FISCAL POLICY AND ECONOMIC ACTIVITY: U.S. EVIDENCE[†]

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Abstract

We investigate the dynamic effects of five different fiscal shocks on the US economy using a structural vector autoregressive (SVAR) model that uses Blanchard-Quah type restrictions. We find that an increase in indirect taxes or in corporate taxes has a contractionary effect on the economy, while an increase in personal taxes is neither contractionary, nor expansionary. These results imply that the Ricardian Equivalence hypothesis holds only for personal taxes. On the spending side, we find that an increase in government wages and salaries has a contractionary effect on the economy, while an increase in defense spending is expansionary. Our results suggest that different fiscal shocks have different and offsetting effects on the economy, and using aggregated data may, therefore, conceal the effects of fiscal policy.

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1. Introduction

This paper investigates the dynamic response of U.S. output, price level, and interest rate to fiscal policy innovations, using a structural vector autoregressive (SVAR) model for the period 1959:2-2001:2.

During the last two decades several experiments led to a revival of interest in fiscal policy. First, the Reagan tax cuts in the U.S. generated a controversy about the supply-side effects of tax policy. Second, fiscal consolidations in Europe and Canada which reduced budget deficits led to an increase in private consumption, which was contrary to the conventional wisdom. Third, the formation of a monetary union in Europe, the Maastricht Treaty, the evolution to single common currency, and the establishment of the European Central Bank reduced the flexibility of monetary policy, made fiscal adjustments crucially important for the member countries and increased the role of fiscal policy. Fourth, the recent Bush tax cuts in the U.S. directed more attention towards the transmission mechanisms of fiscal policy.

For a long period of time fiscal policy analysis was carried out within the Keynesian paradigm. Over the last two decades the Keynesian models have been challenged first at a theoretical level and more recently at an empirical level.

At a theoretical level, conventional (Keynesian) views were challenged first by neoclassical and neoclassical dynamic general equilibrium models, then by the real business cycle models, and finally by the two-country intertemporal general equilibrium models.

In neoclassical dynamic general equilibrium models the effects of fiscal policy disturbances are closely related to the financing decisions of the government. Using a one-sector neoclassical model with variable labor and endogenous capital accumulation, Baxter and King (1993) show that a permanent increase in government purchases financed by lump sum taxes leads to an increase in employment and output and a decrease in real wages. Output falls, however, when government purchases are financed by distortionary income taxes. Dotsey (1994) demonstrates that when current government deficits are financed by future distortionary taxation, lower tax rates and higher deficits lead to reductions in investment and output. Ludvigson (1996), on the other hand, indicates that if the labor supply is elastic, deficit financed cuts in distortionary income taxes may increase output. In a similar way, Ohanian (1997), using an intertemporal general equilibrium model, shows that using a tax-financed fiscal policy during World War II instead of a debt-financed fiscal policy would have resulted in much lower output and welfare. Christiano and Eichenbaum (1992) use a RBC model and show that when aggregate demand shocks arising from stochastic movements in government consumption are incorporated into the analysis, the model generates a strong positive correlation between hours worked and average productivity. Braun (1994) uses a RBC model finds that the first-order effect of an increase in the corporate income tax rate is to lower the after-tax interest rate. This produces an intertemporal substitution effect on the labor supply. The labor supply shifts left, the after-tax real wage rate rises, and employment falls. An increase in the personal income tax rate produces a much larger response because households reduce current consumption as well. Finn (1998) investigates the question of government spending on cyclical economic activity within the context of a quantitative real business cycle model of the U.S. economy. She reaches the conclusion that while shocks to government goods and purchases lead to an increase in private output, employment, and investment, shocks to government employment have the opposite effect. In a recent work, Barry and Devereux (2003) present a dynamic general equilibrium model where fiscal spending reductions may be expansionary.

The lack of consensus which exists among theoretical studies about the effects of fiscal policy is also found in empirical studies. As mentioned in Baldacci et al. (2001), although the literature generally suggests small, positive spending multipliers and small, negative tax multipliers, there is some evidence for both negative spending multipliers and positive tax multipliers.

Vector autoregressive (VAR) models have been extensively used in the literature to analyze the effects of monetary policy shocks. It is only recently, however, that attention has been directed towards estimating the effects of fiscal policy using VAR models. Ramey and Shapiro (1998) identify three dates of military buildup that are associated with the Korean War, the Vietnam War, and the Carter-Reagan military spending buildup. The exogenous shocks are measured by a dummy variable corresponding to these dates. They find that both total and private GDP increase in response to military buildups. Employing the same approach, Edelberg, Eichenbaum, and Fisher (1999) find that employment, output, and nonresidential investment rise, while real wages, residential investment and consumer expenditures fall in response to an exogenous increase in U.S. government purchases. Burnside, Eichenbaum, and Fisher

(2004) identify fiscal policy shocks in a similar manner and find that exogenous changes in military purchases lead to a persistent increase in government purchases and tax rates on capital and labor income, a rise in aggregate hours worked, and a decline in real wages. Yuan and Li (2000) and Fatas and Mihov (2001) examine the effects of government spending innovations for the U.S. economy by employing VAR models where identification is based on Choleski ordering. Yuan and Li (2000) find that positive innovations in U.S. government spending increase U.S. output and the total hours worked. Fatas and Mihov (2001) find that output responds positively and persistently to a government spending shock and the GDP deflator declines slightly but returns to its trend. An increase in government spending is followed by an increase in consumption, investment, employment, real wages, and the real interest rate. Garcia-Mila (1989) identifies fiscal policy shocks by Choleski decomposition and finds a positive multiplier effect of state and local government purchases on output. Military purchases, on the other hand, are found to be only slightly expansionary in the very short term.

