The effect of changes in Government Expenditure and Exchange Rate on the income of the United Kingdom

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Abstract:

This paper examines the effect of changes in policies relating to fiscal policy, monetary policy and international competitiveness and trade flows within a Mundell-Fleming type open economy model by using time series data of the UK economy. Policy scenarios was analysed using ex-post forecasts from 1990 to 2001 and ex-ante forecasts for 2001-2020. The results indicate that the expansionary policy, with growth of government expenditure, by various percentages, will raise income and as a consequence, the predicted values of tax, consumption, and imports will increase. However, when using a contractory policy, cutting government expenditure, by different percentages we find that the most notable outcome is the decrease in predicted tax. This decrease for income, consumption and import is shown in the early years of the forecasting period. However, in the long run, these variables will increase. Concerning the monetary policy represented in change in the exchange rate, we have two cases. When the pound appreciates against the dollar, it was found that exports fall and imports rose causing net exports to decline. Import will increase in the first three years. The predicted values of income, consumption and tax will increase. The opposite happens in the second case which is the depreciation in the pound. Finally, impulse response analysis is used to determine the response of income, consumption, and investment over time to a shock.

Key words: Simultaneous equations model, fiscal policy, monetary policy, Exchange rate, Income, UK.

1. Introduction

The main objective of this paper is to examine the effect of changes in some policies on the output of the United Kingdom using ex post forecasts from 1990 to 2001 and ex-ante forecasts for 2001-2020. The changes in both fiscal policy represented by government expenditure and monetary policy represented by the exchange rate will be examined to ascertain their effects on the output of the UK. According to the Keynesian school, it is argued that fiscal policy has a strong impact on aggregate demand, output and employment where the economy is well operated under a full capacity national output and the economy needs a demand- stimulus. The Keynesians believe that the government has an influential role in managing the level of aggregate demand by making fiscal policy measures work actively.

Kolluri et al. (2000) argue that the growth of government expenditure and its impact on economic activity, especially output, have been important issues in the economic literature as far back as the mid-1800s. Here, we concentrate on the changes of government expenditure. It is noticed that the UK's government expenditures recorded a significant rise during the 1990s and 2000s. In 1993, these expenditures were £277.8 billion, representing 42.6% of GDP. This figure rose in 1997 to £318.5 billion representing 38.8% of GDP and in 2000 the UK's government expenditures rose to £363.9 billion, 37.9% of GDP. Increase in government expenditures continued to £488 billion, making a rise of 34%. This significant increase in government expenditures helped to ensure the UK's short-term economic growth.

Noord(2002) argues that the increase in UK government expenditures as a share of GDP actually goes back to the 1960s and 1970s, when government expenditures as a share of GDP rose sharply. In general, it is argued that the UK's fiscal situation is better than for many years as the government expenditures now are financed without heavy recourse to borrowing.

Concerning the expenditures and national income, Singh& Sahni (1984) argued that this issue is treated in two major areas of economic analysis. In one area, which is public finance studies, the growth in government expenditure is caused by the growth in national income, whereas most macro econometric models tend to take the opposite view.

Concerning the monetary policy of the UK, it is argued that the policy framework was designed to promote economic stability by keeping inflation rates low and steady. Here, we should mention that there is co-ordination between fiscal and monetary policies in this regard.

Price stability, in turn, is an essential element for high and stable levels of employment and growth. Both UK's fiscal and monetary frameworks are characterised by a high level of openness. However, Cobham(2006) argues that this openness in the current monetary framework is unsatisfactory. The monetary policy itself is characterised by flexibility as it can be changed every month.

Concerning the UK's exchange rate and its important role in monetary policy, it is said that there is no official exchange rate target. The idea of the strong sterling exchange rate is that it reduces the competitiveness of UK exports as the exports will be more expensive, decreasing the demand for UK exports and imports from abroad become cheaper. Therefore, a rising pound, by higher exchange rates, reduces aggregate demand lowering the rate of inflation.

Also, this effect on inflation can occur directly as there will be a fall in the prices of imported goods as a result of increase in the pound. In general, there is a reciprocal relationship between fiscal policy and monetary policy. For example, in a recession, some economists find that the monetary policy may be ineffective in increasing current national spending and income, as was experienced in Japan when trying to stimulate the economy through making interest equal zero. Here, fiscal policy will be more effective in stimulating demand. Other economists see that the monetary policy succeeded in USA during the wake of the terror attacks in autumn of 2001, as they found that cutting the interest rate stimulated domestic demand.

2. The Mundell-Fleming model: Theoretical Background.

The Mundell-Fleming model is an extension of the open economy IS-LM model. The Mundell-Fleming model adds net exports to the IS-LM model of the market for goods and services, so the equation for aggregate demand proposed by the Mundell-Fleming model of a large open economy is:

$$Y = C(Y - T) + I(r^{*}) + G + NX(e)$$

Where:

Y= Aggregate demand.

C= Consumption which depends exogenously on disposable income(Y-T), defined as income less taxes.

I= Investment which depends negatively on interest rate(r) (domestic interest rate) which is dependent on (r*) (world interest rate).

G= Government purchases.

NX= Net export which depends negatively on (e).

Net export is defined as the difference between exports and imports. It is related to real exchange rate (relative price of goods at home and abroad) rather than the nominal exchange rate (relative price of domestic and foreign currencies). If ε denotes real exchange rate, then ε =ep/p*. Where p= domestic prices, p*= foreign prices. According to ppp (purchasing power parity) p=p*/e so, e=p*/p where p is domestic prices, p* is foreign prices, e is exchange rate (absolute ppp approach).

NX= (X-M) so, we can write the basic equation as follows:

$$Y = C(Y-T) + I(r^{*}) + G + (X-M)$$

Where,

X: export, M: import

The Mundell-Fleming model assumes that price levels at home and abroad are fixed-real exchange rate is proportional to nominal exchange rate. Therefore, when nominal exchange rate appreciates, foreign goods become cheaper compared to domestic goods, causing exports to fall and imports to rise.

In the Mundell-Fleming model, domestic interest rate in the money market equation of IS-LM model is equal to the world interest rate.

$$M/P = L(r^{*}, Y),$$

Where,

M/P= supply of real money balances,&

L(r*, Y)= demand for real money balances which depends negatively on the interest rate, which is set equal to the world interest rate r*, and positively on output.

Money supply (M) is an exogenous variable controlled by the central bank, and price level P is exogenously fixed.

Putting the two pieces together, if we assume perfect capital mobility, the Mundell-Fleming model, can be described by two equations,

$$Y = C(Y - T) + I(r^{*}) + G + NX(e)$$

$$M / P = L(r^{*}, Y)$$

The first equation describes equilibrium in the goods market; the second describes equilibrium in the money market. Policy variables G and T (Fiscal policy), M (Monetary policy), P (Price level), and the world interest rate (r*) are exogenous and the endogenous variables are income Y, and exchange rate (e).

3. Methodology

3.1. Macro econometric Mundell-Fleming Model

Our model will be as follows:

Consumption Function:

$$C = a_0 + a_1(Y - T) \qquad (1)$$

Taxation Function:

$$T = t_1 Y \qquad (2)$$

Import function:

$$M = m_1 Y - ke \qquad (3)$$

National Income identified equation:

$$Y = C + I + G + NX(e) \qquad (4)$$

Or,

$$Y = C + I + G + (X - M) \qquad (4)$$

Y, C, T, M are endogenous variables and G, I, X, e are exogenous variables representing government expenditures, investment, exports and exchange rate (domestic currency/foreign currency).

A simultaneous equations model is used to solve the above model to investigate the changes in fiscal policy and monetary policy with respect to trade flows on the output of the UK within the above Mundell- Fleming type open economy model. According to Gujarati(2003, 715), "many economic relationships are of the single equation type." In this type we find that there is only one dependent variable and one or more independent variables which are also called explanatory variables. In this type there is an assumption that the relationship of cause and effect is unidirectional, one way causation, i.e. the causality runs from explanatory variables to dependent variable.

The explanatory variables are the cause and the dependent variable is the effect. However, we can find that there is a twofold or simultaneous relationship between the explanatory variables and the dependent variable where many variables in economics are interdependent (Bhattarai, 2005). Whilst the causality runs from explanatory variables to dependent variable, it may also run in the other direction, i.e. from dependent variable to explanatory variables. Therefore, there is more than one equation in the simultaneous equations model, which has two or more endogenous variables.

