The impact of fiscal policy shocks in the United Kingdom: an empirical investigation

Said Mohamed, Mona Kamal

Queen Mary, University of London
School of Economics and Finance

The Impact of Fiscal Policy Shocks in the United Kingdom: An Empirical Investigation

Submitted for the Examination of the MPhil Degree

MPhil Degree Candidate

Mona Kamal Said Mohamed

Under Supervision of

Dr. Winfried Koeniger

Queen Mary, University of London
School of Economics and Finance

2010

Abstract

This paper empirically examines the impact of shocks to government spending and government revenues on main macroeconomic variables in the UK. We apply the methodology of Mountford and Uhlig (2009) to analyze the effectiveness of fiscal policy in the UK and compare our results with the literature on fiscal policy in the US. The main finding is that the effect of fiscal policy shocks in the UK differs from that in the US. Following a government spending shock in the UK, there is an immediate increase in output, private investment, private consumption and real wages. Regarding the government revenue shock, it is contractionary in the US. In the UK, however, private investment and GDP react positively to this shock.

Contents *Page*

List of Figures

List of Tables

1. Introduction

A substantial empirical literature has investigated the optimal design of monetary policy using Vector Autoregression (VAR) and Structural Vector Autoregression (SVAR) models. This analysis has focused mainly on the impact of shocks to monetary policy on macroeconomic variables. See for example Favero (2001), Bagliano and Favero (1998), Christiano *et al.* (1998), Leeper *et al.* (1996), Uhlig (2005).

On the contrary, there is no intensive investigation of the impact of shocks to fiscal policy on private consumption, employment, private investment and real wages. In the review of the existing literature on fiscal policy shocks below we find that most of the analysis has been done with US data. There is no equivalent research for other developed economies and in particular for the UK.

Moreover, there is still no consensus among economists about the exact impact of shocks to government revenues and government spending on economic variables even in the American economy. This can be attributed to the application of different identification strategies for fiscal policy shocks in the estimated VARs or SVARs. More specifically, there are four main identification approaches. Firstly, the Event-Study Approach introduced by Ramey and Shapiro (1998) to study the effects of large unexpected increases in the American government defence spending which has been extended by Edelberg *et al.* (1999), Eichenbaum and Fisher (2005), Perotti (2007) and Ramey (2008). Secondly, the recursive approach which studies the effects of fiscal policy shocks on consumption and employment by Fatás and Mihov (2001). Thirdly, the mixed SVAR/Event Study Approach of Blanchard-Perotti (2002) which has been extended by Perotti (2005). Finally, the Sign-Restrictions Approach that is applied by Mountford and Uhlig (2009).

This thesis examines the impact of fiscal policy shocks to government spending and government revenues on the main macroeconomic variables in the UK. The framework of the analysis is a (VAR) model using quarterly data for the UK spanning from the first quarter of 1963 to the third quarter of 2008.[1] We adapt the methodologies of Uhlig (2005) and Mountford and Uhlig (2009), through imposing sign restrictions on the impulse responses of some variables.[2] The results show that the effect of fiscal policy shocks in the UK differs from that in the US. Following a government spending shock, output, private investment, private consumption and real wages increase in the UK. This differs from the effect of this shock found for the US where private investment declines, the private consumption response is positive but very weak and real wages do not respond positively. Regarding changes in government revenue, Mountford and Uhlig (2009) and Blanchard and Perotti (2002) found that a government revenue shock is contractionary in the US. The analysis in this thesis with UK data indicates instead that private investment and GDP react positively to this shock. Furthermore, the

[1] Appendix (A): discusses the data sources in details.

[2] Uhlig (2005) applied the pure-sign restriction approach to analyze the impact of monetary policy shocks on output in the US. We use the same methodology to identify fiscal policy shocks separately in the UK.

analysis in this thesis shows that it is essential to incorporate other variables, such as the real effective exchange rate and debt levels, in order to analyze the impact of fiscal policy shocks in the UK.

The remaining parts of this thesis are structured as follows. Section 2 reviews the existing literature and highlights the fact of very little existing evidence on the effects of fiscal policy for the UK. Section 3 discusses the estimation approaches. Section 4 indicates the main findings of our estimations. Finally, Section 5 concludes.

2. Review of the Literature

This section points out the main results of the existing literature on fiscal policy shocks. This will be the basis for comparisons between the data evidence from the US and the UK.

2.1. General Theoretical Background

Many studies have investigated the effects of fiscal policy using a basic *neoclassical* model, (e.g. Aiyagari *et al.*, (1992), Baxter and King (1993), Ramey and Shapiro (1998)). According to this perspective, households behave in a Ricardian manner. In addition: goods, labour and capital markets work without any frictions. An increase in government spending financed by non-distortionary taxes will reduce private consumption and increase labour supply. Hence, total output increases but marginal labour productivity and real wages decline. Furthermore, marginal productivity of capital may rise as well due to the increase in employment. This, in turn, will lead to an increase in private investment.

Nevertheless, the above mentioned results change if the increase in government spending is financed by distortionary taxes. Burnside *et al.* (2004) showed that the primary impact of those taxes is on the timing of how hours worked respond to the shock. Hence, the less elastic is the labour supply, the less willing are households to work after the government spending shock. Finally, in the new steady state consumption, investment and output decline.

More interestingly, even in the neoclassical models, there is no guarantee that consumption falls as a consequence of the government spending shock. This finding had been obtained recently by Bouakez and Rebel (2007) who extended the standard Real Business Cycle (RBC) model along two dimensions (i.e. by allowing government spending to enter the utility function and assuming that consumer preferences exhibit habit formation). They found that private consumption can increase following the government spending shock in this setting.[3]

Many authors commenced in introducing frictions to the standard model and assuming non-Ricardian behaviour of the household. For instance, Rotemberg and Woodford (1992) have analyzed a

[3] This result coincides with some of the empirical evidence using VAR models (e.g. Blanchard and Perotti (2002) and Perotti (2005, 2007).

model with imperfect competition and countercyclical markups, Devereux *et al.* (1996) have incorporated monopolistic competition in the intermediate goods sector to obtain demand effects from government spending changes. The main findings of those authors are that a model with imperfect competition and increasing returns to scale can explain the impact of the government spending more appropriately and an increase in government spending raises private consumption and real wages. Private investment also increases because of the large increase in labour supply due to the increase in the real wages.

Furthermore, Linnemann and Schabert (2003) have introduced price stickiness, and their results show that following a shock to government spending, output increases and private consumption falls. Bilbiie and Straub (2004) have an equivalent result through analyzing government spending shocks in a dynamic general equilibrium model with sticky prices, non-Ricardian behaviour, distortionary taxes and a Walrasian labour market. Their results indicate that the intertemporal substitution effects of labour supply will lead to a decrease in private consumption after its initial rise.

Thus, the introduction of monopolistic competition, increasing returns and price stickiness have not helped to explain the positive consumption response after an increase in government spending which is evident in the data. Therefore, as an additional step in this regard, Ravn *et al.* (2006) have introduced '*deep habits*' into a model with monopolistic competition and have shown that private consumption, real wages and employment increase in response to a government spending shock. Linnemann (2006) has used a modified utility function for which consumption and employment are complements. He emphasizes that this form of utility specification is able to generate increases in private consumption and employment while real wages fall in response to a positive government spending shock.

Concerning the above mentioned models, Perotti (2007) has pointed out that a substantial real wage response is required to obtain a positive consumption response. This important feature is incorporated by Galí *et al.* (2007) who introduce '*rule-of-thumb*' consumers into a model with nominal rigidities. This rule means that a group of consumers cannot save or borrow and they consume their wage period by period. Following a government spending shock, aggregate demand increases because of the presence of sticky prices. Labour demand increases as well, and if the labour supply of the '*rule-of-thumb*' consumers is not too elastic, the real wage increases. With a sufficiently large fraction of '*rule-of-thumb*' consumers, private consumption, output and employment increase.

Recently, Annicchiarico *et al.* (2009) have investigated the macroeconomic implication of fiscal policy using a dynamic stochastic general equilibrium model with nominal rigidities, capital accumulation and finite horizons. They have shown that the mismatch between the results of the empirical literature and the theoretical models regarding the effects of fiscal policies on macroeconomic variables can be due to the exclusion of the interaction between monetary and fiscal policies which should be captured in the analysis.

The above overview of the theoretical background indicates that there is no consensus among economists about the impact of fiscal policy shocks on macroeconomic variables. The following table summarizes the main findings of the above mentioned models.

Table (1): Predicted Effects of a Positive Government Purchases Shock in a Closed Economy

	Y	C	w	L^s	L^d	L
Neoclassical	↑	↓	↓	↑	0	↑
Non-separable utility	↑	↑	↓	↑	0	↑
Deep habits	↑	↑	↑	↑	↑	↑
NK – Nominal rigidities	↑	↓	↑	↑	↑	↑
NK – Rule - of - thumb	↑	↑	↑	↑	↑	↑

Source: Beetsma (2008, p.34).

The symbols are as follows: Y = output, C = consumption, w = real wage, L^S = labour supply, L^d = labour demand, L = employment, NK = New-Keynesian. 0= no response.

2.2. Existing Evidence for the US

The impact of fiscal policy shocks on macroeconomic variables has been analysed extensively using US data. Despite the fact that all empirical studies agree that government spending shocks have a persistent positive effect on output, there is a disagreement among them concerning the consequences of fiscal policy shocks on private consumption, employment, real wages and private investment. This can be attributed to the different identification approaches which have been applied in those studies.

There are four main approaches which can be summarized as follows:

The Event Study Approach examines the effects of fiscal policy by determining specific fiscal events in the US (e.g. the increases in defence spending associated with the military build-up during the Korean and Vietnam wars or spending associated with the war against terrorism after 9/11 or the temporary income tax reductions in 1968 and 1975). Many studies have used this approach (for example: Ramey and Shapiro (1998), Edelberg *et al.* (1999), Burnside *et al.* (2004), Eichenbaum and Fisher (2005), Perotti (2007), Ramey (2008)). [4] The main findings of this approach are as follows. During episodes of large and exogenous increases in defence spending, output and employment increase but private consumption and the real wage fall. Concerning the government revenues shock, Romer and Romer (2010) have concluded that tax increases are highly contractionary. The large effect stems in considerable part from a powerful negative effect of tax increases on investment.

