Comparing alternative methodologies to estimate the effects of fiscal policy

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Preliminary and incomplete

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1 Introduction

Most economists would agree that an exogenous increase in the federal fund rate will lead to a fall in inflation and some slowdown in growth after a while; they would also agree that a large body of empirical research is largely consistent with this view. In contrast, perfectly reasonable economists can and do disagree even on the basic qualitative effects of fiscal policy: for instance, neoclassical models predict that private consumption and the real wage should fall following a positive shock to government consumption, while some models with neo-keynesian features can predict the opposite; most journalistic and policy discussions also take this result for granted. Also in contrast to the case of monetary policy, depending on the methodology used to identify the fiscal policy shocks the existing empirical evidence can be interpreted as supporting either view.

The "Dummy Variable" approach of Ramey and Shapiro (1997), extended to a full-fledged VAR by Edelberg, Eichenbaum and Fisher (1999) and Burnside, Eichenbaum and Fisher (2004), is an application of the methodology developed by Romer and Romer (1989) to study monetary policy. It constructs a dummy variable capturing well identified episodes of significant increases in government spending that can arguably be considered exogenous and unforeseen, mostly because connected to foreign policy events; it then traces the dynamic effects of a shock to this dummy variable in a Vector Autoregression. This methodology typically delivers results that are largely consistent with neoclassical models: it finds that during these episodes of exogenous increases in government spending output increases but private consumption and the real wage fall.

The approach of Blanchard and Perotti (2002), extended by Perotti (2004), is an example of a Structural Vector Autoregression (SVAR) methodology.[1] It uses external information to isolate the components of the VAR innovations in government spending and revenues that represent the automatic responses of these variables to GDP, inflation and interest rates. The remaining components - the cyclically adjusted fiscal policy shocks - represent the true structural shocks to fiscal policy, whose effects can be studied via a standard impulse response analysis. The results from this approach are typically consistent with models that have a neo-keynesian flavor: following a government spending shock, output, private consumption and the real wage increase.

In this paper, I first show that the results from the Dummy Variable approach are due to the imposition of a strong restriction, namely that all Ramey-Shapiro episodes must have the same dynamics, up to a scale factor. Once this restriction is relaxed, it becomes evident that the results obtained so far are due exclusively to the Korean War episode, which quantitatively dominates the other two - namely, the Vietnam War and the

[1] The approach has also been used by Canzoneri, Cumby and Diba (2002) and Galí, Lopez-Salido and Vallés (2006) among others. Other recent VAR investigations of fiscal policy, using different identification sschemse from the two discussed here, include Fatas and Mihov (2001), Mountford and Uhlig (2002), and Canova and Pappa (2003).

Carter-Reagan military buildups. In these latter episodes both the real wage and private consumption move in the same direction as output, conditional on a government spending shock. The SVAR approach also delivers responses that are quantitatively comparable to those of the non-Korean War episodes of the Dummy Variable approach. Second, the differences in the responses observed in the Korean War on one hand and the other two Ramey-Shapiro episodes on the other are consistent with the different behavior of the tax rate in these episodes. Third, independent evidence from the US input output tables also shows that during the last two Ramey-Shapiro episodes, the sectors that were most intensive in the government spending shock also experienced on average significantly higher increases in the real product wage.

The structure of the paper is as follows. The next section discusses some recent models of fiscal policy and their key testable predictions. Section 3 presents the two empirical approaches introduced above. Section 4 discusses briefly their main advantages and disadvantages. Section 5 presents the data. Section 6 presents the effects of fiscal shocks on private consumption. Section 7 discusses alternative explanations of the differences among the Ramey-Shapiro episodes, mainly the tax policies accompanying the government spending shocks and the composition of government spending. Section 8 presents the results regarding employment and the real product wage in the labor market. Section 9 discusses the evidence from input -output tables around two Ramey-Shapiro episodes. The last section concludes.

2 A brief review of recent models of fiscal policy

This section briefly reviews the effects of purchases of goods and services by the government in the recent macro literature, to point out the key testable differences. In all cases, I will assume that taxation is lump-sum, government spending does not enter the utility function of the private sector, and there is only one sector in the economy. The discussion will focus on the effects of government spending on GDP, private consumption, employment, and the real wage; the signs of the effects on private investment in each model are often ambiguous, and depend on features like the persistence of the government spending shock.