Despite a number of studies incorporating government spending into VAR models, only a few studies have attempted to investigate the effects of tax policy innovations. Blanchard and Perotti (2002) incorporate an aggregate tax revenue variable into the VAR framework by employing U.S. data. They estimate the effects of exogenous shocks to real government purchases and real net taxes on economic activity within a structural VAR model by computing impulse response functions (IRFs). They use institutional information about tax and transfer systems and the timing of tax collections to identify the automatic stabilizing aspects of fiscal policy and use this in deriving fiscal shocks. Their results consistently show that positive government spending shocks have a positive effect on output, while positive tax shocks have a negative effect. Perotti (2002) studies the effects of fiscal policy on GDP, prices and interest rates in five OECD countries using a structural VAR approach. He argues that the effects of fiscal policy on GDP and its components have become substantially weaker in the last twenty years. He also contends that the tax multipliers tend to be negative but small, and that there is some evidence on positive tax multipliers while the net tax shocks have negative small effects on prices. Finally, he indicates that the U.S. is an outlier in many dimensions, so the responses to fiscal shocks estimated on U.S. data are often not representative of the average OECD country.

Economic theory suggests that different tax groups have different effects on the economy. For instance, Atkinson and Stiglitz (1980) develop a basic intertemporal model, which shows that income taxes and consumption taxes have different effects on household saving decisions. Neoclassical dynamic general equilibrium models developed by Baxter and King (1993), among others, indicate that lump sum taxes and distortionary taxes have different effects on the economy. There is also empirical support for different effects by different tax groups. Using a panel of twenty two OECD countries, Kneller, Bleaney and Gemmell (1999) argue that distortionary taxation (income taxes and social security taxes) reduces growth whereas non-distortionary taxation (corporate taxes and indirect taxes) does not, and productive government expenditures (such as expenditures on infrastructure) enhance growth, while non-productive government expenditures (such as recreational expenditures) do not.

Baxter and King (1993) Ahmed and Yoo (1995), and Ohanian (1997) distinguish between government consumption expenditures on goods and services and government investment expenditures. Finn (1998) Ardagna (2001), and McGrattan and Ohanian (2003) distinguish between government consumption expenditures with and without compensation of government employees.

Alesina and Perotti (1995, 1997) and Alesina and Ardagna (1998) show that cuts in government employment are expansionary, and stimulate business investment. Alesina, Ardagna, Perotti, and Schiantarelli (2002) find that spending cuts, particularly in government wages and transfers, lead to expansions in output.

In this paper, we investigate the response of output, price level, and interest rate to innovations in different revenue and spending instruments within a SVAR model which uses Blanchard and Quah (1989) type long-run restrictions.

Our results indicate that different taxes and different categories of government expenditures have different effects on macroeconomic activity. When we estimate a SVAR with total taxes and total government expenditures for the U.S. economy, we find that fiscal policy is neither expansionary, nor contractionary. Nonetheless, when we decompose total taxes into three groups (personal taxes, corporate taxes, and indirect taxes) and estimate three different SVAR models, each with a different tax group, we find that an increase in indirect taxes or in corporate taxes has a contractionary effect on the economy, while personal taxes have neither expansionary, nor contractionary effects. Likewise, when we estimate a SVAR with government wages and salaries, an increase in government wages and salaries has a contractionary effect on the economy. On the other hand, when we estimate a SVAR with defense spending, defense spending has an expansionary effect on the economy. This evidence implies that choosing total taxes or total government expenditures as a measure of fiscal policy variable could be misleading and decomposing total taxes or total government expenditures into sub-categories would yield a more accurate picture.

The remainder of the chapter is organized as follows: Section 2 explains the data and methodology used, Section 3 presents the empirical results, and Section 4 provides some concluding remarks.

2. Data and Methodology

2.1. Data

The data used in this paper are obtained from two different sources: the data for four different types of government revenues, namely personal, corporate, and indirect taxes, government consumption expenditures and gross investment, national defense expenditures, government wages and salaries, real and nominal GDP are obtained from the DRI database. The data for the CPI and the 3-month Treasury bill rate are obtained from the St. Louis Federal Reserve Bank Fred II data base. The different types of taxes, national defense expenditures, and government wages and salaries are deflated by the GDP deflator which is obtained after dividing nominal GDP by real GDP. The exact definitions of the variables and their source codes are presented in Table 1. The data consist of quarterly observations for the 1959:1-2001:2 period.

2.2. Methodology

To investigate the response of macroeconomic variables to fiscal policy innovations, we use a SVAR model. Our structural VAR model imposes long-run identifying restrictions, pioneered by Blanchard (1989) and Blanchard and Quah (1989), on an ordinary VAR model in order to infer structural shocks from it. The long-run restrictions are based on neutrality restrictions. Prior to implementing this procedure, the model is transformed into first differences. Then, real variables are ordered before nominal variables, and output is ordered before the policy variables. The long-run effect of a shock on the level of a variable is simply the cumulative sum of the relevant moving average representation. As there is more agreement upon the long-run relationships between the economic variables, there is less controversy over the use of long-run restrictions relative to contemporaneous restrictions.

Assume an unrestricted VAR model written in moving average form:

$$\Delta X_t = A(L)e_t \ , \qquad (1)$$

where X is a vector of macroeconomic variables, $A(L)$ is a polynomial matrix of lag-length l, L is the lag operator and e is a vector of reduced form shocks in the elements of X with variance-covariance matrix $E(e_t e_t') = \Sigma$. These reduced form shocks are likely to be correlated so they cannot be interpreted as pure structural shocks. Imposing identifying restrictions, the SVAR model obtains:

$$\Delta X_t = B(L)u_t \ , \qquad (2)$$

where B(L) is a polynomial matrix in L, u_t is a vector of serially and contemporaneously uncorrelated, normalized structural residuals with $E(u_t u_t') = I$, and $A\Sigma A' = BB'$. Here A and B are k x k matrices to be estimated and the expression on either side is symmetric This model only requires a minimum number of k.(k+1)/2 restrictions, and it enables us to make the same assumptions regarding each and every fiscal policy instrument. In addition, in many cases, economic theory provides more guidance about long-run relationships between economic variables rather than their short-run dynamics.

The vector X of macroeconomic variables comprises of the following variables. Output (Y, measured by real GDP), the price level (P, measured by the CPI), the 3-month Treasury-bill rate (R), tax revenue (T, measured by tax revenue of the i^{th} group measured in U.S dollars, deflated by the GDP deflator), and real government expenditures (G, in US dollars, deflated by the GDP deflator). As mentioned above, each model was differenced before being included in the estimation. In order to choose lag-lengths, the results of the Akaike Information Criterion (AIC) were used, and the lag length for all models was chosen as 5.