The Recursive Approach relies on the causal ordering of the model variables. In Fatás and Mihov (2001) and Caldara and Kamps (2008), the fiscal variable (i.e. government spending) is ordered first

[4] The existing literature also refers to the Event Study Approach as the 'Dummy Variable Approach' or the 'Narrative Approach'.

in their VAR estimation. This implies that other endogenous macro variables do not affect government spending contemporaneously. The main finding of this approach is that private consumption and real wages significantly and persistently increase in response to a positive government spending shock.

The Blanchard-Perotti Approach is a mixed SVAR/Event Study strategy. The identification of fiscal policy shocks is achieved by using institutional information about the taxes, transfers and spending programmes. Blanchard and Perotti (2002) and Perotti (2005, 2007) have found that positive government spending shocks will lead to a positive effect on output but a negative effect on investment. Interestingly, it has been found by Perotti (2007) that the effect of fiscal shocks on consumption differs over time in the US. His main conclusion is that a government spending shock has a positive and statistically significant impact on consumption in the 1960s and 1970s. The positive impact, however, becomes insignificant in the 1980s and 1990s. Furthermore, he provides evidence that the real wage persistently and significantly increases while employment does not react. For the government revenues shock, Blanchard and Perotti (2002) and Perotti (2005, 2007) have found that it has a strong negative effect on output and investment spending.

The Sign-Restrictions Approach depends on imposing restriction on the sign of the responses functions of the variables. The application of this approach delivers a positive but weak response of consumption and a decline in real wages and in private investment as a consequence of the government spending shock. Concerning government revenue shocks, Mountford and Uhlig (2009) have shown that they have strong negative effects on output and other real economic variables. Table (B.1) of Appendix (B) indicates the main findings of the above mentioned papers.

Recently, Caldara and Kamps (2008) have provided a comparative analysis through applying those four identification approaches using the US data. [5] They have shown that, despite the disagreement in the empirical literature about the qualitative effects of fiscal policy shocks on the main macroeconomic variables, controlling for differences in specification of the reduced-form VAR models (e.g. using the same data sample and variables), will lead to the four approaches yielding qualitatively and quantitatively very similar results as regards *government spending shocks*.[6] However, regarding the *tax shocks* they have found diverging results. They attribute this finding to the difference in the size of automatic stabilizers which have been estimated or calibrated for different identification approaches.

Moreover, one limitation of the existing empirical VAR/SVAR based analysis of fiscal policy shocks in the US is that those models do not explicitly take into account the government debt. Recently, some papers have tried to overcome this shortcoming. For instance, Favero and Giavazzi (2007) have shown that including government debt in the set of variables has important implications

[5] Their data spans the period 1955:Q1 to 2006:Q4.

[6] In response to such shocks real GDP, real private consumption and the real wage all significantly increase following a hump-shaped pattern, while private employment does not react.

for the response of interest rates to fiscal policy shocks, whereas the responses of other macroeconomic variables are not strongly affected. In addition, Chung and Leeper (2007) have addressed this issue by imposing a debt-stabilizing condition derived from the intertemporal government budget constraint on the estimated VAR model.[7] Their results suggest that imposing fiscal solvency has quantitatively important implications at very long horizons. This, also, coincides with the results obtained by Afonso and Sousa (2009a) who argue that the main implication will be on the persistent responses of long-term interest rates and GDP to the fiscal policy shocks.

2.3. Existing Evidence for the UK

The number of contributions regarding the impact of fiscal policy for Europe and the UK is limited. [8] Nevertheless, we think that there will be much more analysis of fiscal policy in those countries especially after the recent recession. [9]

As for the UK, few studies exist. Early contributions of Benjamin and Kochin (1984), Barro (1987) have analyzed the economic effect of government spending using data from the outset of the eighteenth century through World War I. They have pointed out that temporary government purchases affect the term structure of real interest rates. Specifically, they have bad positive effects on long term interest rates.

More recently, Perotti's (2005) results for the UK suggest that government spending shocks have significant effects on the real short-term interest rate. [10] Also, net tax shocks have very small effects on prices. He has found that for the post-1980 period, positive shocks to government spending and negative shocks to taxes tend to elicit negative responses in output, private consumption, and private investment.

Monacelli and Perotti (2006) have found that following a positive government spending shock in the UK, output and private consumption increase, the trade balance deteriorates and the real exchange rate depreciates. [11] Ravn *et al.* (2007) have used the same sample period for the UK and have found similar results. Their analysis, however, is based on a VAR for a panel of countries including the UK.

Afonso and Sousa (2009a) have evaluated the effect of fiscal policy on economic activity identifying fiscal policy shocks using a recursive identification scheme in a Bayesian Structural

---

[7] Chung and Leeper (2007) have followed the Blanchard-Perotti approach in their identification of the VAR model. They have estimated quarterly VARs using US data for the period from 1947:Q2 to 2006:Q2.

[8] Examples for those studies are for Germany: Perotti (2005) and Heppke-Falk *et al.* (2006), for Italy: Giordano *et al.* (2007). Furthermore, Marcellino (2006) has used an estimated VAR for France, Germany, Italy and Spain. He has found differences across countries in the effects of non-systematic fiscal policy, and substantial uncertainty about the size of these effects).

[9] In addition we think that this topic is going to gain more attention to analyze the role of each member's fiscal policy after joining the European Monetary Union (EMU) and to assess the effectiveness of the Maastricht Treaty's fiscal requirements. Furthermore, the interaction between only one monetary policy implemented by the European Central Bank (ECB), and many fiscal policies implemented by the members of the (EMU) will raise the interest in studying the activism of fiscal policy and the impact of automatic stabilizers.

[10] Perotti (2005) estimated the effects of government expenditures and revenues for 5 OECD countries (specifically: the US, Germany, the UK, Canada, and Australia) using the Blanchard-Perotti identification approach.

[11] Their analysis covered Australia, Canada, and the US as well.

Vector Autoregression (BSVAR) model. They have used quarterly data from 1964:Q2 to 2007:Q4. [12] Their results for the UK show that private consumption is not affected by the government spending shock. The effects on private investment are rather negative and very persistent. The effects on wages and productivity tend to be positive. Their results support the idea that private investment reacts positively to the government revenue shocks.[13]

Afonso and Sousa (2009b) have found that it is important to explicitly consider the government debt dynamics when assessing the macroeconomic effects of fiscal policy and its impact on asset markets in the UK. [14] Fiscal policy shocks increase the variability of housing and stock prices. Specifically, government spending shocks have a positive and persistent effect on output, the price level and housing prices while, government revenue shocks have an initial negative effect on GDP that later becomes positive. They also have a positive impact on housing prices, the unemployment rate, and a persistent negative effect on the price level.

According to our knowledge, there is no research which has extended the sign-restriction approach of Mountford and Uhlig (2009) using UK data. Thus, this thesis provides new evidence in this regard.

3. Identification Approaches

Much attention has been devoted to study the effects of monetary policy on macroeconomic variables using VARs and SVARs models. This requires making identifying assumptions relating structural shocks to the reduced form errors of the VAR. While, many identification approaches have been proposed for identifying those shocks, the most often adopted approach is to obtain identification through short-run restrictions. These restrictions specify that some structural shock has no contemporaneous effect on one or more variables. Common identification approaches include a recursive ordering of variables, contemporaneous restrictions on the error terms, restrictions on the long-run dynamics of the model, or decomposition in temporary and permanent components (e.g. Blanchard and Quah, 1989). [15]

This paper applies the sign-restriction identification approach to analyze the effect of fiscal policy in the UK. This approach has been applied initially to monetary policy (e.g. Faust (1998), Canova and De Nicoló (2002), Uhlig (2005), Peersman (2005)). [16] It has been extended by Mountford and Uhlig (2009) to identify fiscal policy shocks.

---

[12] Their paper provides empirical evidence on fiscal policy shocks using different data samples of other countries (i.e. the US, Germany, and Italy).

[13] The two authors also discuss other findings related to housing prices, stock prices and the real effective exchange rate.

[14] Their analysis also lead to the same conclusion for the US, Germany and Italy.

[15] Faust *et al.* (2004, p. 1108) and Buckle *et al.* (2002, p. 6) provide several examples for restrictions in the VAR literature used for monetary policy analysis.

[16] Peersman (2005) has extended this approach for the joint identification of oil price, aggregate supply, aggregate demand and monetary policy shocks.

In order to apply this approach, sign restrictions are usually imposed depending on prior economic knowledge and theoretical findings. Our starting point in the estimation is a standard reduced-from VAR: [17]

$$Y_t = \sum_{l=1}^{L} B_l Y_{t-l} + u_t \qquad (1)$$

Where, Y_t is an $m \times 1$ vector of endogenous variables, L is the lag length of the VAR, B_l is $m \times m$ coefficient matrices and u_t is prediction error with zero mean and a variance-covariance matrix $E(u_t u_t') = \sum_u$. Equation (1) can be consistently estimated with the Ordinary Least Squares (OLS) method, and the estimate of $\sum_u$ is given by the sample covariance matrix of the OLS residuals.

The estimated VAR in this paper includes quarterly data from 1963:Q1 to 2008:Q3 for ten variables: GDP, GDP deflator, private consumption, private investment, monetary aggregate (M_4), real wages, Producer Price Index (PPI), short-term real interest rate, government spending, and government revenues. The VAR is estimated using the logs of variables and 4 lags.[18] Appendix A provides details on the data.

The problem of identification is to translate the prediction errors u_t into economically meaningful or fundamental shocks v_t. We adopt the common assumptions in the VAR literature that there are *(m)* fundamental shocks, which are orthogonal and normalized to be of variance 1. Thus, $E(v_t v_t') = I_m$.

Identification of these shocks amounts to identifying a matrix A, such that $u_t = Av_t$ and $AA' = \sum_u$. Hence, matrix A allows computing the contemporaneous impact of structural shocks on the (m) variables. Specifically, the j^{th} column of matrix A, is an impulse vector (a) and corresponds to the contemporaneous impact of the j^{th} structural shock on each of the variables of interest. Therefore, the covariance structural becomes $\sum_u = E[u_t, u_t'] = AE[v_t, v_t']A' = AA'$.