The endogenous variable in one equation may appear as an explanatory variable in another equation of the system and so there is high non- linearity in parameters and errors in one equation are transmitted through the whole system (Bhattarai, 2005). The most important problem in this type of model is that the explanatory variables and errors are correlated (Koop, 2000). This problem is called simultaneity. In this case, application of the Ordinary Least Square (OLS) method will be inconsistent and biased.

Verbeek(2004) argues that it is useful to consider the reduced form of the model where the endogenous variables are expressed as a function of the exogenous variable and error term. In our model we will avoid simultaneity by using Indirect Least Square (ILS), although the equations are not exactly identified, as will be shown below. However, this method is the best method to solve our model. In brief, it involves estimating the parameters of model in the reduced form by applying OLS and then using the coefficient from the reduced form model to retrieve the structural parameters of the system.

Time series data of the UK economy will be used. The source of our data is World Development Indicators (2002) CD-ROM, World Bank, updated by WDI as well. The data are for national income (Y), consumption (C), investment (I), tax (T), government expenditure (G), export (X), import (M) and exchange rate (e) from 1990 to 2001.

3.2. The model Identification

According to Gujarati (1995, 657), the identification problem means "whether numerical estimates of the parameters of a structural equation can be obtained from the estimated reduced- form coefficients. If this can be done, we say that the particular equation is identified. If this can not be done, then we say that the equation under consideration is unidentified, or under identified." Econometricians use order and rank conditions to identify individual equations. The order condition, which is a necessary but not sufficient condition of identification, tells us if the equation under consideration is exactly, over, or under identified and so the second one, which is rank condition, should be applied. According to Bhattarai (2004, 18), "the rank condition tells us whether the equation under consideration is identified or not." The rank condition is both a necessary and sufficient condition for identification. The model is defined by the rank of the matrix which should have a dimension (M-1)(M-1), where M is the number of endogenous variables in the model.

Rank and order conditions of Identification

Order condition: $K-k \geq m-1$

Rank condition: $P(A) \geq (M-1)(M-1)$ =>order of the matrix

Where:

M= Number of endogenous variables in the model

K= Number of exogenous variables in the model including the intercept.

The number of endogenous variables in an equation is m.

The number of exogenous variables in a given equation is k.

We have four cases:

First: if $K-k>m-1$ and the rank of the p (A) is M-1 then the concerned equation is over identified.

Second: if $K-k=m-1$ and the rank of the p (A) is M-1 then the equation is exactly identified.

Third: if $K-k \leq m-1$ and the rank of the p (A) is less than M-1 then the equation is under identified.

Fourth: if $K-k<m-1$ the structural equation is unidentified. The rank of the p (A) is less than M-1 in this case.

Let us begin with the order condition which is:

$K-k \geq m-1$

For consumption function:

$C=a_0+a_1(Y-T)$

m =3 K=4 k=0

$4-0 \geq 3-1$

$4>2$

So, the consumption equation is over identified.

For tax function:

$T=t_1Y$

m =2 K=4 k=0

$4-0 \geq 2-1$

$4>1$

So, the tax function is over identified.

For import function:

$M=m_1Y-ke$

m =2 K=4 k=1

$4-1 \geq 2-1$

$3>1$

So, the import function is over identified.

It is obvious that all the equations are over identified depending on the order condition. This means it is possible to retrieve more than one structural coefficient from the reduced form of the equation. But the order condition is not sufficient so we must make sure of the identification by the Rank condition.

To obtain the rank condition involves following several steps. Gujarati (2003, 752) summarises that the first step should be to write down the system in a tabular form. After that, we should strike out the coefficients of the row where the equation under consideration appears. The next step is to strike out the columns corresponding to those coefficients in the previous step which are nonzero. Then, the entries left in the table will give only the coefficients of the variables included in the system but not in the equation under consideration.

All possible matrixes will be formed from these entries, like A, of order M-1 and we should obtain the corresponding determinants, which have to be unequal to zero. The Rank matrix is formed from the coefficients of the variables (both endogenous and exogenous) excluded from that particular equation, but included in the other equations in the model. The rank condition tells us whether the equation under consideration is identified or not. The Rank of the matrix is the order of a non-singular matrix.

Rank condition: $p(A) \geq (M-1)$ $(M-1)$ =>order of the matrix. Let us apply the steps to our model as follows:

Table of coefficients in a macro econometric model (Mundell-Fleming):

	constant	Y	C	T	M	I	X	G	e
C	$-a_0$	$-a_1$	1	$-a_1$	0	0	0	0	0
T	0	$-t_1$	0	1	0	0	0	0	0
M	0	$-m_1$	0	0	1	0	0	0	k
Y	0	1	-1	1	0	-1	-1	-1	0

For consumption function:

$$A_1 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & k \\ 1 & -1 & 0 \end{bmatrix} \qquad p(A_1) = M-1=4-1=3$$

$|A1| = 1(0+k) = k \neq 0$

It is clear that there exists at least one non-singular matrix of order M-1

For tax function:

$$A_1 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & k \\ -1 & -1 & 0 \end{bmatrix}$$

$$|\bar{A1}| = 1(0+\bar{k}) = k \neq 0$$

For import function:

$$M = \begin{bmatrix} 1 & -a_1 & 0 \\ 0 & 1 & 0 \\ -1 & 1 & -1 \end{bmatrix}$$

$$|A1| = 1(-1-0)-(-a_1)(0+0) = -1-0 = -1 \neq 0$$

3.3. The Reduced form of the model

Our basic model equation is:

$Y=C+I+G+(X-M)$

But: $C=a_0+a_1(Y-T)$

$C=a_0+a_1Y-a_1T$ $\quad T=t_1Y$ $\quad M=m_1Y-ke$

So, $Y=a_0+a_1Y-a_1t_1Y+I+G+X-m_1Y+ke$

$Y-a_1Y+a_1t_1Y+m_1Y = a_0+I+G+X+ke$

$Y(1-a_1+a_1t_1+m_1) = a_0+I+G+X+ke$ $\quad$ Let $(1-a_1+a_1t_1+m_1) = A$

$Y= (a_0/A) + (1/A)*I+ (1/A)*G+ (1/A)*X+ (k/A)*e+u_{1t}$

$Y=\prod_{10}+\prod_{11}I+\prod_{12}G+\prod_{13}X+\prod_{14}e+u_{1t}$

$\prod_{10} =a_0/A =a_0/ (1-a_1+a_1t_1+m_1)$ $\quad$ $\prod_{11}=1/A=1/ (1-a_1+a_1t_1+m_1)$

$\prod_{12}=1/A=1/ (1-a_1+a_1t_1+m_1)$ $\quad$ $\prod_{13}=1/A=1/ (1-a_1+a_1t_1+m_1)$

$\prod_{14}=k/A=k/ (1-a_1+a_1t_1+m_1)$

$C=a_0+a_1(Y-T)$

$$(Y-T)= \begin{bmatrix} (a0/A)+(1/A)*I+(1/A)*G+(1/A)X+(k/A)*e \\ -t1\{(a0/A)+(1/A)*I+(1/A)*G+(1/A)*X+(k/A)*e\} \end{bmatrix}$$

$$= \begin{bmatrix} (a0/A)+(1/A)*I+(1/A)*G+(1/A)*X+(k/A)*e \\ -(a0t1/A)-(t1/A)*I-(t1/A)*G-(t1/A)*X-(kt1/A)*e \end{bmatrix}$$

$$= \{(a0-a0t1)/A\} + \{(1-t1)/A\} *I + \{(1-t1)/A\} *G + \{(1-t1)/A\} *X + \{k(1-t1)/A\} *e$$