To identify the structural shocks from the VAR model, ten identifying restrictions are required. These are: Tax revenue innovations do not have a permanent effect on output (1); government expenditure shocks do not have a permanent effect on output (2), and on tax revenues (3); monetary shocks, as proxied by the interest rate, do not have a permanent effect on output (4), on tax revenues (5) and on government expenditures (6); and finally, price level shocks do not have a permanent effect on output (7), on tax revenues (8), on government expenditures (9) and on the interest rate (10).

These restrictions can be illustrated in the matrix form:

$$\begin{bmatrix} \Delta Y \\ \Delta T \\ \Delta G \\ \Delta R \\ \Delta P \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 \\ b_{21} & b_{22} & 0 & 0 & 0 \\ b_{31} & b_{32} & b_{33} & 0 & 0 \\ b_{41} & b_{42} & b_{43} & b_{44} & 0 \\ b_{51} & b_{52} & b_{53} & b_{54} & b_{55} \end{bmatrix} \begin{bmatrix} u_Y \\ u_T \\ u_G \\ u_R \\ u_P \end{bmatrix} \tag{3}$$

Impulse response functions (IRFs) are calculated from the SVAR estimation. This approach has recently been implemented by Aarle et al. (2003), without estimating the Monte-Carlo confidence bands. In our paper, one-standard deviation confidence intervals are obtained from a Monte Carlo simulation based on 1000 draws.

3. Empirical Results

3.1. The Effects of Tax Innovations

The IRFs of all model variables to a one-standard deviation shock to total taxes and different tax groups are presented in Figures 1- 4. Figure 1 presents the IRFs of *Y, T, G, R*, and *P* to a positive innovation in *T*. The response of output is negative, indicating that an increase in taxes has a negative impact on output. As indicated by the one-standard deviation confidence band, however, the response of output is not significantly different from zero. The response of *T* is positive and significant, implying that the innovation is permanent. The response of *G* is positive, indicating that government expenditures rise in response to a permanent increase in tax revenues, but this is not significantly different from zero. Interest rates fall, and again this is not significantly different from zero. The response of the price level is negative. This result is significant especially between the 3rd and 5th quarters.

Figure 2 presents the IRFs of *Y*, T_P, *G, R*, and *P* to a positive innovation in personal taxes T_P. The initial response of output is positive. It becomes negative after the 10th quarter; however, in both cases the response of output is not significantly different from zero. The response of T_P is positive and significant, implying that the innovation to personal taxes is permanent. The response of *G* is positive, but this is not significantly different from zero. The response of the interest rate is not significantly different from zero. The response of the price level is negative, and this is significant in the 3rd quarter. The initial response of output, even though it is not significantly different from zero, is somewhat puzzling. One reason could be due the aggregated nature of the data. Personal income taxes include taxes on all sorts of income, which may have different response patterns. Since income tax data reported by individuals reflect the tax liability on the cumulative sum of personal income, we do not have the means to estimate the response of output to changes in the components of personal income taxes.

Figure 3 presents the IRFs of Y, T_I, G, R, and P to a positive innovation in indirect taxes T_I. The response of output is negative and significantly different from zero until the 15th quarter. The response of T_I is positive and significant, implying that the innovation to indirect taxes is permanent. The response of G is positive, but it is not significantly different from zero. The interest rate and price level both fall in response to an increase in indirect taxes.

Figure 4 presents the IRFs of Y, T_C, G, R, and P to a positive innovation in indirect taxes T_C. The response of output is negative and significantly different from zero until the 6th quarter. The response of T_C is positive and significant, implying that the innovation to corporate taxes is permanent. The response of G is negative and significantly different from zero. The response of G to T_C innovations is very different from other innovations. The IRFs indicate that government expenditures fall in response to an increase in corporate taxes. This may happen if the government is using corporate taxes as a tool of last resort to reduce the deficit. The interest rate and price level both fall in response to an increase in corporate taxes.

We can draw two important conclusions from the analysis of impulse response functions analyzed above. First, different taxes may have different effects on the economy. Aggregating these taxes and using the sum as a measure of fiscal policy may actually add more noise to the system and prevent us from seeing the different effects of these taxes on the economy. The second conclusion that emerges from the above findings is related to the Ricardian equivalence hypothesis. The Ricardian equivalence hypothesis states that a switch from lump-sum tax finance to bond finance has no effect on the macro economy, holding everything else constant. The IRFs above indicate that while the economy contracts in response to increases in indirect and corporate taxes, it is not affected by personal taxes. In this sense, the evidence from IRFs is inconclusive. On the other hand, indirect taxes are the least distortionary and they can be regarded as lump-sum taxes. In this sense, we get the best evidence from the IRFs of indirect tax innovations, which reveal that the Ricardian equivalence hypothesis does not hold.

3.2. The Effects of Government Spending Innovations

The impulse response functions of all model variables to a one-standard deviation shock to government expenditures and to two components of government expenditures are presented in Figures 5-7. Figure 5 presents the impulse response functions of *Y, T, G, R*, and *P* to a positive innovation in government expenditures *G*. The response of output is negative, indicating that an increase in government expenditures has a negative impact on output. As indicated by the one-standard deviation confidence band, however, the response of output is not significantly different from zero. The response of *T* is negative and it is not significantly different from zero. The response of *G* is positive and significant, indicating that the innovation to government expenditures is permanent. The interest rate falls, and the negative response of the interest rate is significantly different from zero. The response of the price level is negative, but it is not significantly different from zero.

We get a more interesting picture when we make a distinction between the wage component of government expenditures and defense expenditures. Figure 6 presents the impulse response functions of *Y, T,* G_W, *R*, and *P* to a positive innovation in government wages and salaries G_W. The response of output is negative, and it is significantly different from zero until the 9th quarter, indicating that an increase in government wages and salaries has a negative impact on output. The response of *T* is positive and significant. The response of G_W is positive and significant, indicating that the innovation to government wages and salaries is permanent. The responses of both the interest rate and the price level are negative and significant.

Figure 7 presents the impulse response functions of *Y, T,* G_D, *R*, and *P* to a positive innovation in defense spending G_D. The response of output is positive and significantly different from zero for the first two quarters. The response of *T* is not significantly different from zero. The response of G_D is positive and significant, indicating that the innovation to defense spending is permanent. The response of the interest rate is not significantly different from zero but the response of the price level is positive and significant.