This paves the way towards illustrating the two identification approaches which are used in this paper:

Firstly, we use the 'Pure Sign Restriction' approach as in Uhlig (2005). In this case, the shocks are constructed separately. In other words, we look at a single shock as if it is equivalent to identifying a single impulse vector. We identify four main shocks: (i) the business cycle shock, (ii) the monetary policy shock, (iii) the government expenditure shock and (iv) the government revenue shock.
This approach imposes sign restrictions on the impulse responses of certain variables and then evaluates the response to a fiscal policy innovation. No restrictions are imposed on the response of other variables.

[17] Constants, time trends, and exogenous variables can be added to equation (1).
[18] We use this specification as it is standard for any analysis that utilizes quarterly data.

Definition (1): The vector $a \in R^m$ is called an impulse vector, if there is some matrix A, so that $AA' = \sum_u$ and so that (a) is a column vector of A.

In addition, any shock or impulse vector (a) can be written as:

$$a = \tilde{A}\, q. \qquad (2)$$

where q are the identifying weights which are to be determined and $q = [q_1, \ldots, q_m]$, $\|q\| = 1$, and $\tilde{A}$ is the lower triangular Cholesky factor of $\sum_u$.

The impulse response of the j^{th} variable at horizon k to the i^{th} column of $\tilde{A}$ is denoted by $r_{ji}(k)$. The (m) dimensional column vector $r_i(k)$ as $[r_{1i}(k), \ldots, r_{mi}(k)]$.

Therefore, given an impulse vector (a) it is easy to calculate the appropriate impulse response $r_a(k)$ at period k. This can be written as:

$$r_a(k) = \sum_{i=1}^{m} q_i r_i(k) \quad . \qquad (3)$$

The following table summarizes the assumptions imposed on the impulse responses.

Table (2): The Identifying Assumptions Using the Pure-Sign Restriction Approach

Assumption (1):	*A Business Cycle shock*
A business cycle impulse vector is an impulse vector (a_{bc}), so that the impulse responses to (a_{bc}) of the government revenues, real GDP, consumption and investment are not negative, for a horizon of one year.	
Assumption (2):	*A Monetary Policy Shock*
A monetary policy impulse vector is an impulse vector (a_{mp}), so that the impulse responses to (a_{mp}) of the short-term real interest rate is not negative, where the responses of the monetary aggregate (M_4), prices and real GDP are not positive, for a horizon of one year.	
Assumption (3):	*A Government Spending Shock*
A government expenditure impulse vector is an impulse vector (a_{ge}), so that the impulse responses to (a_{ge}) of government expenditure is not negative, for a horizon of one year.	
Assumption (4):	*A Government Revenue Shock*
A government revenue impulse vector is an impulse vector (a_{gr}), so that the impulse responses to (a_{gr}) of government revenues are not negative, for a horizon of one year.	

Source: Prepared by the researcher to indicate the identified sign restriction for each shock separately. Those assumptions were identified using WinRATs code.

Hence, to apply the pure sign-restriction approach we took a number of draws from the posterior of the VAR and identified the shocks. For each draw, the impulse responses were calculated and it

was checked, whether the sign restrictions had been satisfied or not. If they were, the draw was kept. If not, this draw received zero prior weight and the process continued.

For all variables, the time period over which the sign restriction is binding was set equal to one year. Finally, impulse responses and error bands were computed based on Monte Carlo integration with 1000 draws from the posterior. In all resulting figures, we report the median of the responses together with 84th and 16th quartiles error bands.

Then the resulting impulse response functions are analyzed to check the impact of the shock on the main variables of interest.

Secondly, we use the 'Agnostic Identification' approach introduced by Mountford and Uhlig (2009) for the US. We then compare the responses obtained from identifying each impulse vector separately in the 'Pure Sign Restriction' approach with those obtained with the 'Agnostic Identification' approach which identifies a matrix of impulses while assuming orthogonality of some of the shocks.

The 'Agnostic Identification' approach assumes that there are (m) fundamental shocks which are mutually orthogonal and normalized to be of variance one. Following Mountford and Uhlig (2009) we state: [19]

Definition (2): An impulse matrix of rank n is a n × m sub-matrix of some m × m matrix A, such that $AA' = \sum_u$.

Hence we are dealing with an impulse matrix $[a^{(1)},.....a^{(n)}]$which can be written as the product $[a^{(1)},.....a^{(n)}] = \tilde{A}Q$ of the lower triangular Cholesky factor $\tilde{A}$ of $\sum_u$ with an n × m matrix $Q = [q^{(1)},....,q^{(n)}]$, where Q is an orthonormal matrix with $QQ' = I$. The matrix Q plays the crucial role in the 'Agnostic-Identification' approach because it collects the identifying weights with each column of Q corresponding to a particular fundamental shock.

We use the penalty function approach to compute the individual elements of Q. This approach consists in minimizing a criterion function, which penalizes impulse responses violating the sign restrictions, with respect to the identifying weights. In order to apply this approach we take 100 draws from the posterior of the VAR coefficients. These draws are satisfying the sign restrictions.

We then define the function f on the real line where f(x)=100x if $x \geq 0$ and f(x) = x if $x \leq 0$. Let s_j be the standard error of variable j. Let $(J_{s,+})$ be the index set of variables, for which identification of a given shock restricts the impulse response to be positive and $(J_{s,-})$ be the index set of the variables for which identification restricts the impulse response to be negative. So, we solve the following minimization problem:

$$a = \arg\min_{a=\tilde{A}q} \psi(a) \quad . \tag{4}$$

where the criterions function $\psi(a)$ is given by

[19] See, Mountford and Uhlig (2009).

4. Results

In this section we present the results of implementing the identification procedures that have been discussed above. The impulse responses for the fundamental shocks that have been obtained from the *'Pure-Sign Restriction Approach'* can be seen in figures 2 through 5. Whereas, those obtained from the *'Agnostic Identification Approach'* are plotted in figures 6 to 9. The impulse responses are reported for all the ten variables in the estimated VAR. We now provide a comparison between the results of the two approaches for the four shocks of interest:

(i) By construction, in response to the *business cycle shock*, output, private consumption, private investment and government revenue increase in the first year whereas the responses of the monetary variables, prices and the government spending to the business cycle shock are not restricted. The main findings of the two above mentioned approaches are qualitatively similar regarding the responses of the main variables of interest to this shock. See Figures (2) & (6).

Figure (2) shows that government revenues increase immediately after the shock to almost 1.5%. Consumption and investment increase by 0.4% and 0.25%, respectively. There is almost no response from real wages and government expenditure. A surprising result that is inconsistent with theoretical findings is the slight decline in prices as indicated by the responses of the PPI and the GDP deflator. Moreover, Figure (6) shows that government revenues increase to 3.1% immediately after the shock.[21] GDP and consumption increase by almost 1.3%, and investment increases by 1.6%. Quantitatively, the response obtained with the *'Agnostic Identification Approach'* is larger compared with the response obtained with the *'Pure-Sign Restriction Approach'*. Also, with the *'Agnostic Identification Approach'* the real wages respond positively to the business cycle shock by increasing 0.3%. These effects are in line with economic theory.

Prices do not increase in response to the shock, however. The GDP deflator and the PPI decline by 0.06% and 0.6%, respectively. Government expenditures respond sluggishly with a rise of 0.06%. Interestingly, government expenditures behave in a counter-cyclical manner for a short lived period after the shock and then reverse the course of action to a cyclical pattern. This pattern of behaviour differs from the findings of Blanchard and Perotti (2002) and Mountford and Uhlig (2009) who found that government spending is not countercyclical during the whole period of investigation for the US.[22]

(ii) The response to *a monetary policy shock* is depicted in Figures (3) & (7), where the shock is attributed to the real short-term interest rate. Interestingly, the results here for the monetary policy shock in the UK differ from those of Uhlig (2005) and Mountford and Uhlig (2009) since there is a decline in the GDP in response to the shock in the UK. On the contrary, Uhlig (2005) concluded that a

[21] According to Caldara and Kamps (2008) the assumption that the business cycle shock is ordered first in the identification rules out that the responses of the model variables to a fiscal policy shock have the same sign as those for the business-cycle shock. Therefore, this assumption implies that whenever government revenues and output move in the same direction, this is due to the business cycle.

[22] They used quarterly data that spans the period from 1955 to 2000.

contractionary monetary policy shock has no clear effect on real GDP, even though prices move only gradually in response to a monetary policy shock.

Also, the result here is consistent with the conventional view that a surprise rise in the interest rate leads to immediate reduction in output, consumption, government expenditure, real wages, monetary aggregate and prices. What is little surprising is the rise in investment and government revenues in response to the rise in interest rates. The results from the 'Agnostic Approach' are shown in Figure (7). By construction, the monetary policy shock is orthogonal to the business cycle shock. A monetary policy shock should be such that a rise in the interest rate causes reduction in output, monetary aggregate M_4 and prices. Both identification approaches give the same qualitative response of the variables except for the government expenditure which increase slightly by 0.17%. Also, as a result of this shock, consumption falls slightly by 0.16% after the shock. However, investment increases by 0.26%. Over the medium and long terms monetary policy shocks are associated with negative real interest rates and the decline in prices is persistent.

(iii) Regarding the *government spending shock*, Figure (4) implies that the government spending shock does not stimulate the economic activity as there is no immediate response of output, private consumption, and real wages. Prices do not increase due to the government expenditure shock. Also, although no restriction is imposed on the response of government revenue, it does not change significantly. In Figure (8) the *government spending_shock* is identified as a shock that is orthogonal to both the business cycle and monetary policy shocks and government spending is restricted to rise for a year after the shock. In line with the economic theory, this shock stimulates the economy. This impact is reflected in an immediate increase in output, consumption, investment, and real wages. However, the impact on those four variables is very weak and short-lived. The real interest rate also rises after the shock. Our results for the UK differ from those obtained by Afonso and Sousa (2009a) who they found no response of private consumption and a decline in investment. However, our results are similar regarding the response of real wages.