So,

C= $\{a0 + a1a0(1-t1)/A\}$ + $\{a1(1-t1)/A\}$ *I+ $\{a1(1-t1)/A\}$ *G+ $\{a1(1-t1)/A\}$ *X+ $\{a1k(1-t1)/A\}$*e

$$C=\begin{array}{l}[\{ao(1-a1+a1t1+m1)+a1a0(1-t1)\}/A]+[\{a1(1-t1)/A\}*I]+\\ [\{a1(1-t1)/A\}*G]+[\{a1(1-t1)/A\}*x]+[\{a1k(1-t1)/A\}*e]\end{array}$$

$$C=\begin{array}{l}\{(a0-a0a1+a0a1t1+m1+a1a0-a0a1t1)/A\}+[\{a1(1-t1)/A\}*I]+\\ [\{a1(1-t1)/A\}*G]+[\{a1(1-t1)/A\}*X]+[\{a1k(1-t1)/A\}*e]\end{array}$$

$$C=[(a0+m1/A)]+\ [\{a1(1-t1)/A\}*I]+[\{a1(1-t1)/A\}*G]+$$
$$[\{a1(1-t1)/A\}*X]+[\{a1k(1-t1)/A\}*e]$$

$C=\prod_{20}+\prod_{21}I+\prod_{22}G+\prod_{23}X+\prod_{24}e+u_{2t}$

$\prod_{20}=(a_0+m_1)/A$ $\qquad$ $\prod_{21}=a_1\ (1-t_1)/A$

$\prod_{22}=a_1\ (1-t_1)/A$ $\qquad$ $\prod_{23}=a_1\ (1-t_1)/A$

$\prod_{24}=a_1k\ (1-t_1)/A$

$T=t_1Y$

$= (t_1a_0/A) + (t_1/A)*I + (t_1/A)*G + (t_1/A)*X + (t_1k/A)*e$

$T=\prod_{30}+\prod_{31}I+\prod_{32}G+\prod_{33}X+\prod_{34}e+u_{3t}$

$\prod_{30}=t_1a_0/A$ $\qquad$ $\prod_{31}=t_1/A$ $\qquad$ $\prod_{32}=t_1/A$

$\prod_{33}=t_1/A$ $\qquad$ $\prod_{34}=t_1k/A$

$M=m_1Y-ke$

$M= (m_1a_0/A) + (m_1/A)*I + (m_1/A)*G + (m_1/A)*X + (m_1k/A)*e-ke$

$= (m_1a_0/A) + (m_1/A)*I + (m_1/A)*G + (m_1/A)*X + \{(m1k/A)-k\}*e$

$A= (1-a_1+a_1t_1+m_1)$ So $\{(m1k-Ak)/A\}=(m_1k-k+a_1k-a_1t_1k-m_1k)/A$

$= (m_1a_0/A) + (m_1/A)*I + (m_1/A)*G + (m_1/A)*X + \{(m1k-k+a1k-a1t1k-m1k)/A\}*e$

$= (m_1a_0/A) + (m_1/A)*I + (m_1/A)*G + (m_1/A)*X + \{k(a1-1-a1t1)/A\}*e$

$M=\prod_{40}+\prod_{41}I+\prod_{42}G+\prod_{43}X+\prod_{44}e+u_{4t}$

$\prod_{40}=(m_1a_0/A)$ $\qquad$ $\prod_{41}=(m_1/A)$ $\qquad$ $\prod_{42}=(m_1/A)$

$\prod_{43}=(m_1/A)$ $\qquad$ $\prod_{44}=k\ (a_1-1-a_1t_1)/A$

So the reduced form of the macro Model is:

$Y=\prod_{10}-\prod_{11}X+\prod_{12}I+\prod_{13}G+\prod_{14}e+u_{1t}$

$C=\prod_{20}-\prod_{21}X+\prod_{22}I+\prod_{23}G+\prod_{24}e+u_{2t}$

$T=\prod_{30}-\prod_{31}X+\prod_{32}I+\prod_{33}G+\prod_{34}e+u_{3t}$

$M=\prod_{40}-\prod_{41}X+\prod_{42}I+\prod_{43}G+\prod_{44}e+u_{4t}$

4. Empirical results

The regression analysis begins with checking the stationarity of the variables included in the model to identify the order of the integration for each time series. The results obtained provide evidence that all the time series are non-stationary, i.e. they are integrated of order one I (1). This means that these variables have a stochastic trend and in this case we can not reject the null hypothesis of the existence of unit roots for any of the variables under study with consideration of the excluded variables stated above. However, all variables are stationary, i.e. I (0) in their first difference at 1% significance.

4.1. The reduced form equations

Our simultaneous two-equation model was estimated by Indirect Least Square (ILS), as stated above, using Givewin/PcGive. It was used in estimating the model to avoid or at least to reduce the simultaneity problem. The estimated coefficients of the reduced form are reported in the following table.

Table 1
ILS Estimates

The reduced form coefficient	Estimated coefficient for the reduced form	Standard Error
For *Y* equation		
Π_{10} (constant)	0.01218	0
Π_{11}	1.699	0.029
Π_{12}	1.699	0
Π_{13}	1.699	0.0531
For *C* equation		
Π_{20} (constant)	0.6763	0.0819
Π_{21}	0.8215	0.27
Π_{22}	0.8493	0.06
Π_{23}	0.6292	0.0471
For *T* equation Π_{30} (constant)	- 0.04552	0.207
Π_{31}	0.7173	0.712
Π_{32}	3.973	0.145
Π_{33}	0.3866	0.0383
For *M* equation		
Π_{40} (constant)	- 0.02382	0.21
Π_{41}	0.6967	0.711
Π_{42}	1.746	0.15
Π_{43}	0.6994	0.0788

So, the reduced form equations are:

Y = 1.218e+005+1.699*I + 1.699*G + 1.699*X + 2.952e+004*e
(SE) (0) (0.029) (0) (5.31e+004) (2.98e+004)

C = 6.763e+004 +0.8215*I + 0.8493*G + 0.6292*X + 5.899e+004*e
(SE) (0.0819) (0.27) (0.06) (4.71e+004) (4.23e+004)

T = - 4.552e+005+0.7173*I + 3.973*G + 0.3866*X - 2.89e+004*e
(SE) (0.207) (0.712) (0.145) (3.83e+004) (9e+004)

M = - 2.382e+005+ 0.6967*I + 1.746*G + 0.6994*X - 2.755e+004*e
(SE) (0.21) (0.711) (0.15) (7.88e+004) (9.78e+004)

4.2. The retrieved structural coefficients

The estimated coefficients of the reduced form were retrieved to get the parameters of all equations. The Process of retrieving the estimated coefficients of the reduced form is stated, in detail, through the following lines.

The reduced form of the macro Model is:

$$Y=\prod_{10}-\prod_{11}X+\prod_{12}I+\prod_{13}G+\prod_{14}e+u_{1t}$$
$$C=\prod_{20}-\prod_{21}X+\prod_{22}I+\prod_{23}G+\prod_{24}e+u_{2t}$$
$$T=\prod_{30}-\prod_{31}X+\prod_{32}I+\prod_{33}G+\prod_{34}e+u_{3t}$$
$$M=\prod_{40}-\prod_{41}X+\prod_{42}I+\prod_{43}G+\prod_{44}e+u_{4t}$$

So,

$\prod_{30}/\prod_{10}=(t_1a_0/(1-a_1+a_1t_1+m_1))*((1-a_1+a_1t_1+m_1)/a_0)=t_1$
$t_1=4.552e+005/1.218e+005=3.74$

$\prod_{40}/\prod_{10}=(m_1a_0/(1-a_1+a_1t_1+m_1))*((1-a_1+a_1t_1+m_1)/a_0)=m_1$
$m_1=2.382e+005/1.218e+005=1.95$

$\prod_{10}/\prod_{20}=(a_0/(1-a_1+a_1t_1+m_1))*((1-a_1+a_1t_1+m_1)/(a_0+m_1))=a_0/(a_0+m_1)$

$1.218e+005/6.763e+004=a_0/(a_0+m_1)$

$1.8=a_0/(a_0+1.95)$

$a_0=1.8a_0+3.5$

$0.8a_0=3.5$

$a_0=4.37$

$\prod_{21}/\prod_{12}=(a_1(1-t_1)/(1-a_1+a_1t_1+m_1))*(1-a_1+a_1t_1+m_1)/1=a_1(1-t_1)$

$0.8215/1.699=a_1(1-3.74)$

$0.48=a_1\,(2.74)$

$a_1=0.2$

$\prod_{34}/\prod_{30}=(t_1k/(1-a_1+a_1t_1+m_1))*(1-a_1+a_1t_1+m_1)/t_1a_0=k/a_0$

$-2.89e+004/-4.552e+005=k/4.37$

$k=0.277$

So,

$C=a_0+a_1(Y-T)$

$C=4.37+0.2(Y-T)$

$T=t_1Y$

$T=3.74Y$

$M=m_1Y-ke$

$M=1.95-0.27e$

First of all "there are no right or wrong empirical results" (Koop, 2000, 213). The basic equation on which the model is based is the equation for aggregate demand proposed by the Mundell- Fleming model of a large open economy which is:

$$Y=C(Y-T)+I(r)+G+NX(e)$$

Where Y represents income or output, $C(Y-T)$ represents consumption as a function of disposable income. $I(r)$ represents investment as a function of the interest rate, where an increase in the interest rate decreases investment and vice versa. G represents government spending which is predominately unaffected by interest rates. $NX\ (e)$ represents net exports, defined as exports less imports as a function of the real exchange rate.