While it is difficult to reach a conclusion as to whether an increase in government expenditures have an expansionary or contractionary effect on the economy, by analyzing the effects of different components of government expenditures we can make more convincing arguments. We find that while increases in wages and salaries have a contractionary effect on the economy, increases in defense spending have an expansionary effect.

3.3. Residual Analysis

Do estimated tax shocks make sense? As the history of tax policy is most well-known for the U.S., we compared the estimated shocks with the dates of actual policy changes. Figures 8-9 display the residual analysis for the U.S.

The top income tax rate in the U.S was reduced in the following years: 1964 (from 91% to 77 %), 1965 (from 77% to 70%), 1970 (from 77 to 71.75%), 1981 (from 70% to 69.13%), 1982 (from 69.13% to 50%). and 1987 (from 50% to 38.5%). All of these policy changes are captured by our estimated shocks. In addition, we managed to capture the tax resurges of 1968 and 1975. When we look at the corporate tax shocks, our estimated shocks capture the corporate tax rate cuts of 1965 (top rate was decreased from 50% to 48%), 1970 (from 52.8 % to 49.2 %), 1979 (from 48% to 46%), 1987 (from 46% to 40%) and finally 1988 (from 40% to 34%). We also capture the increases in the corporate tax rate in 1968 (from 48% to 52%) and 1993 (from 34% to 35%). The biggest estimated negative shocks (1975 and 1992), however, do not coincide with actual policy changes.

4. Conclusion

This paper investigates the dynamic response of U.S. output, price level, and interest rate to fiscal policy innovations, using a structural vector autoregressive (SVAR) model for the period 1959:2-2001:2 which uses Blanchard-Quah type restrictions. We consider three types of tax innovations and two types of government spending innovations: on the revenue side innovations to personal, corporate, and indirect taxes and on the expenditure side innovations to government wages and defense spending. We find that an increase in indirect taxes or corporate taxes has a contractionary effect on the economy, while an increase in personal taxes is neither contractionary, nor expansionary. These results imply that the Ricardian Equivalence hypothesis holds only for personal taxes. On the spending side, we find that an increase in government wages and salaries has a contractionary effect on the economy, while an increase in defense spending is expansionary. Our results suggest that different fiscal shocks have different and offsetting effects on the economy, and that using aggregated data may conceal the effects of fiscal policy.

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TABLE 1:
Definition and Data Source for the Variables Used

Variable	Definition	Data Source and Code
Personal Taxes	Federal, state, and local; income, other, Billions of dollars, SAAR	DRI, TXP
Corporate Taxes	Federal, state, and local, Billions of dollars, SAAR	DRI, TXCORP
Indirect Taxes	Federal, state, and local; excise taxes, custom duties, sales taxes, property taxes, billions of dollars, SAAR	DRI, TXIM
Government wages and salaries	Compensation of government employees, billions of dollars, SAAR	DRI, YPCOMPWSG
National Defense Expenditures	Government consumption expenditures and gross investment, billions of dollars, SAAR	DRI, GFML
Real Government Expenditures	Government consumption expenditures and gross investment, billions of dollars, SAAR	DRI, GR
Real GDP	Gross Domestic Product, billions of chained 2000 dollars, SAAR	DRI, GDPR
Nominal GDP	Billions of dollars, SAAR	DRI, GDP
Treasury-bill rate	3-Month Treasury bill, secondary market rate	FRED II, TB3MS
CPI	Consumer price index for all urban consumers, all items, SA	FRED II, CPIAUSL