Although, government revenues are not restricted, they fall immediately by 1.7%. Furthermore, the response of prices to the increase in government spending is a little puzzling since the GDP deflator does not respond immediately but starts reacting positively from the first quarter. The PPI shows a decline by 0.54% but reacts positively with a lag period of 6 quarters. Although this is inconsistent with the theory (e.g. a government spending shock will lead to a shift in the aggregate demand curve resulting in higher prices), this finding has been obtained also in other studies (e.g Edelberg *et al.* (1999), Canova and Pappa (2003), Mountford and Uhlig (2009)) using US data. They have found a negative relationship between prices and government spending.

Moreover, the findings for the US in Mountford and Uhlig (2009) - show that private investment declines after a government spending shock. The response of private consumption is positive but very weak and real wages do not respond positively to the government spending shock and indeed are negative in the medium-term and the effect on prices is not considerable. In addition, our results

regarding the government spending shock for the UK are in line with the findings related to the impact of this shock on macroeconomic variables as in New Keynesian theoretical models (e.g. Ravn *et al.* (2006)). [23]

(iv) Concerning *the government revenue shock,* Figure (5) indicates that the fiscal policy shock is identified with the innovations in the government revenue variable. More interestingly, it shows that output, private consumption and private investment increase (however the increase is very weak). Also, there is almost no response for real wages, prices and the monetary aggregate.

In Figure (9) the government revenue shock is identified as a shock that is orthogonal to both the business cycle and the monetary policy shocks and where government revenue is restricted to increase for a year after the shock. The figure reflects an increase in GDP by almost 0.18%. The figure shows that private consumption declines by 0.28%. But, what is quite puzzling is the increase in investment by almost 0.29% since the economic theory predicts that a government revenue shock would lead to a decline in aggregate demand and lower investment. Real wages increase by 0.2% but after the first quarter. The responses of the monetary variables are in line with theory as interest rates fall and the monetary aggregate increases. Although no restriction is placed on the behaviour of government spending for this shock, government spending declines.

Our results here and those obtained by Mountford and Uhlig (2009), Romer and Romer (2010), and Blanchard and Perotti (2002) who have concluded that government revenue shock is highly contractionary in the US. For the UK, however, Afonso and Sousa (2009a) have found similar results which support the idea that private investment reacts positively to the government revenue shocks. This requires a deeper investigation of the tax system in the UK.

5. Concluding Remarks

The main objective of this paper is to compare the results for the US regarding the impact of fiscal policy shocks on the main macroeconomic variables to those for the UK. A review of the literature indicates a little investigation of the British case. In order to reflect the importance of the 'Agnostic Identification Approach' of Mountford and Uhlig (2009), we have compared the responses obtained from identifying each impulse vector separately with those obtained under the assumption of orthogonality of the fiscal policy shock to both monetary and business cycle shocks.

Our analysis indicates that assuming orthogonality is important to isolate the fiscal impulse from those caused by the movements in the economy that are created by the business cycle and monetary policy. There is a positive response of output, private consumption, private investment and real wages to a government spending shock. So, if the results of Mountford and Uhlig (2009) suggest that the

[23] Using the 'Agnostic Identification Approach' indicates an increase in output, consumption, investment and real wages following the government spending shock. See, Figure (8).

government spending shock is consistent with the neoclassical model. We find in contrast that this shock leads to findings in the UK consistent with the New Keynesian model.

Regarding the government revenue shock, our results for the UK contradicts those obtained for the US since we have found positive responses of output and private investment to this shock in the UK.

Further research may be done in the following directions.

Firstly, the evidence obtained in the *'Rule of Thumb'* models or *'Deep habit models'* can be parameterized and simulated for the UK as they are data consistent with our results for the government spending shock. So, extending those models by incorporating the role of the Bank of England and its coordination with the Treasury under the inflation targeting regime, introducing debt solvency and wage rigidities can lead to interesting results regarding government spending and revenues shocks.

Secondly, since theoretical models impose solvency and allow for corporate debt in the government budget constraint, it is essential to include a variable for debt levels or its ratio to GDP. Including this variable could affect our results regarding the responses of variables to fiscal policy shocks in the UK. This issue has been pointed out recently for the US by many authors who have found that imposing fiscal solvency has quantitatively important implications at very long horizons.

Finally, it is fruitful to provide a comparative analysis of fiscal policy shocks using different identification strategies (as we have discussed for the US in subsection 2.2) with UK data, and to introduce other variables such as the real effective exchange rate.

Bibliography

- Afonso, António and Sousa M. Ricardo (2009a), "The Macroeconomic Effects of Fiscal Policy", *The European Central Bank*, Working Paper Series No. 991, January.
- Afonso, António and Sousa M. Ricardo (2009b), "Fiscal Policy, Housing and Stock Prices", *The European Central Bank*, Working Paper Series No. 990, January.
- Aiyagari, S. Rao, and Christiano, Lawrence J. and Eichenbaum, Martin, (1992), "The Output, Employment, and Interest Rate Effects of Government Consumption", *Journal of Monetary Economics,* Vol. 30(1), pp. 73-86, October.
- Bagliano, Fabio C. and Favero, Carlo A., (1998), "Measuring Monetary Policy with VAR Models: An Evaluation", *European Economic Review*, Vol. 42(6), pp. 1069-1112, June.
- Annicchiarico, Barbara, and Giammarioli, Nicola and Piergallini, Alessandro (2009) "Budgetary Policies in a DSGE Model with Finite Horizons", *Munich Personal RePEc Archive (MPRA)*, Working Paper No. 12650, January.
- Barro, Robert. J. (1987), "Government Spending, Interest Rates, Prices, and Budget Deficits in the United Kingdom, 1701-1918", *Journal of Monetary Economics*, Vol. 20(2), pp. 221-247, September.
- Baxter, Marianne and King, Robert G, (1993), "Fiscal Policy in General Equilibrium", *American Economic Review*, American Economic Association, Vol. 83(3), pp. 315-333, June.
- Beetsma, Roel (2008), "A Survey of the Effects of Discretionary Fiscal Policy", *Rapport till Finanspolitiska rådet* No., 2008/2.
- Benjamin, D. K. and L. K. Kochin (1984), "War, Prices and Interest Rates: A Martial Solution to Gibson's Paradox" in M. D. Bordo and J. Schwartz (eds) A Retrospective on Classical Gold Standard, 1821-1931. Chicago: Chicago University Press.
- Bilbiie, Florin O. and Straub Roland (2004), "Fiscal Policy, Business Cycles and Labour Market Fluctuations", *The Central Bank of Hungary*, Working Paper No. 2004/6.
- Blanchard, Olivier and Roberto Perotti (2002), "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output", *Quarterly Journal of Economics,* Vol. 117 (4), pp.1329-1368, November.
- Blanchard, O.J. and D. Quah (1989), "The Dynamic Effects of Aggregate Demand and Supply Disturbances", *The American Economic Review*, Vol. 79(4), pp. 655-673, September.
- Bouakez, Hafedh and Norman Rebel (2007), "Why Does Private Consumption Rise After a Government Spending Shock?," *Canadian Journal of Economics*, Canadian Economics Association, Vol. 40(3), pp. 954-979, August.
- Buckle, Robert A., Kim, Kunhong, Kirkham, Heather, McLellan, Nathan and Sharma, Jared (2002), "A Structural VAR Model of the New Zealand Business Cycle", *New Zealand Treasury*, Working Paper No. 02/26, December.
- Burnside, Craig, Eichenbaum, Martin and Jonas D.M. Fisher (2004), "Fiscal Shocks and Their Consequences", *Journal of Economic Theory*, Vol. 115(1), pp. 89-117, March.
- Caldara, Dario and Kamps, Christophe (2008), "What Are The Effects Of Fiscal Policy Shocks? A VAR-Based Comparative Analysis", *The European Central Bank*, Working Paper Series No.877, March.
- Canova, Fabio and Evi Pappa (2003), "Price Dispersions in Monetary Unions: The Role of Fiscal Shocks" , *CEPR Discussion Paper Series*, No. 3746, February.
- Canova, F. and G. De Nicoló (2002), "Monetary Disturbances Matter for Business Fluctuations in the G-7", *Journal of Monetary Economics*, Vol. 49 (6), pp. 1131-1159, September.
- Christiano, L., M. Eichenbaum and C. Evans (1998), "Monetary Policy Shocks: What Have We Learned and to What End?", *National Bureau of Economic Research,* Working Paper No.6400, February.
- Chung, H., and E.M. Leeper (2007), "What Has Financed Government Debt?", *National Bureau of Economic Research*, Working Paper No.13425, September.