NX reflects the international linkages based directly on service and merchandise flows across borders, in addition indirectly reflecting capital flows into and out of a particular country. Merchandise flows are sensitive to domestic income levels and preferences for foreign-made goods.

In addition these flows are influenced by exchange rates which affect the domestic price of goods and services produced abroad. The other equations on which the model is based are:

Consumption function: $C=a_0+a_1(Y-T)$ where, along the consumption function, consumption spending depends on the level of disposable income which is the money that consumers have left to spend after taxes.

Consumer spending and disposable income move together over time. The consumption function indicates the relationship between the level of income in the economy and the amount households plan to spend on consumption, other things constant.

The relationship between consumption spending and disposable income is captured by the slope of the consumption function (a_1) which is (0.2) and the influence of other factors that are independent of income is captured by the intercept (a_0) which is (4.37) and the equation is C=4.37+0.2(Y-T).

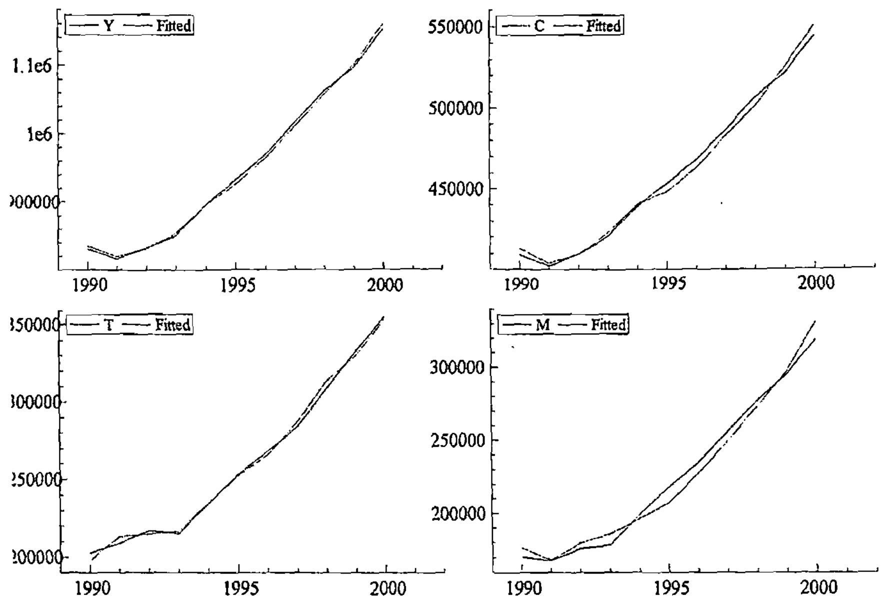
Taxation function: $T=t_1Y$ where the positive relationship between tax and income. An increase in income leads to increase in the revenue from taxes and in this model the equation is T=3.74Y. Import function: $M=m_1Y-ke$ where there is a positive relationship between import and income. The increase in income increases imports, thereby

increasing the welfare of society and the equation after estimating coefficients is M=
0.27e.

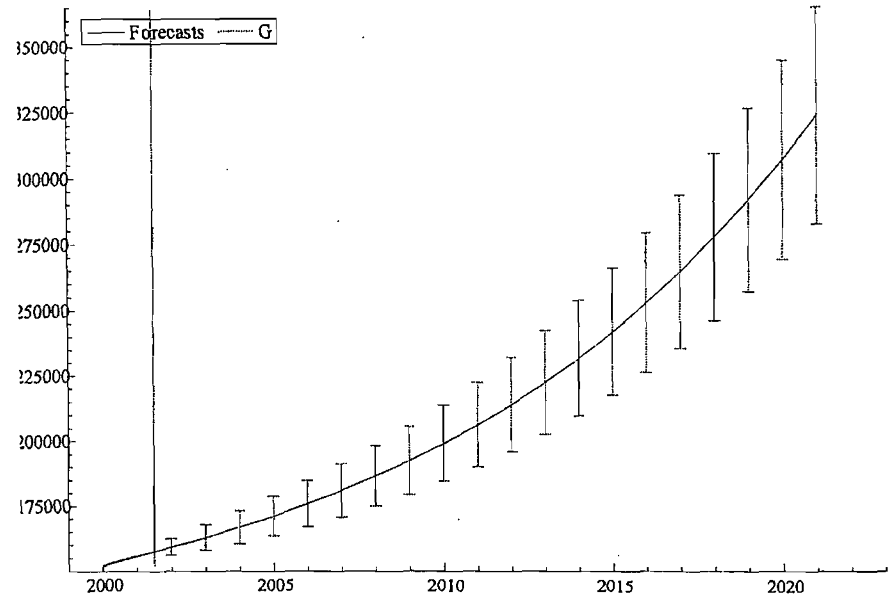
4.3. The ex-post forecasts from 1990 to 2001 and ex-ante forecasts for 2001-2

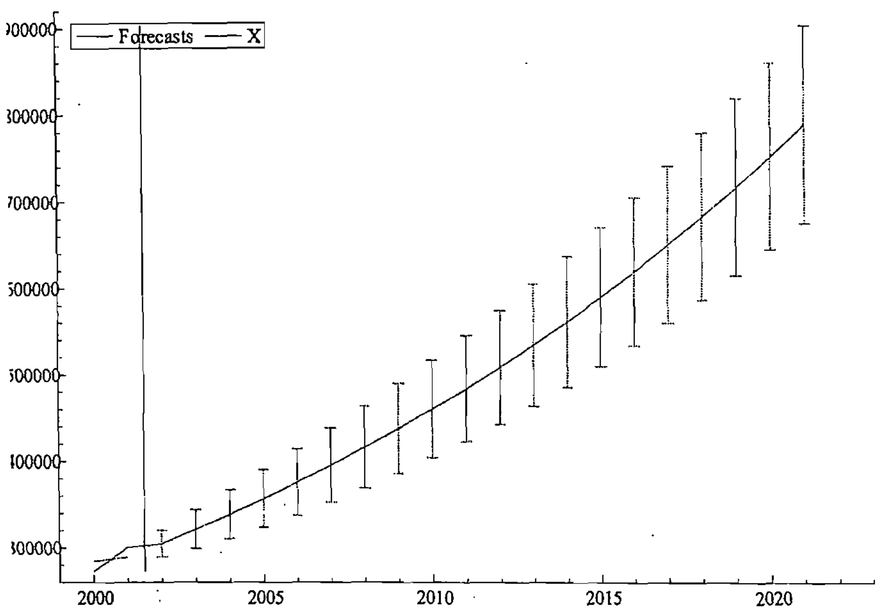
4.3.1. Ex-post simulation for endogenous variables (1990-2001)