Figure 1: Shock to Total Taxes

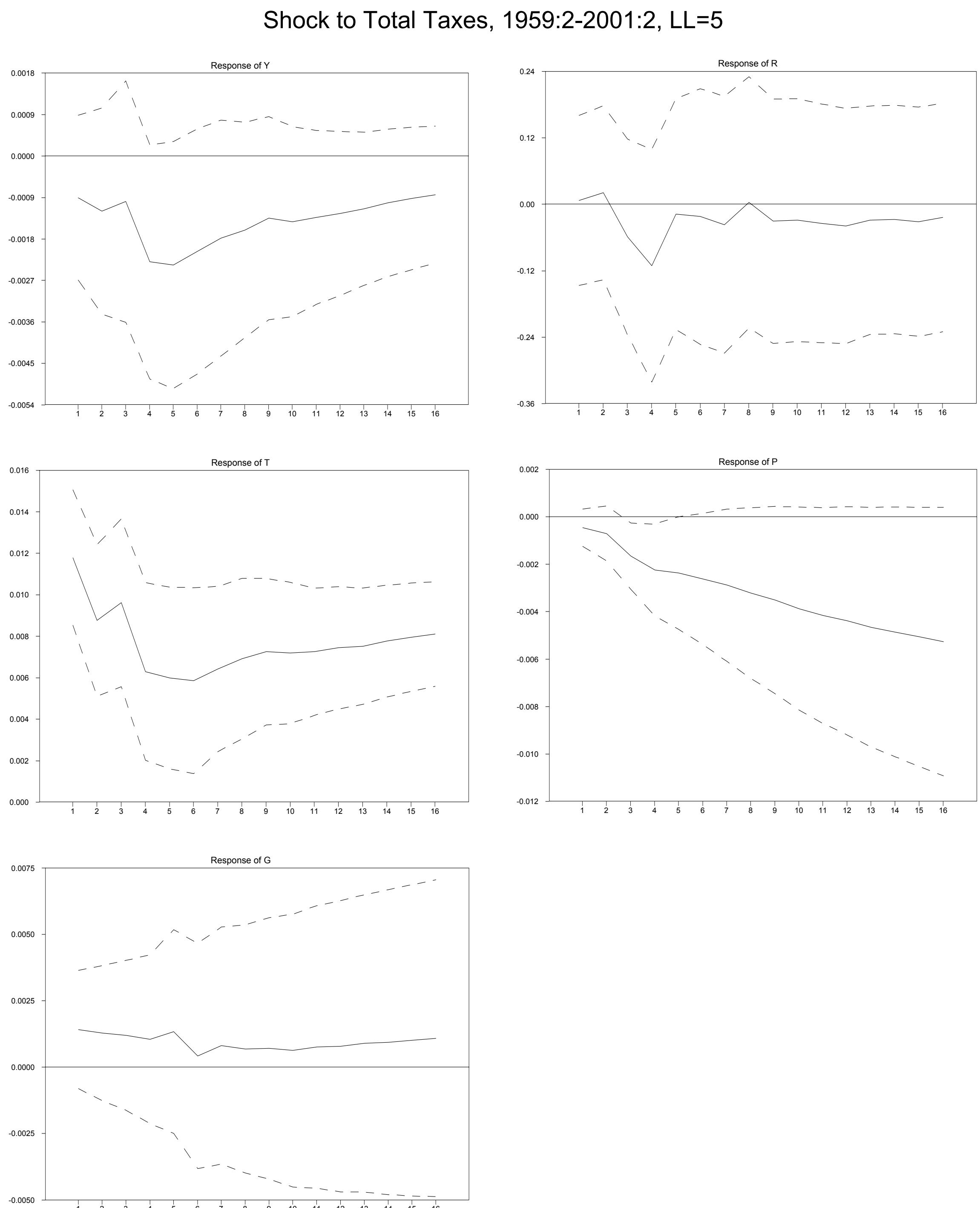

Figure 2: Shock to Personal Taxes

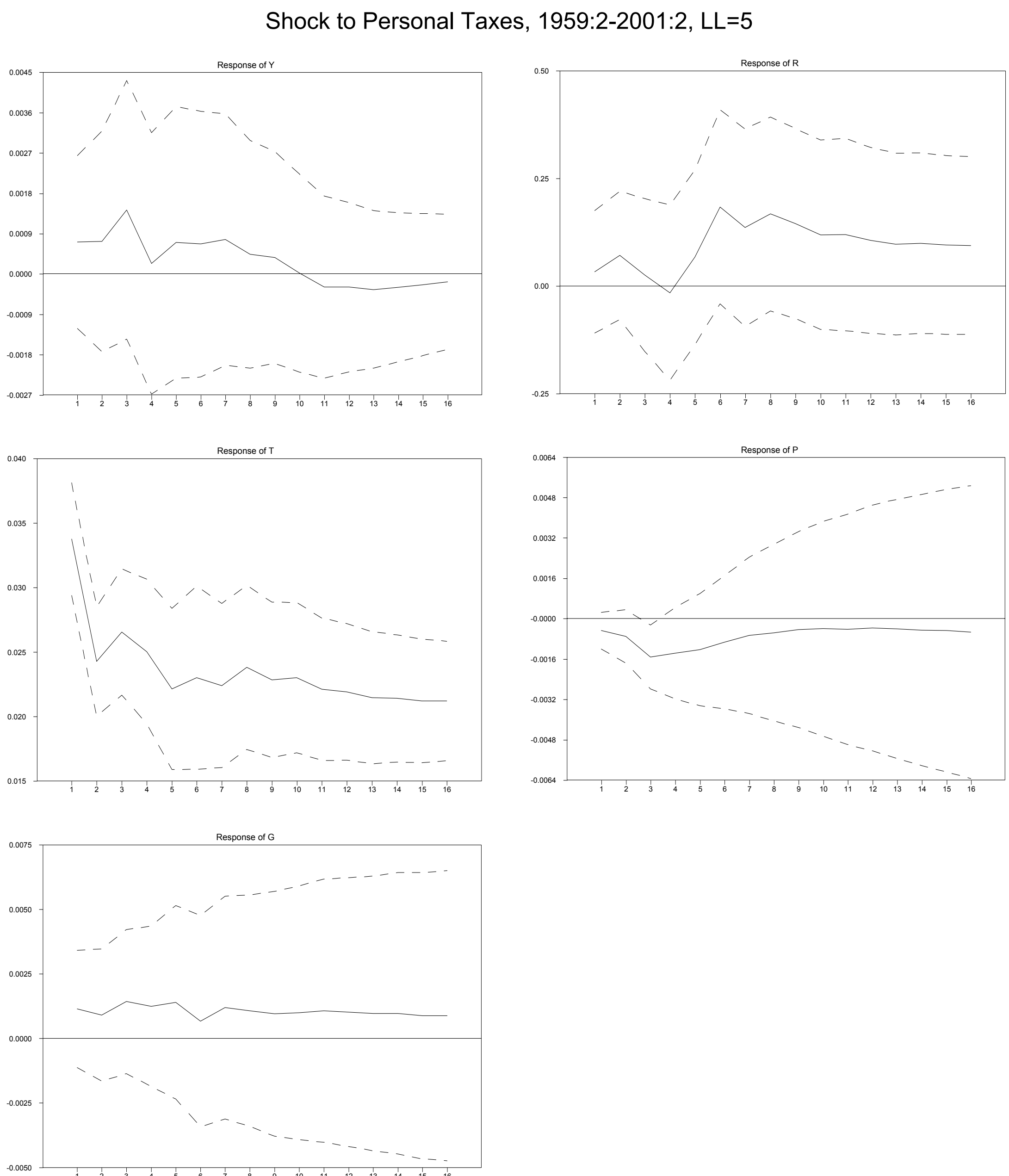