- Devereux, Michael B., Allen C. Head, and Beverly J. Lapham (1996), "Monopolistic Competition, Increasing Returns, and the Effects of Government Spending", *Journal of Money, Credit and Banking*, 28(2), pp. 233-54, May.
- Edelberg, Wendy, Martin Eichenbaum, and Jonas D.M. Fisher (1999), "Understanding the Effects of a Shock to Government Purchases", *Review of Economics Dynamics*, Vol. 2 (1), pp. 166-206, January.
- Eichenbaum, Martin and Fisher, Jonas D M (2005), "Fiscal Policy in the Aftermath of 9/11", *Journal of Money, Credit and Banking*, Vol. 37(1), pp. 1-22, February.
- Emmerson, Carl, and Frayne, Chris and Love, Sarah, (2004), "Updating the UK's Code for Fiscal Stability", *The Institute for Fiscal Studies (IFS)*, Working Paper No. 29, November.
- Fatás, Antonio, and Ilian, Mihov (2001), "The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence", *CEPR Discussion Paper Series*, No. 2760, April.
- Faust, Jon, Swanson, Eric T. and Wright, Jonathan H. (2004), "Identifying VARs Based on High Frequency Futures Data", *Journal of Monetary Economics*, Vol. 51(6), pp. 1107-1131,September.
- Faust, Jon (1998), "The Robustness of Identified VAR Conclusions About Money", Board of Governors of the Federal Reserve System, *International Finance Discussion Papers Series*, No. 610, April.
- Favero, C.A., and F. Giavazzi (2007), "Debt and the Effects of Fiscal Policy", *National Bureau of Economic Research*, Working Paper No. 12822, January.
- Favero A., Carlo (2001), "Applied Macroeconometrics", Oxford University Press, Oxford.
- Galí, Jordi, David Lopéz-Salido, and Vallés, Javier (2007), "Understanding the Effects of Government Spending on Consumption", *Journal of the European Economic Association*, Vol. 5 (1), pp. 227-270, March.
- Giordano, R., Momigliano, S., Neri, S., and Perotti, R. (2007), "The Effects of Fiscal Policy in Italy: Evidence from a VAR Model", *European Journal of Political Economy*, Vol. 23 (3), pp. 707-733, September.
- Heppke-Falk, H. Kirsten and Tenhofen, Jörn and Wolff, B. Guntram (2006), "The Macroeconomic Effects of Exogenous Fiscal Policy Shocks in Germany: A Disaggregated SVAR Analysis", *Deutsche Bundesbank*, Discussion Paper Series, No. 41/2006.
- Leeper, M., Eric and Sims, Christopher A. and Zha, Tao (1996), "What Does Monetary Policy Do?", The Brookings Institution, *Brookings Papers on Economic Activity*, Vol. 27(2), pp. 1-78, February .
- Linnemann, Ludger (2006), "The Effects of Government Spending on Private Consumption: A Puzzle?", *Journal of Money, Credit and Banking*, Vol. 38 (7), pp. 1715-1735, October.
- Linnemann, Ludger and Andreas Schabert (2003), "Fiscal Policy in the New Neoclassical Synthesis", *Journal of Money, Credit and Banking*, Vol. 35 (6), pp. 911-929, December.
- Marcellino, Massimiliano, (2006), "Some Stylized Facts on Non-Systematic Fiscal Policy in the Euro Area", *Journal of Macroeconomics*, Vol. 28(3), pp. 461-479, September.
- Monacelli, Tommaso and Perotti, Roberto (2006), "Fiscal policy, the Trade Balance and the Real Exchange Rate: Implications for International Risk Sharing", IGIER (Innocenzo Gasparini Institute for Economic Research), Bocconi University, June.
- Mountford, Andrew and Uhlig, Harald (2009), "What Are the Effects of Fiscal Policy Shocks?", *Journal of Applied Econometrics*, Vol. 24(6), pp. 960-992, September .
- Peersman Gert (2005), "What Caused the Early Millennium Slowdown? Evidence Based on Vector Autoregressions", *Journal of Applied Econometrics*, Vol. 20(2), pp. 185-207, Special Issue.
- Perotti, Roberto (2005), "Estimating the Effects of Fiscal Policy in OECD Countries", Proceedings, *Federal Reserve Bank of San Francisco*.
- Perotti, Roberto (2007), "In Search of the Transmission Mechanism of Fiscal Policy," *National Bureau of Economic Research*, Working Paper No. 13143, June.

- Ramey, Valerie (2008), "Identifying Government Spending Shocks: It's All in the Timing", Discussion Paper, University of California, San Diego, June. Available at: http://econ.ucsd.edu/~vramey/research/IdentifyingGovt.pdf
- Ramey, Valerie A. and Shapiro, Matthew D., (1998), "Costly Capital Reallocation and the Effects of Government Spending", *Carnegie-Rochester Conference Series on Public Policy*, Vol. 48(1), pp. 145-194, June.
- Romer, Christina and David H. Romer (2010), "The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks", *American Economic Review*, Vol. 100 (3), pp. 763-801, June.
- Ravn, Morten, Schmitt-Grohe, Stephanie, Uribe, Martin (2007), "Explaining the Effects of Government Spending Shocks on Consumption and the Real Exchange Rate", *National Bureau of Economic Research*, Working Paper No. 13328, August.
- Ravn, Morten, Schmitt-Grohe, Stephanie, Uribe, Martin (2006), "Deep Habits", *Review of Economic Studies*, Vol. 73 (1), pp.195–218, January.
- Rotemberg, Julio and Woodford, Michael (1992), "Oligopolistic Pricing and the Effects of Aggregate Demand on Economic Activity", *Journal of Political Economy*, Vol. 100(6), pp. 1153-1207, December.
- Uhlig, Harald (2005), "What are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure", *Journal of Monetary Economics*, Vol. 52(2), pp. 381-419, March.

Appendices

Appendix (A): Data Description and Sources

The data in this paper spans the period from 1963:Q1 to 2008:Q3[24] for the United Kingdom. The data were taken from three sources. The Office for National Statistics (ONS) in the UK, the Main Economic Indicators (MIE) provided by the website of the Organization of Economic Cooperation and Development (OECD), and the International Financial Statistics (IFS) published by the International Monetary Fund (IMF).

Following the relevant empirical literature, the *government spending* variable is defined as total purchases of goods and services, i.e., government consumption plus government investment. Furthermore, the *net taxes* variable is defined as total tax revenues minus transfers (including interest payments).

GDP: Data for GDP are quarterly, seasonally adjusted. The source is the Office for National Statistics.

GDP Deflator: All variables were deflated by the GDP deflator. Data are quarterly, seasonally adjusted. The source is the Office for National Statistics.

Private Consumption: The source is the Office for National Statistics. Consumption is defined as the households' final consumption or expenditure (Series "RPQM"). Data are quarterly and seasonally adjusted.

Private Investment:

The source is the IMF, International Financial Statistics (series 93E.CZF). Investment is defined as total gross fixed capital formation expenditure including non-profitable institutions serving households. Data are quarterly, seasonally adjusted.

[24] Most of the series mentioned were available starting from 1955:Q1 (e.g. GDP, GDP deflator, government revenue, government spending) or from 1957:Q1 (e.g. private consumption and investment). However, two series were available from 1963:Q1, namely, (monetary aggregates and wages). Therefore, the estimations of the VAR commenced from 1963:Q1 to 2008:Q3.

Monetary Aggregate:

The source is the Office for National Statistics. The used series is Broad Money (M_4) (series "AUYN"). The data is quarterly, seasonally adjusted.

Wages:

The source is the OECD, Main economic Indicators (MIE). Wages are defined as the index (2005=100) of weekly earnings in manufacturing. Data are quarterly, seasonally adjusted. [25]

Producer Price Index (PPI):

The source is the IMF, International Financial Statistics (series 63...ZF). Data are quarterly.

Treasury Bill Rate:

The source is the IMF, International Financial Statistics (series 60C..ZF). Data are quarterly, and this series represents the short-term nominal interest rate. However, the short-term real interest rate has been calculated and used in the estimated VAR.

Government Spending:

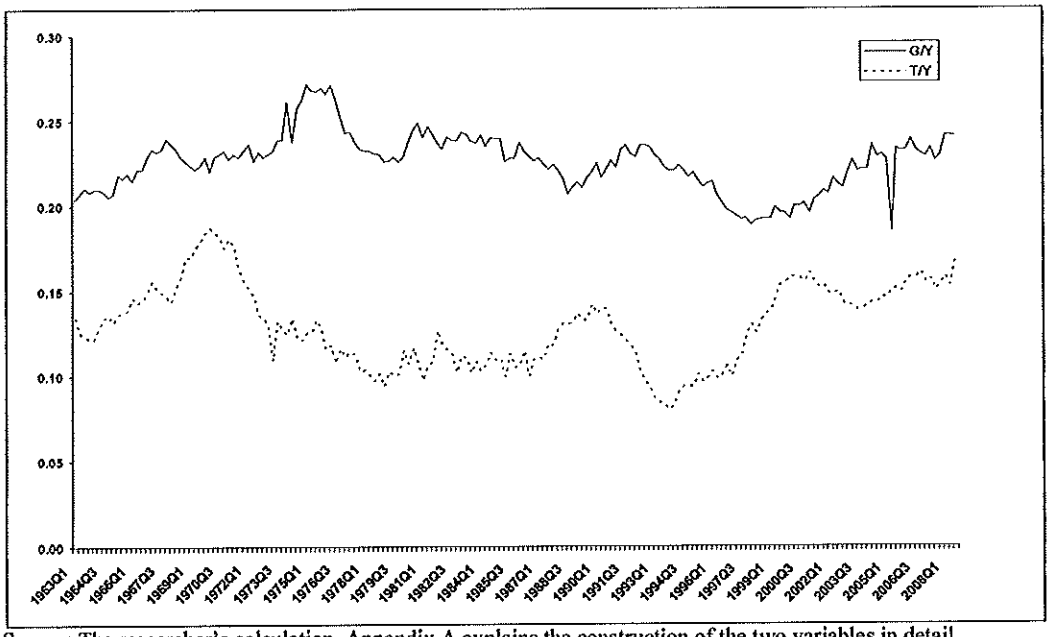
The source is the Office for National Statistics. Government spending includes both current (consumption) and capital (investment) spending. It is the sum of two series; gross fixed capital formation by the government series ("NNBF") and consumption of goods and services series ("GZSN"). Data are quarterly and seasonally adjusted.

Government Revenues (i.e. Net Taxes):

The net tax variable is constructed using the data available from the Office for National Statistics. It is constructed as the sum of direct as well as indirect taxes series ("NMYE", "ANSO", "NMGI", "MJBC") minus total transfer payments (series "NMRL and ANLY") minus interest payments series "ANLO". Data are quarterly and seasonally adjusted.

[25] Most of the data series had been seasonally adjusted, already, at the data sources. However, this was not the case for the series of government spending, revenues and wages. Therefore, we had to seasonally adjust those series using TRAMO–SEATS method because plotting the actual series confirmed the need for this step (i.e. it indicted a seasonal component in the series).
TRAMO–SEATS is a method which estimates and forecasts the trend, seasonal and irregular components of a time series. It can be found in any statistical package such as: E-views.

Figure (1): Net Taxes and Government Spending, Share of GDP



Source: The researcher's calculation. Appendix A explains the construction of the two variables in detail. The solid line plots the ratio of government spending to GDP, the dotted line the ratio of net taxes to GDP over the period 1963:Q1 to 2008:Q3.

