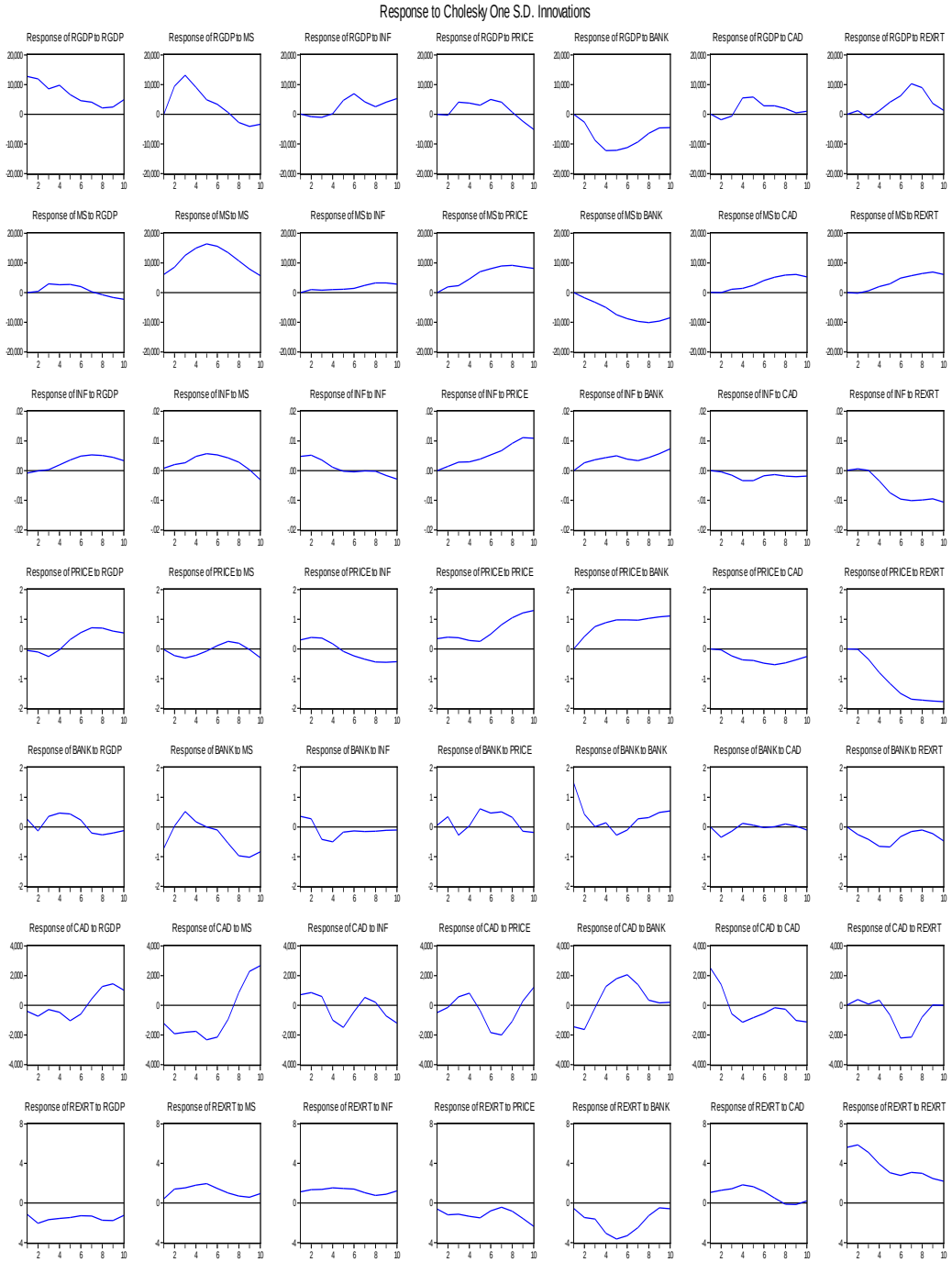
Appendix:


Response to Cholesky One S.D. Innovations
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