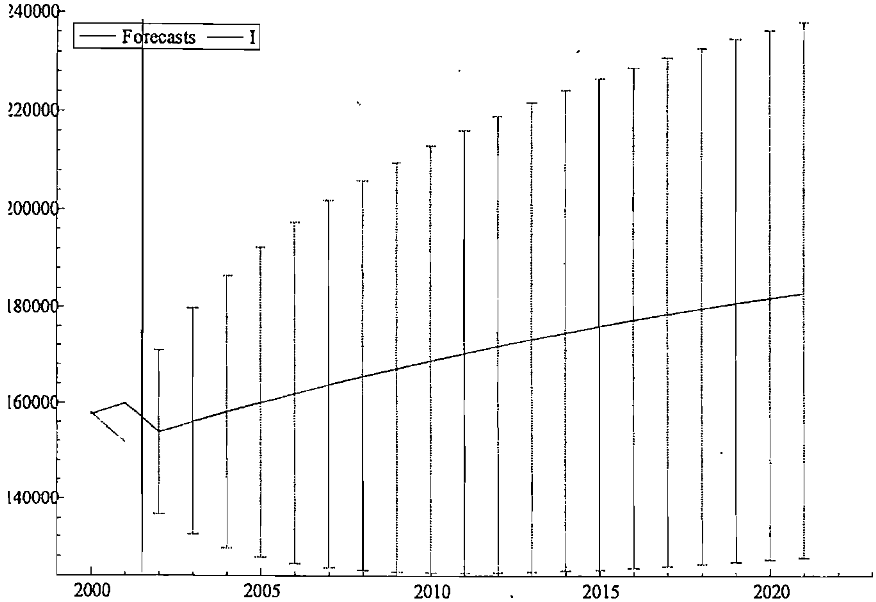
Figure (1)

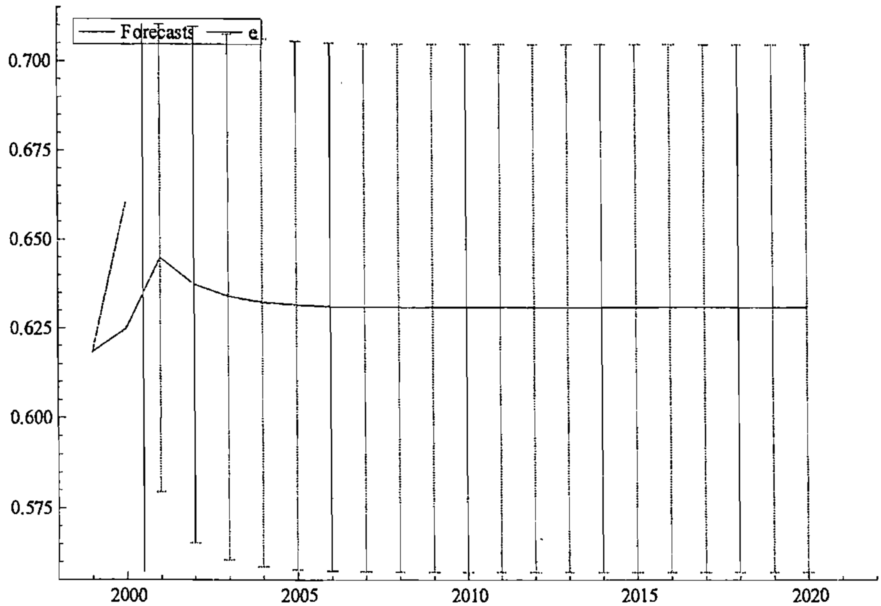


Forecasting of exogenous variables, G,X,I,&e, (2001-2020) Figure (2)