Figure 3: Shock to Indirect Taxes

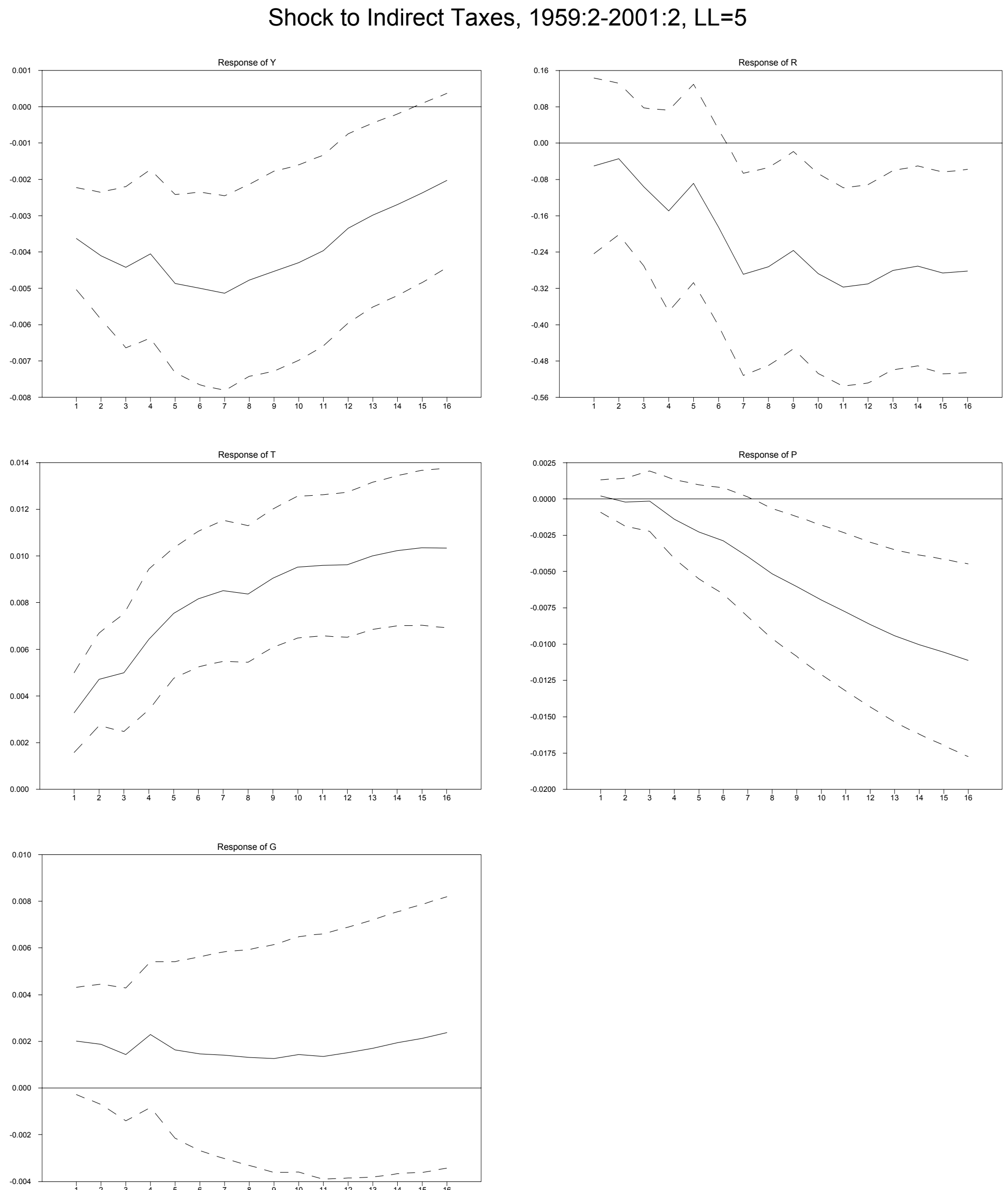

Figure 4: Shock to Corporate Taxes

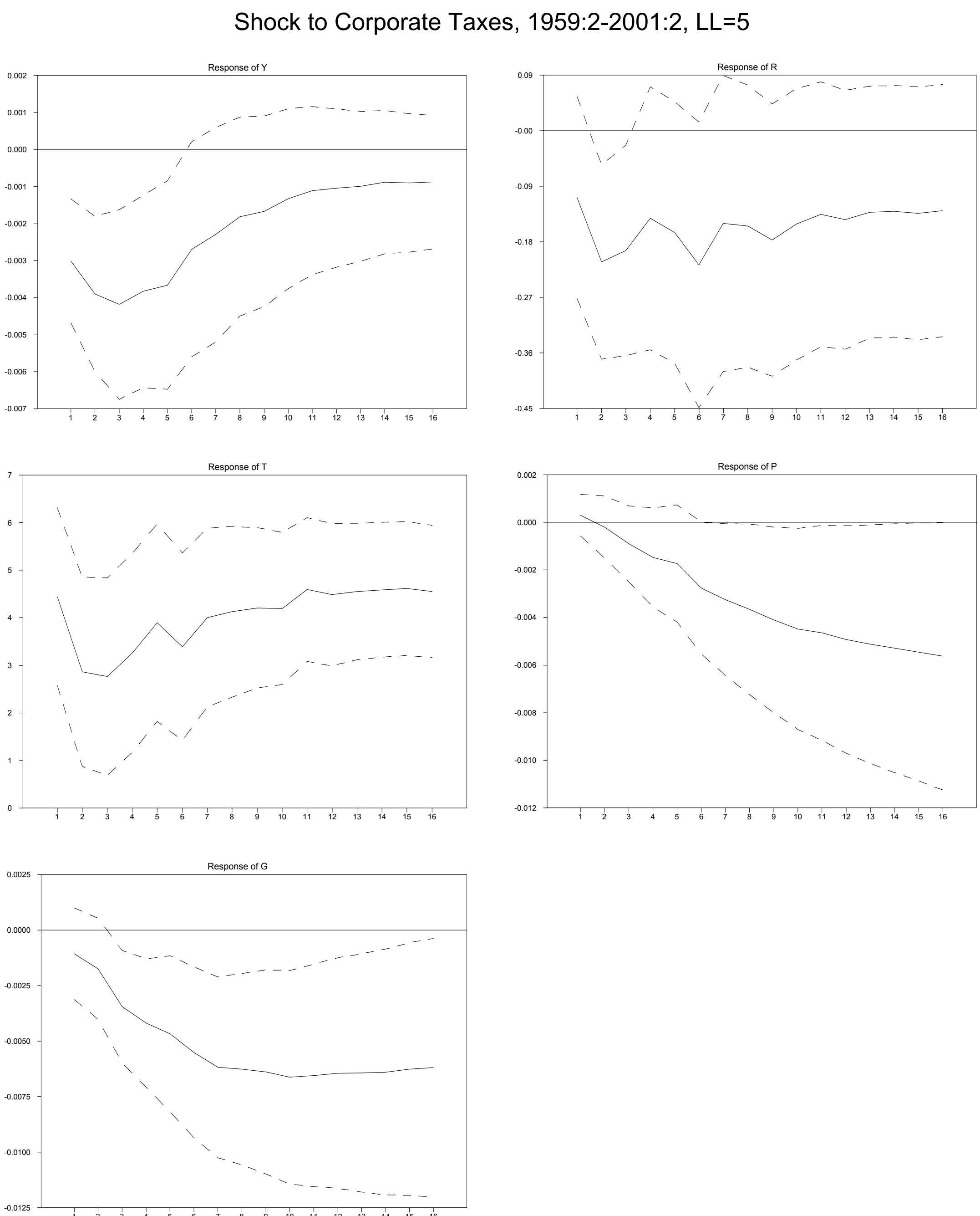

Figure 5: Shock to Government Expenditures