The above figure shows the evolution of the two main variables (i.e. the government spending to GDP ratio and of the net tax to GDP ratio over the sample period 1963:Q1 to 2008:Q3). The figure reveals some fiscal episodes. As regards the spending ratio one can see the increase in the mid-1970s due to the absence of clear fiscal targets, the drop in the mid 1990s associated with the adoption of the *Code for Fiscal Stability (CFS)* and transparent fiscal reforms. The increase in the beginning of 2000s is related to military spending in the context of the Iraqi war in 2003. The sharp decline in the second quarter of 2005 is due to the drop in government gross fixed capital formation in this quarter however the ratio reversed action after the onset of the war on terrorism following July 2005 as government expenditure increased. Regarding the tax ratio the figure indicates the strong drops in the mid-1970s, the early 1980s and 1990s, related to the economic activity downswings.

Appendix (B): Summary Tables for the Effect of Government Spending Shocks in the US and UK

Table (B.1): The Impact of a Government Spending Shock on the Main Macroeconomic Variables in the US

	Response of			
The Identification Method	***Consumption***	***Output***	***Real wages***	***Investment***
Recursive Approach Fatás and Mihov (2001) and Caldara and Kamps (2008)	↑	↑	↑	↓
Blanchard-Perotti Approach* Blanchard and Perotti (2002) and Perotti (2005, 2007)	↑	↑	↑	↓
The Sign-Restriction Approach Mountford and Uhlig (2008)	↑ *(weak response)*	↑	↓	↓
The Event Study Approach* Ramey and Shapiro (1998), Edelberg et al. (1999), Burnside *et al.* (2004), Eichenbaum and Fisher (2005), Perotti (2007).	↓	↑	↓	↑ *or* ↓

Source: *prepared by the researcher.*
Summary of the main findings of the existing literature which has investigated the effect of fiscal policy shocks on the main economic variables in the US economy.
** The results of this approach are consistent with some of the New Keynesian models, where government spending causes a shift in labor demand, for instance because of countercyclical markups generated by nominal price rigidities or other reasons. The resulting increase in the real wage can induce higher consumption via a substitution effect.*
*** The results of the Event Study Approach are consistent with the neoclassical model.*

Table (B.2): The Impact of a Government Spending Shock on the Main Macroeconomic Variables in the UK

The Identification Method	***Consumption***	***Output***	***Real wages***	***Investment***
Using a Bayesian Structural Vector Autoregression model Afonso and Sousa (2009)	*(no response)*	↓	↑	↓
Using SVAR and Panel VAR, respectively Monacelli and Perotti (2006) and Ravn *et al.* (2007)	↑	↑	↑	*Was not of the main interest of Ravn et al* However, Monacelli and Perotti found a fall in investment*
Our results in this paper	↑	↑	↑	↑

Source: *prepared by the researcher. The table indicates the difficulty of comparing the main four identification approaches as in the US due to little evidence in the UK.*
**They have indicated a deterioration of the trade balance, and a depreciation of the real exchange rate.*

Figures Obtained from Using the Identification Approaches[26]

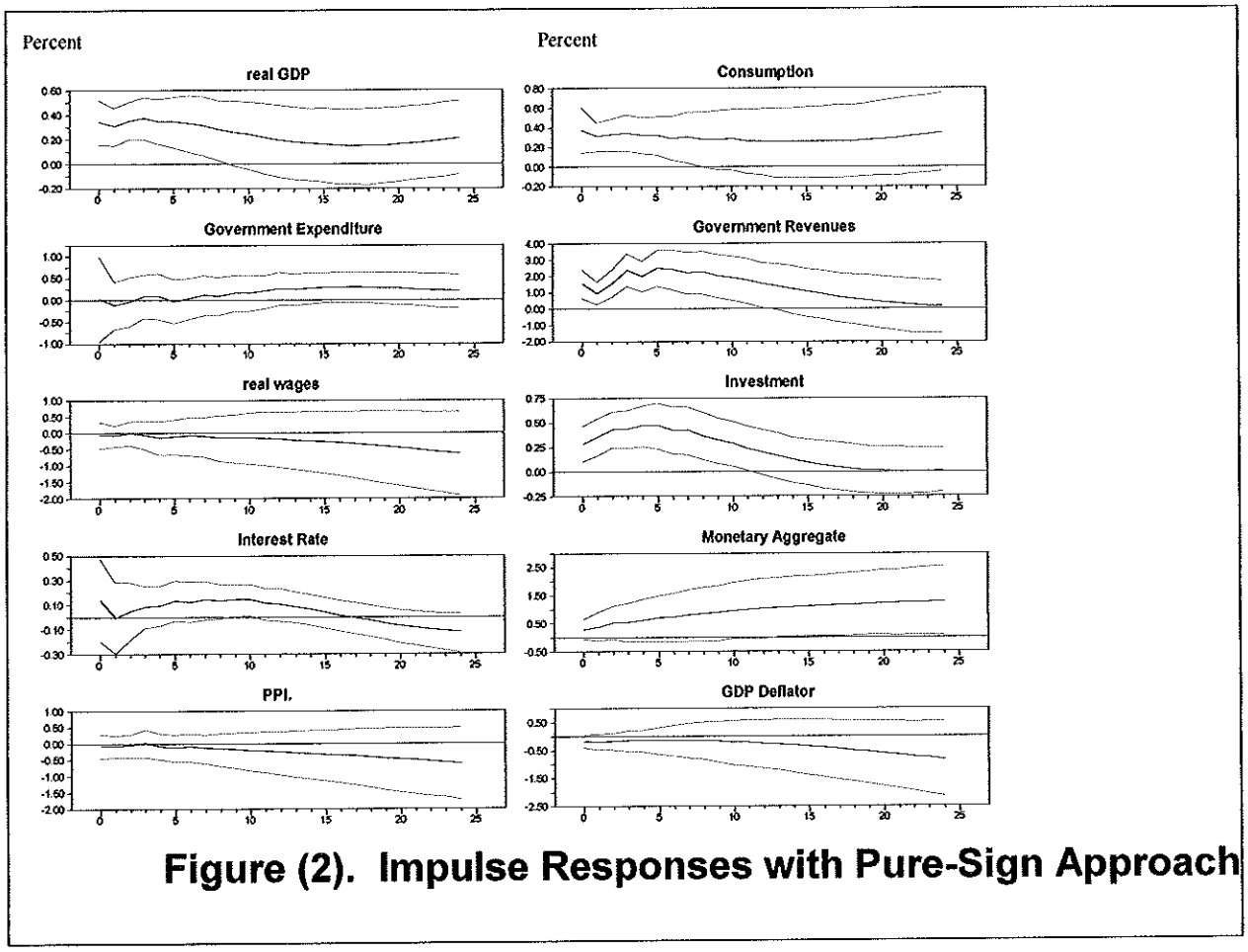


Figure (2). Impulse Responses with Pure-Sign Approach

Impulse responses after the **Business Cycle Shock** using the 'Pure-Sign Restriction Approach'. See Table (2) for identifying assumptions.

[26]The Figures plot the 16th, 50th and 84th quantiles of these impulse responses. Figures 2 through 5 obtained through using WinRATS 7.1 econometric software. While, Figures 6 through 9 are obtained by using GAUSS.

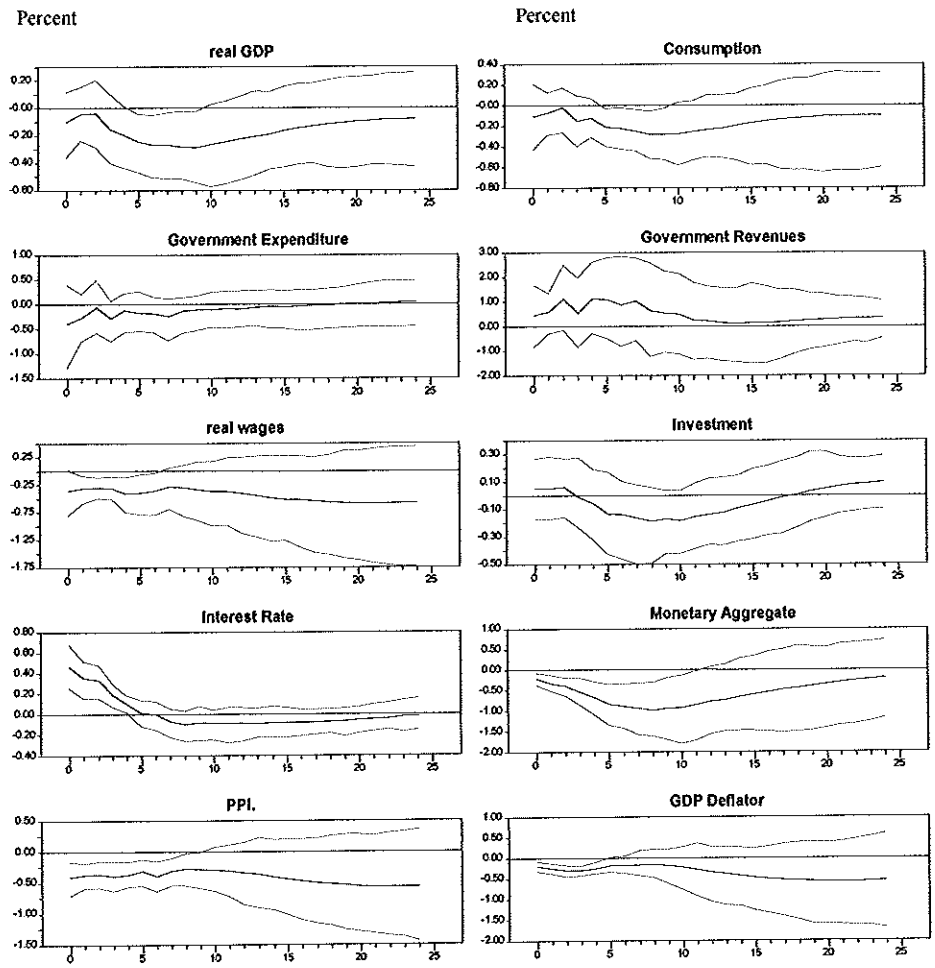


Figure (3). Impulse Responses with Pure-Sign Approach

Impulse responses after the **Monetary Policy Shock** using the 'Pure-Sign Restriction Approach'. See Table (2) for identifying assumptions.