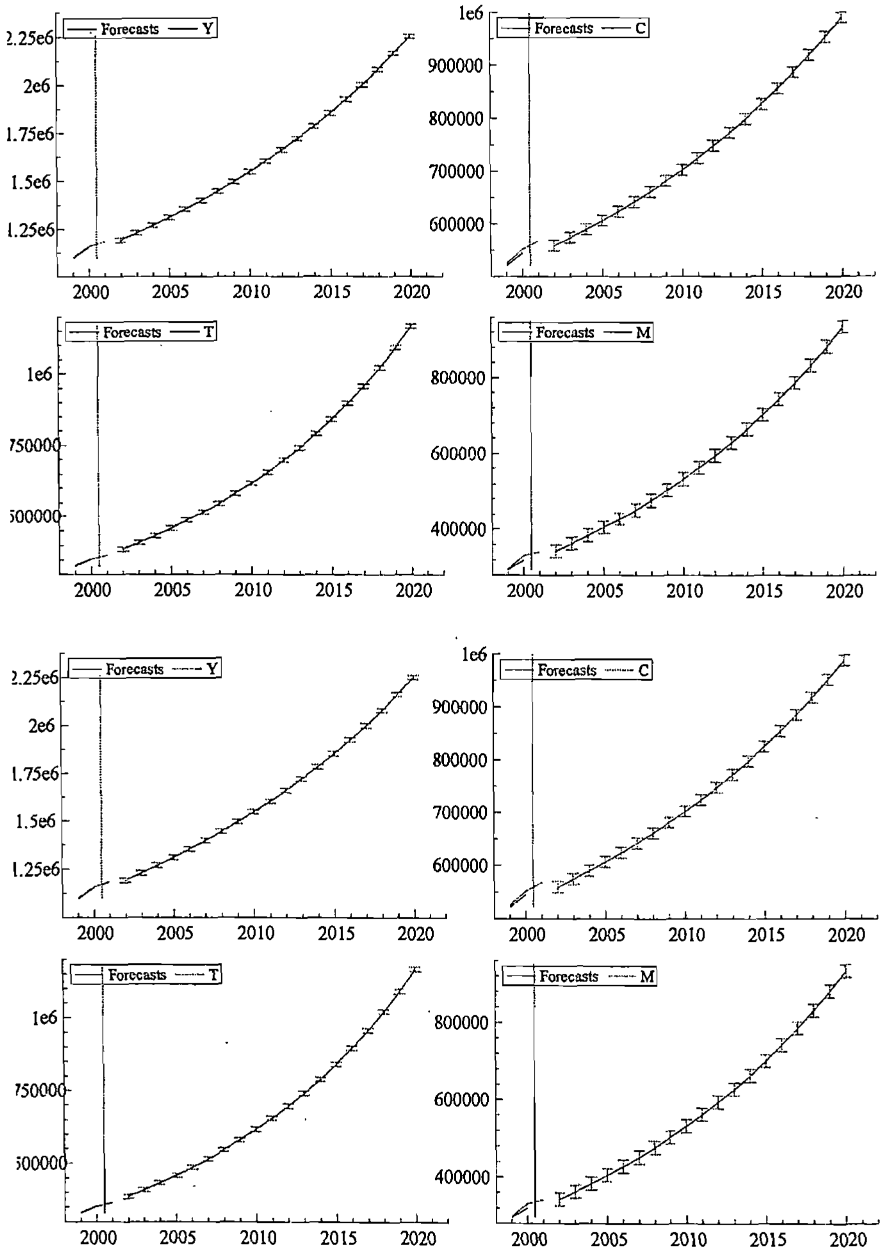



Forecasts
I
240000
220000
200000
180000
160000
140000
2000
2005
2010
2015
2020

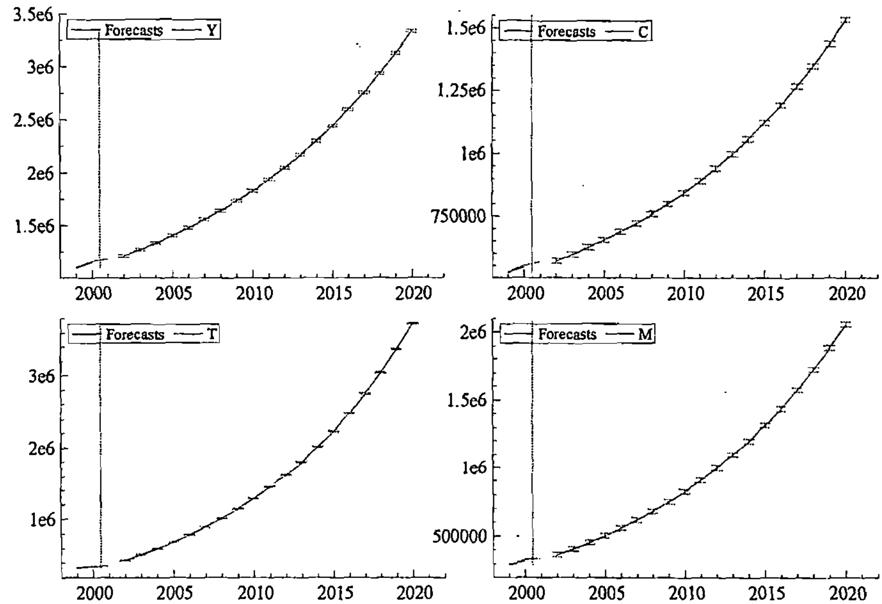

Forecasts
e
0.700
0.675
0.650
0.625
0.600
0.575
2000
2005
2010
2015
2020

4.3.2. Ex-ante Macroeconomic forecast

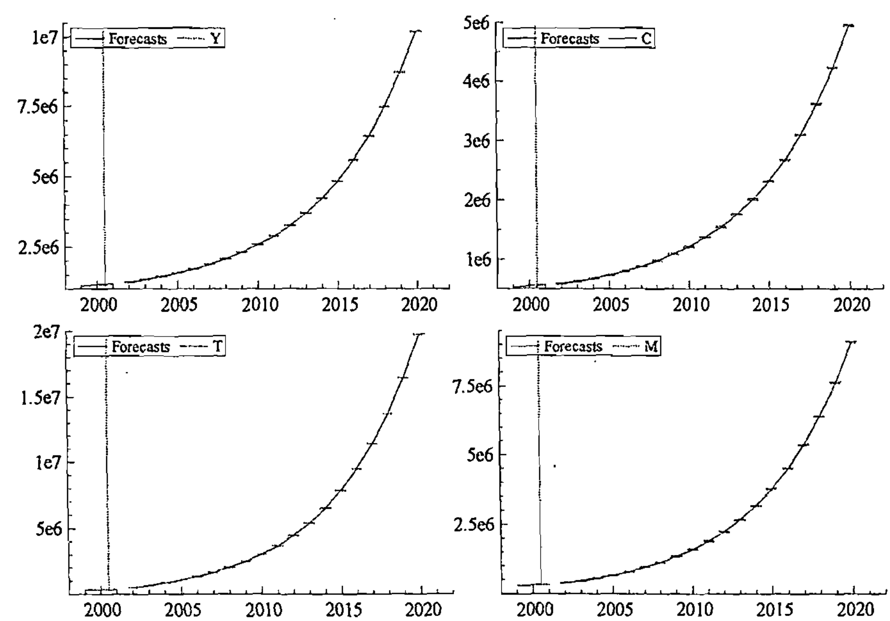
Ex-ante simulation of the model: The effects of the fiscal policy (growth of the government expenditure at 5% annually over 2000-2020). Figure (3)



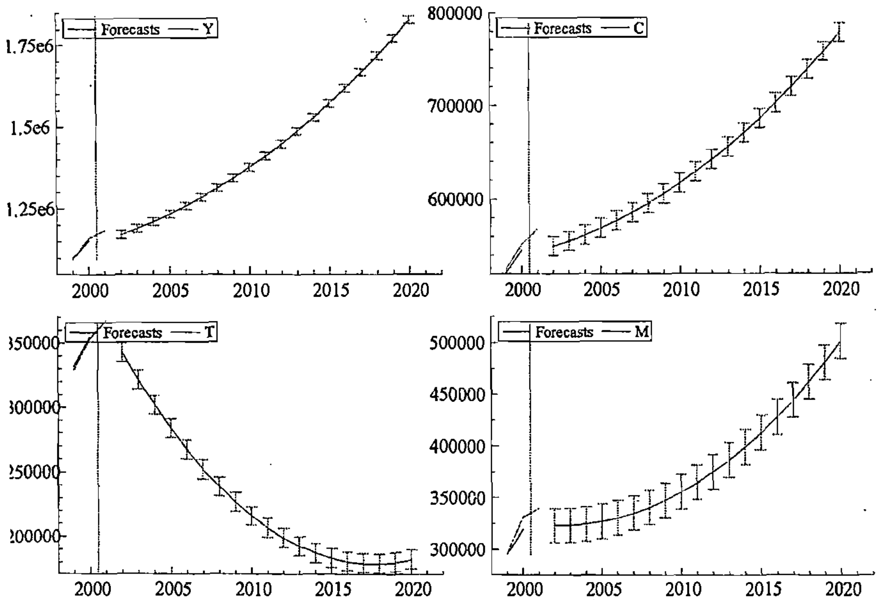
The effects of the fiscal policy (growth of government expenditure at 10% annually over 2001-2020). Figure (4)



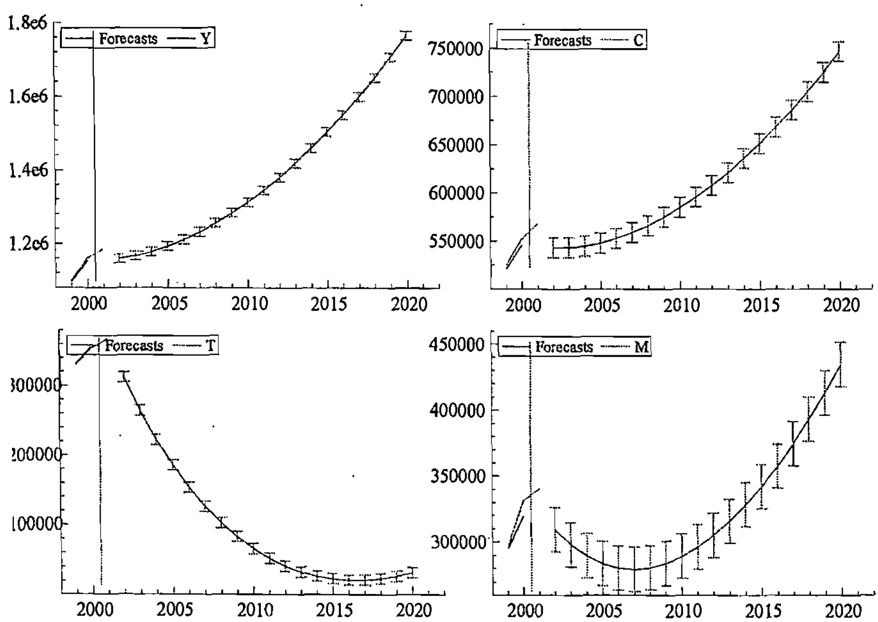
The effects of the fiscal policy (growth of the government expenditure at 20% annually over 2001-2020). Figure (5)



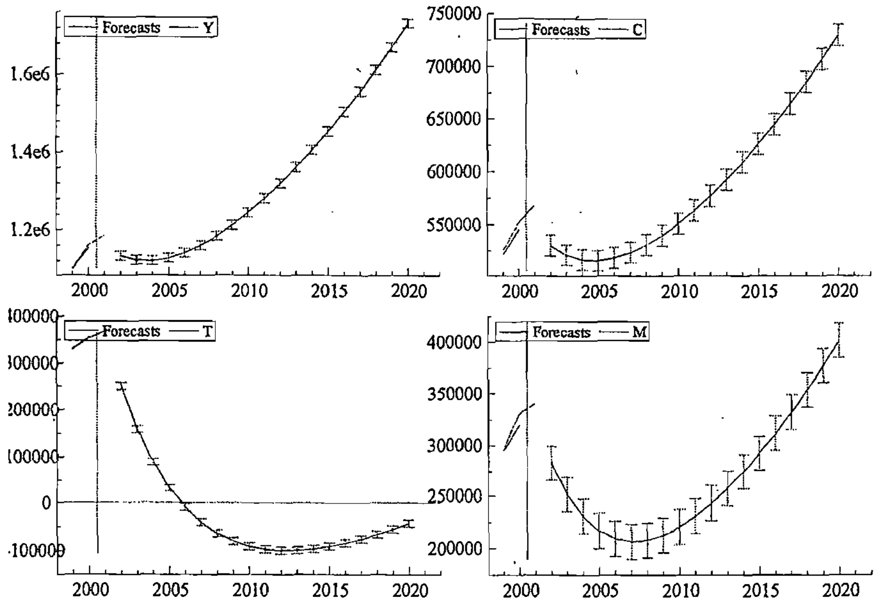
The effects of the cut of government expenditure at 5% annually over 2001-2020 Figure (6)