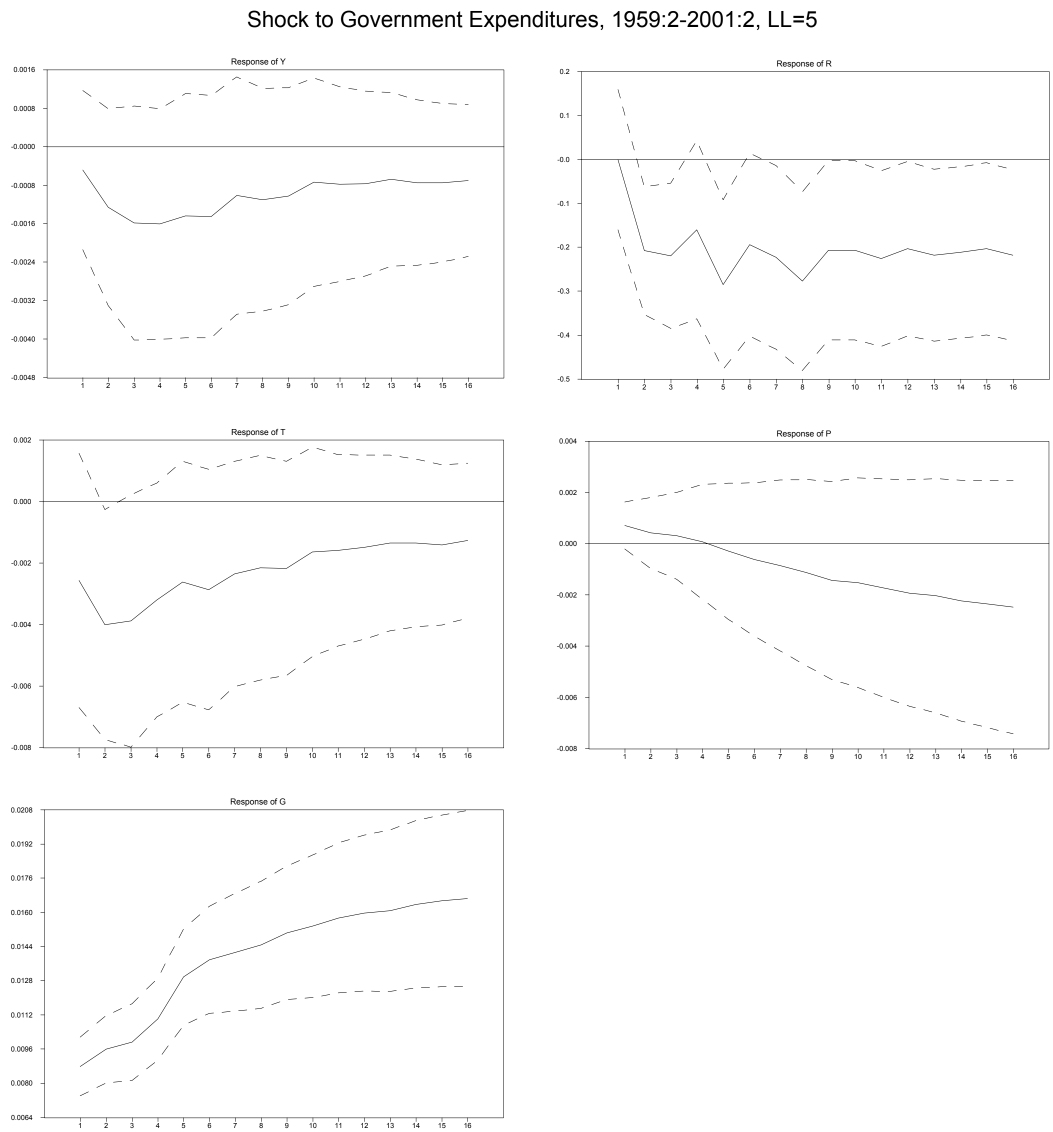

Figure 6: Shock to Government Wages and Salaries

Shock to Government Employment, 1959:2-2001:2, LL=5