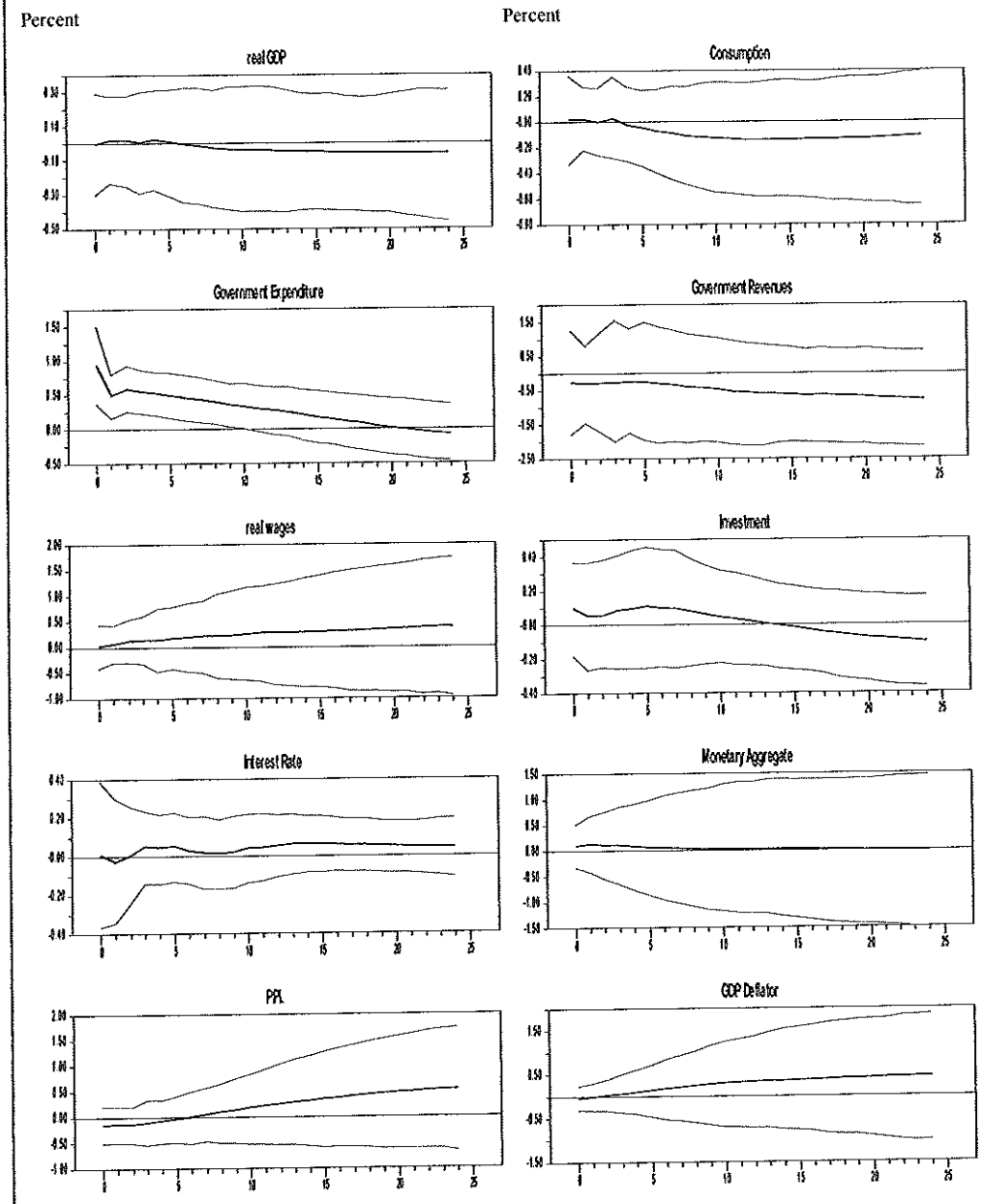


Figure (4). Impulse Responses with Pure-Sign Approach

Impulse responses after the **Government Expenditure Shock** using the 'Pure-Sign Restriction Approach'. See Table (2) for identifying assumptions.

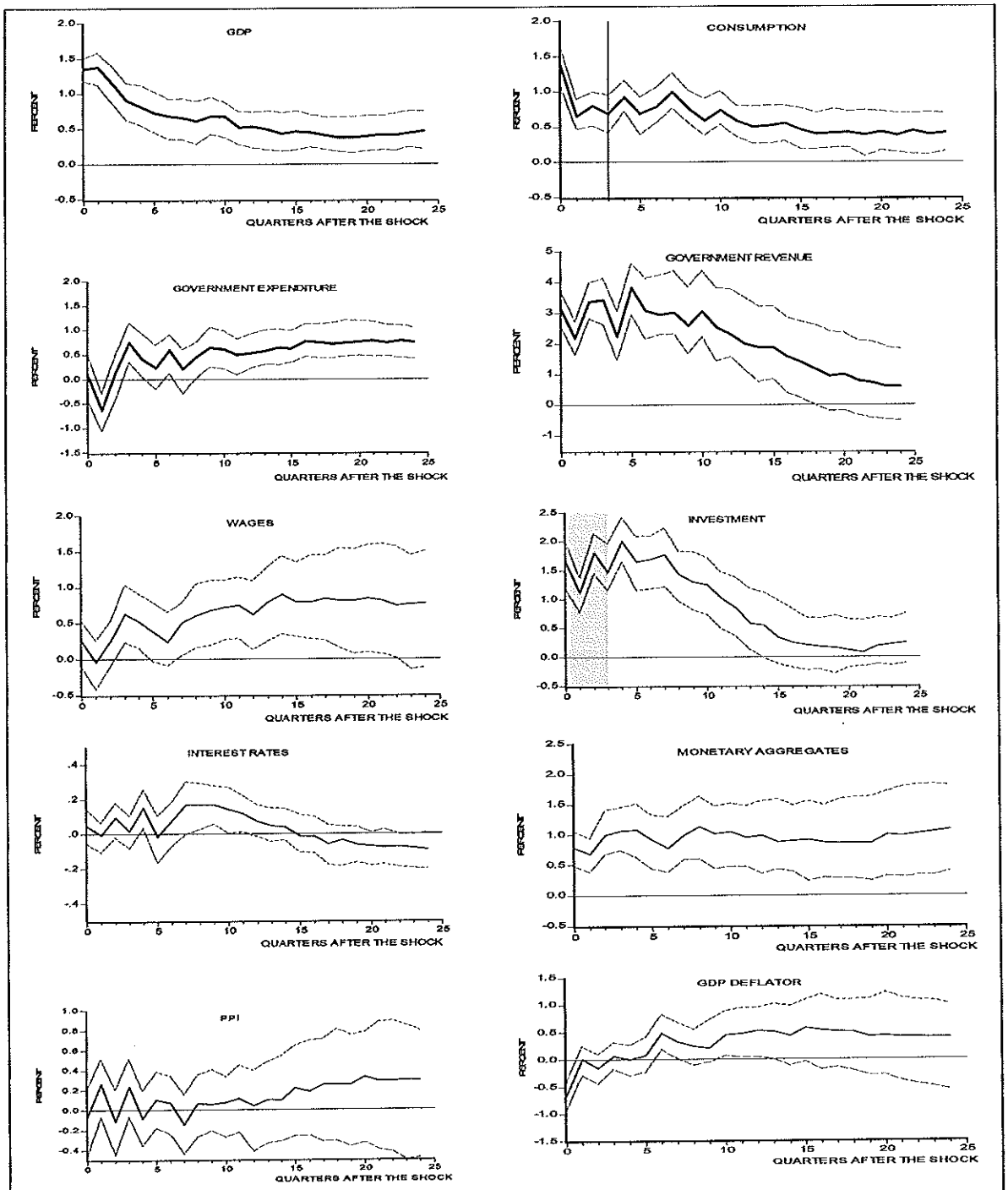


Figure (6): Impulse Responses with the Agnostic Approach

Impulse responses after the **Business Cycle Shock** ordered first using the 'Agnostic Approach'. See Table (3) for identifying assumptions.