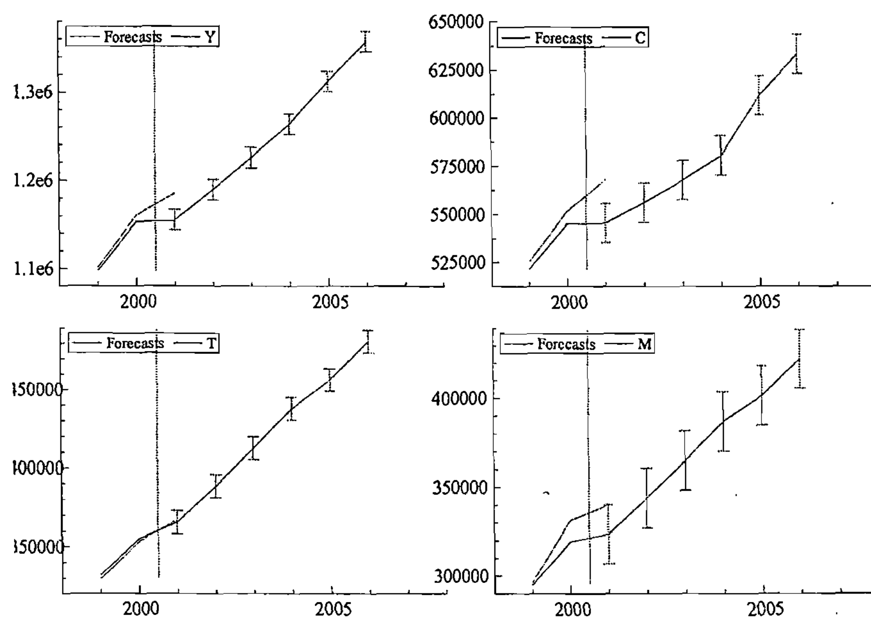
The effects of the cut of government expenditure at 10% annually over 2001-2020 Figure (7)



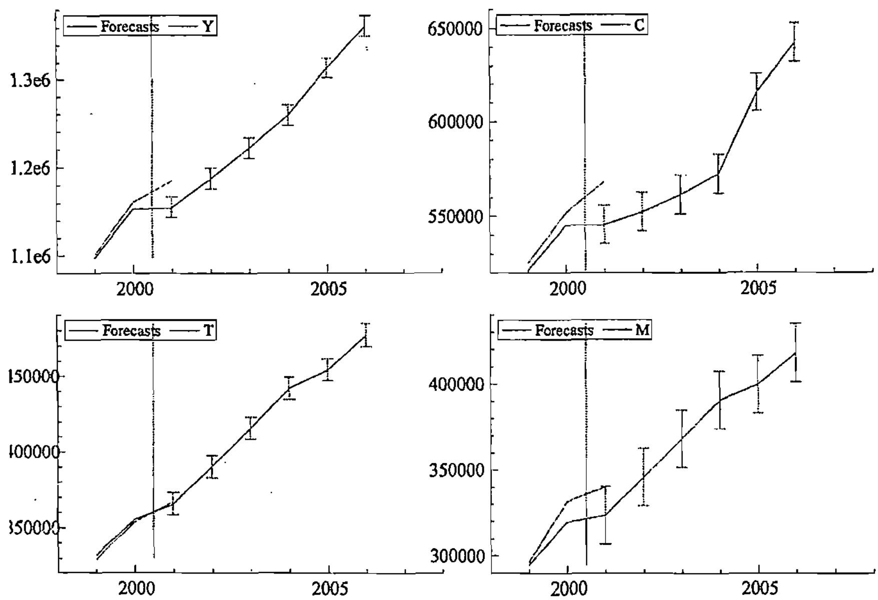
The effect of the cut of the government expenditure at 20% annually over 2001-2020 Figure (8)



10% appreciation of pound annually in the early three years of the ex-ante simulation period and 10% depreciation of pound annually in the 4^{th},5^{th},6^{th} years of the model simulation. Figure (9)

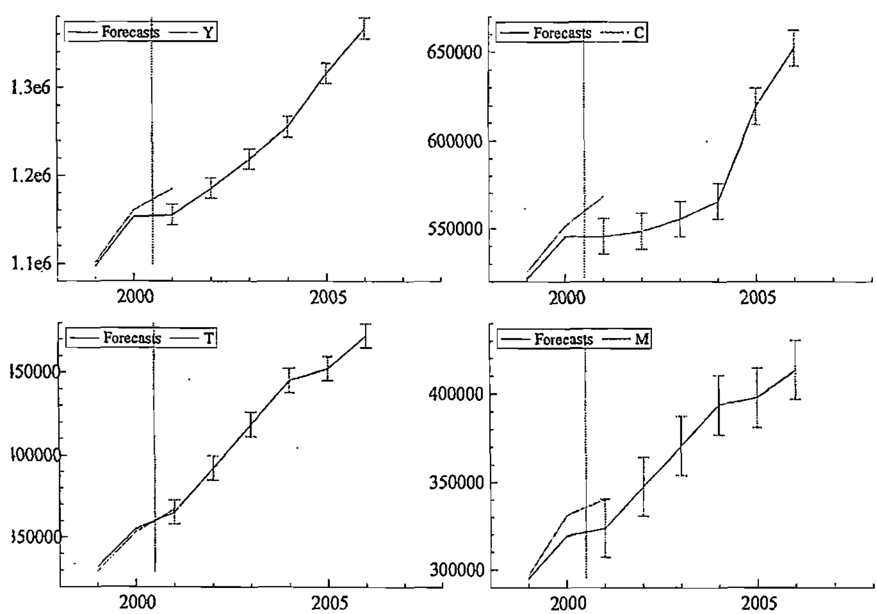


20% appreciation and 20% depreciation of pound in the previous years. Figure (10)



30% appreciation of pound in the early three years and 30% depreciation of pound in 4^{th},5^{th},6^{th} years of the model simulation.

Figure (11)



4.3.3. A (VAR) model of income, consumption and investment.

"A Vector Autoregressive (VAR) model was used to show the dynamic effect o the impact of unitary shocks on a variety of macroeconomic variables" (Stait, 2005, 12) The impulse response is to determine how each endogenous variable responds over tim to a shock in that variable and in every other endogenous variable. The impulse respons function traces the response of the endogenous variables to such shocks. The VAR o Income, consumption and investment can be stated as follows.

Var (1, 1)

$Y=\alpha_{10}+\alpha_{11}Y_{t-1}+\alpha_{12}C_{t-1}+\alpha_{13}I_{t-1}+e_{1t}$

$C=\alpha_{20}+\alpha_{21}Y_{t-1}+\alpha_{22}G_{t-1}+\alpha_{23}I_{t-1}+e_{2t}$

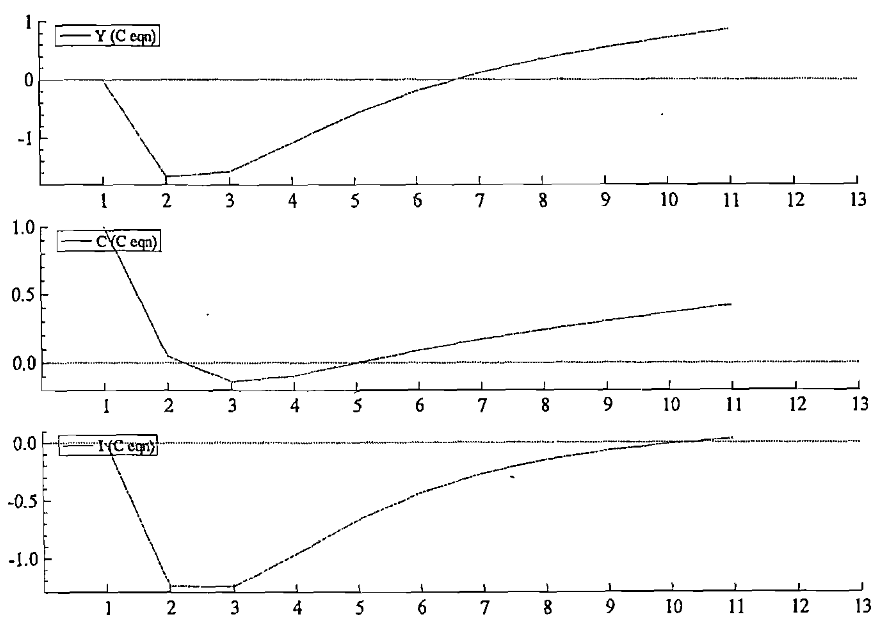
$I=\alpha_{30}+\alpha_{31}Y_{t-1}+\alpha_{32}G_{t-1}+\alpha_{33}I_{t-1}+e_{3t}$