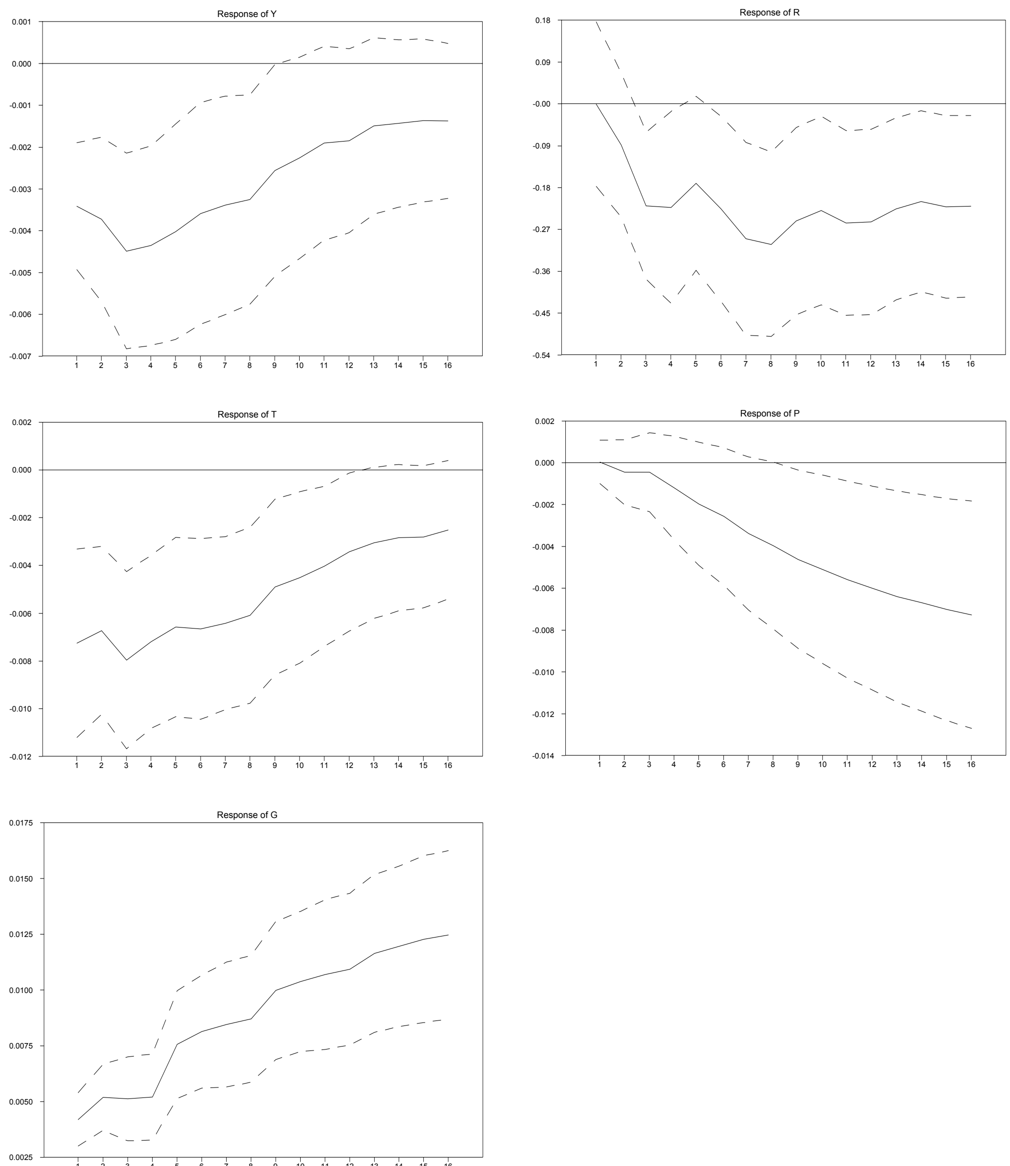

Figure 7: Shock to Government Defense Spending

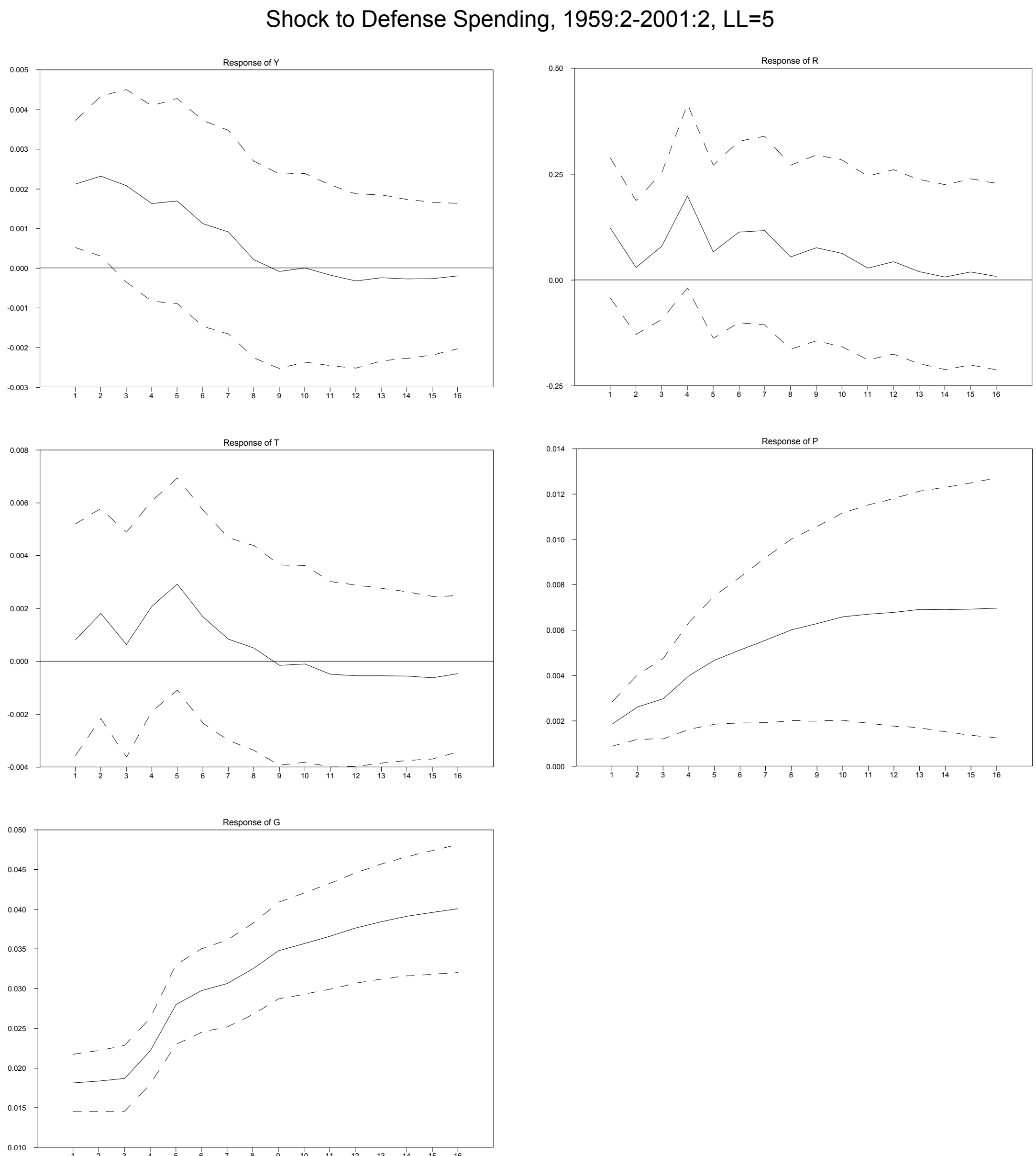

Figure 9: The Residual Analysis