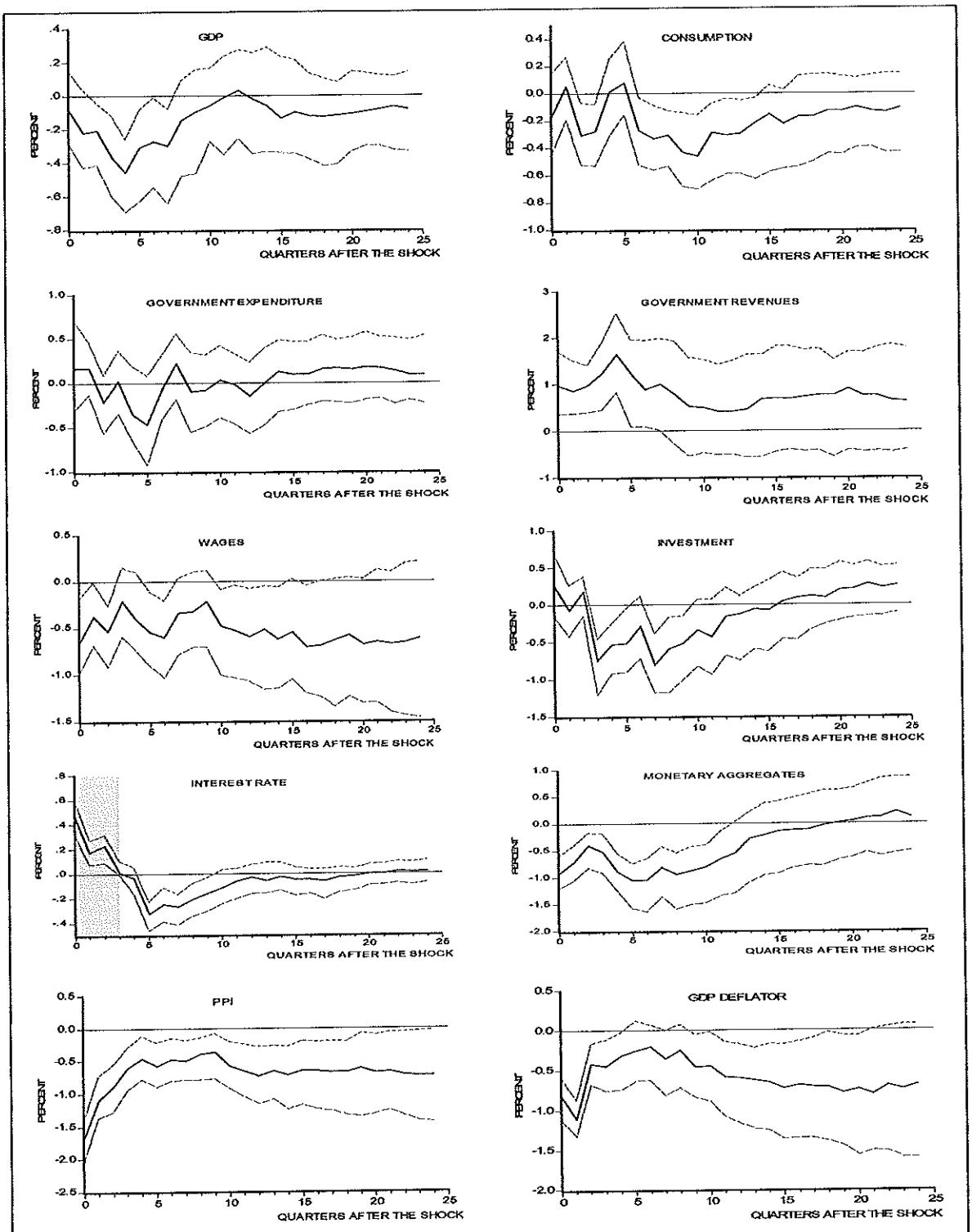


Figure (7): Impulse Responses with the Agnostic Approach

Impulse responses after the **Monetary Policy Shock** ordered second using the 'Agnostic Approach'. See Table (3) for identifying assumptions.

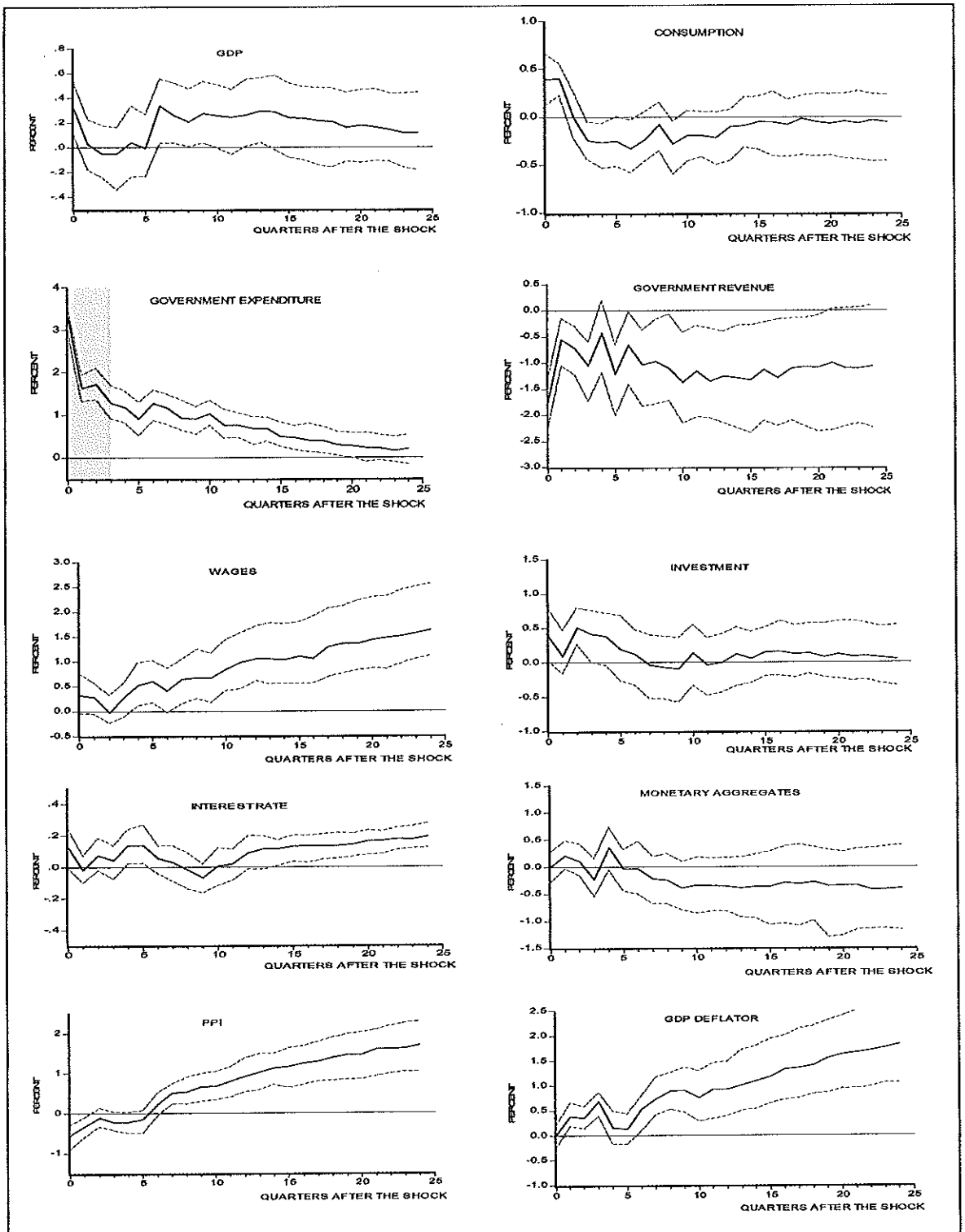


Figure (8): Impulse Responses with the Agnostic Approach

Impulse responses after the **Government Expenditure Shock** ordered third using the 'Agnostic Approach'. See Table (3) for identifying assumptions.

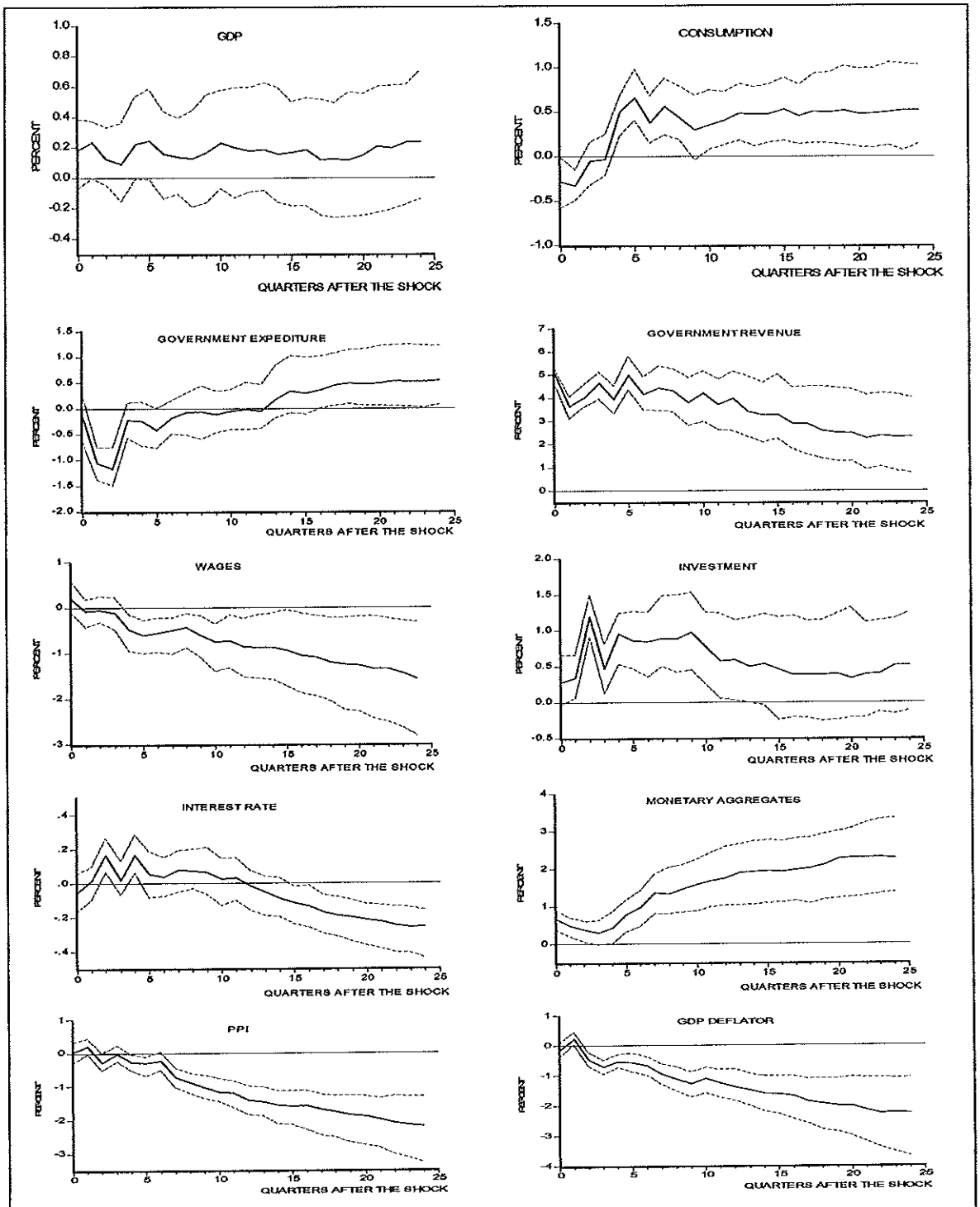


Figure (9): Impulse Responses with the Agnostic Approach

Impulse responses after the **Government Revenue Shock** ordered third using the 'Agnostic Approach'. See Table (3) for identifying assumptions.