$(I-A_1)=\ e_t$

$$\begin{matrix}1&0&0\\0&1&0\\0&0&1\end{matrix}\ \begin{matrix}Y_t\\C_t\\I_t\end{matrix}\ -\ \begin{matrix}\alpha_{10}&\alpha_{11}&\alpha_{12}&\alpha_{13}\\\alpha_{20}&\alpha_{21}&\alpha_{22}&\alpha_{23}\\\alpha_{30}&\alpha_{31}&\alpha_{32}&\alpha_{33}\end{matrix}\ \begin{matrix}Y_{t-1}\\C_{t-2}\\I_{t-3}\end{matrix}\ =\ \begin{matrix}e_{1t}\\e_{2t}\\e_{3t}\end{matrix}$$

Impulse response Analysis

Figure(12)



Cumulative Impulse Response Analysis:
Figure(13)

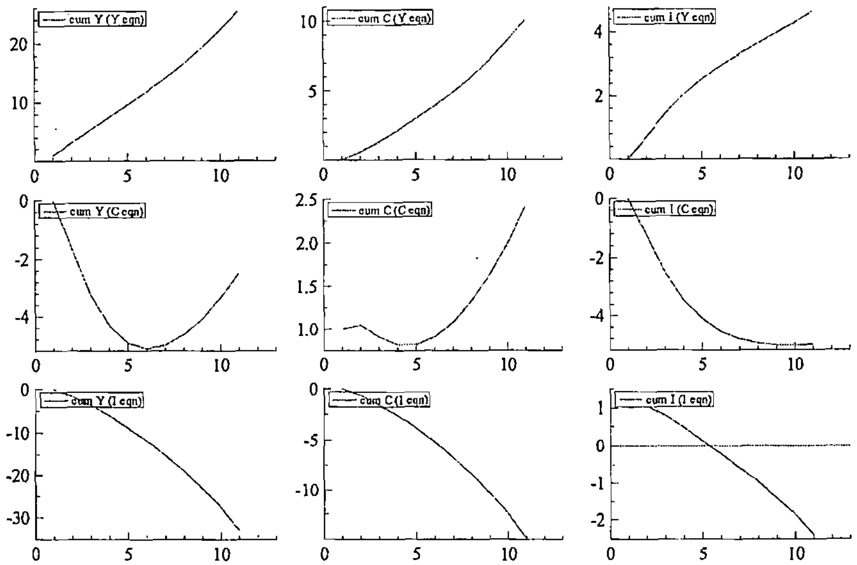


Figure (1) shows ex-post simulation for endogenous variables in the period 1990-2001 with the actual and simulated values taken by endogenous variables, income (Y), consumption (C), tax (T), and import (M) and as we see in figure (1) all of them are fitted. Figure (2) indicates forecasting of exogenous variables or policy variables, government expenditures (G), exports(X), investment (I), and exchange rate (e).

Also figure (2) indicates ex-ante simulation of the model (endogenous variables). Figures (3) to (5) indicate the effects of the growth of government expenditures (expansionary policy) by 5, 10, and 20 percent annually respectively over 2000-2020 period on the growth path of the forecasted series generated. Government expenditure is a reflection of the fiscal needs and policies of the public sector in a given economy.

This type of expenditure might be in reaction to the demand for public goods and services by private households and businesses through voting or other types of political activity. In addition, government expenditure could be used as a deliberate policy tool to increase nominal incomes in the hope of simulating aggregate demand.

Figure (3) indicates that the increasing of G by 5% will raise income and as a consequence the predicted values of tax, consumption and imports will increase.

We will find that the increase of Y, C, T, and M is similar; all of them will rise at an increasing rate. In figures (4) and (5) for increase in G by 10% and 20%, we will find the slope of all curves will increase more than in figure (3). This means that the effects of the increase of G will be larger and this is obvious to our "eye ball" or visual examination of the effect of expansionary fiscal policy in figure (5). But we can notice another feature of the forecasts which indicate that in the year 2020 there is a stable situation, not like in figures (3) and (4) where there is a continuous increase.

Figures (6) to (8) indicate the contractory fiscal policy where government expenditure is cut and the effects of these cuts on the predicted growth of the economy over the period 2001-2020. The most noticeable thing is the decrease in predicted taxes (T) and this is logical, as a cut in government expenditure means cut in incomes from reduction in employment and other issues. The reduction in incomes leads to a corresponding decrease in the tax revenues.

In figure (6) we notice that both Y and C are increasing but the slopes are much smaller than in the case of expansionary fiscal policy. However here, as noted previously, the decrease in tax is very obvious and we will notice that in the curve of M the forecast band is wider and there is an increase in imports, but this is in the first four years, as income increases. In figures (7) and (8) we see an obvious effect of cuts of 10% and 20%. We find that in the long run of the forecasting period there is a decrease in the early years in the curves of Y, C, and M because of the cut in G. After that Y,Cand M will increase. However, the tax curve continues to decrease until it falls below 0.

Figure (9) indicates the effects of a 10% appreciation in the pound annually in the first three years of the ex-ante simulation period and a 10% depreciation in the pound annually in the 4^{th}, 5^{th}, and 6^{th} years of the model simulation where 10% appreciation of pounds means a rise in the exchange rate where exchange rate = domestic currency/foreign currency ($) i.e. a higher $/£ exchange rate means the pound has appreciated.

The dollar has simultaneously depreciated. A fall in the $/£ exchange rate has the opposite effect. As the real exchange rate rises, domestic currency is relatively more valuable and thus the price of domestic goods is relatively more expensive than the price of the foreign goods. In this case, exports fall and imports rise, causing net exports to decline. Therefore, the predicted import will increase in the early three years. The predicted Y also will increase and C and consequently T will increase. The opposite will happen in the case of depreciation in the pound by 10%.

Figure (10) indicates the effects of a 20% appreciation in the pound annually in the first three years of the ex-ante simulation period and a 20% depreciation in the pound annually in the 4^{th}, 5th, and 6^{th} years of the model simulation. The effects of the appreciation and depreciation in the pound are very obvious in the figures (10) and (11) where figure (11) indicates a 30% appreciation in the pound in the first three years and a 30% depreciation in the pound in the 4^{th}, 5th, and 6^{th} years of the model simulation. Figure (12) indicates the impulse response analysis which determines the response of Y, C, and I to a shock over time. We will find that this analysis may appear in period 2-3 for Y, the response of Y to shocks in C and period 3 the response of C to shocks in C and period 2-3 the response of I to shocks in C. Figure (13) indicates cumulative impulse response analysis.

Appendix 1
Estimates of the reduced form

Equation for: Y

		Coefficient	Std.Error	t-value	t-prob
I		1.69901	---		
G		1.69901	0.02905	58.5	0.000
X		1.69901	---		
e		29509.9	5.310e+004	0.556	0.098
Constant	U	121804.	2.984e+004	4.08	0.006

sigma = 5796.05

Equation for: C

		Coefficient	Std.Error	t-value	t-prob
I		0.821739	0.08188	10.0	0.000
G		0.849645	0.2695	3.15	0.020
X		0.629013	0.05999	10.5	0.000
e		59069.0	4.712e+004	1.25	0.057
Constant	U	67528.1	4.227e+004	1.60	0.061

sigma = 5087.58

Equation for: T

		Coefficient	Std.Error	t-value	t-prob
I		0.715847	0.2072	3.45	0.014
G		3.97065	0.7121	5.58	0.001
X		0.387673	0.1452	2.67	0.037
e		-29351.6	3.830e+004	-0.766	0.072
Constant	U	-454664.	9.003e+004	-5.05	0.002

sigma = 3671.84

Equation for: M

		Coefficient	Std.Error	t-value	t-prob
I		0.696325	0.2101	3.31	0.016
G		1.74576	0.7110	2.46	0.049
X		0.699679	0.1496	4.68	0.003
e		-27675.7	7.879e+004	-0.351	0.037
Constant	U	-238051.	9.777e+004	-2.43	0.051

sigma = 8366.49

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