The benchmark case is that of a forward-looking representative agent who can borrow and lend freely at the market interest rate, and derives no utility from government spending; the utility function is separable in consumption and leisure, and all prices are perfectly flexible. This is the case studied in Baxter and King (1993): I will call this the "**benchmark neoclassical model**". The effects of government purchases follow directly from the wealth effect on the consumer. From the intertemporal government budget constraint, the higher government spending must be matched by an increase in taxation of the same value in present discounted value terms. The negative wealth effect causes the consumer to decrease her consumption and leisure; as labor supply shifts out, output increases and the real wage falls.

Each of the next two models introduces one departure from the benchmark assumptions; accordingly, each generates one departure from the benchmark predictions, on private consumption and the real wage, respectively. In the model of Linnemann (2006), the only difference relative to the benchmark neoclassical model is that the utility function is non-separable in leisure and consumption. As leisure falls following the negative wealth effect, the substitutability between consumption and leisure implies that the marginal utility of consumption must increase, making the agent want to consume more. Thus, private consumption and government spending now covary positively conditional on a government spending shock; the other variables move as in the neoclassical model. I will call this the "**non-separable neoclassical model**"

Consider now a different modification of the benchmark neoclassical model: introducing price rigidities, as in Linnemann and Schabert (2003). Like in the benchmark neoclassical model, private consumption falls because of the negative wealth effect. The key difference is in the labor market: because of the price rigidity, not only labor supply, but also labor demand increases as output rises. If the interest rate rule does not put too much weight on output, the expansion in output and labor demand are sufficient to generate an increase in the real wage. I label this the "**nominal rigidities model**".

The last two models make more substantial departures from the benchmark assumptions, and both predict a positive response of both private consumption and the real wage to a government spending shock. In addition to nominal rigidities, Galí, Lopez-Salido and Vallés (2006) introduce a credit market imperfection, in the form of a share of population that cannot borrow or lend. As before, the shift in labor demand causes the real wage to increase. Since the consumption of credit constrained individuals depends only on the real wage, their consumption increases too. With enough credit constrained individuals, the model can generate a positive response of total private consumption to a government spending shock. I call this the "**neokeynesian model**".[2]

In Ravn, Schmitt-Grohé and Urı́be (2006) the representative individual forms habits not just on aggregate consumption, but on the individual varieties. The resulting demand function facing each producer has a price-elastic component that is a function of aggregate demand, and a price-inelastic component that is a function of the produceRSpecific habit. An increase in aggregate demand, caused for instance by a shock to government spending, increases the share of the price-elastic component and thus the elasticity of demand, which in turn makes the markup countercyclical. Hence, when government spending increases labor demand shifts out and the real wage increases. Although the wealth effect still operates, the higher real wage causes a substitution from leisure into consumption, hence the latter increases as well. I will call this the "**deep habit model**".

[2] Obviously what defines exactly a neokeynesian model is largely a matter of labeling. If nominal rigidities are viewed as one defining featire of neokeynesian model, then even the "nominal rigidities model" of Linnemann and Schabert should fall under this heading.

Table 1 summarizes the key results discussed in this section.

Table 1: **Models**

	Y	C	W/P	L	L^s	L^d
Benchmark neoclassical	↑	↓	↓	↑	↑	=
Non-separable utility	↑	↑	↓	↑	↑	=
Nominal rigidities	↑	↓	↑	↑	↑	↑
Neo-keynesian	↑	↑	↑	↑	↑	↑
Deep-habits	↑	↑	↑	↑	↑	↑

Benchmark neoclassical: Baxter and King (1993).
Non-separable utility: Linnemann (2006).
Nominal rigidities: Linnemann and Schabert (2003).
Neo-keynesian: Galí, Lopez-Salido and Vallés (2006).
Deep habits: Ravn, Schmitt-Grohé and Uríbe (2006).

Because the preedictions of the various models are sharpest about the effects of government spending shock, in this paper I will focus on the latter, leaving a in-depth analysis of tax shocks to future research.

3 Specification and identification

To fix ideas, consider a benchmark specification in which the vector of endogenous variables $X_ì$ includes the log of real government spending on goods and services per capita g_t, a tax variable t_t, the log of real output per capita y_t, an inflation variable π_t, and a nominal interest rate variable i_t. The precise definition, with other data issues, will be taken up in section 5.

3.1 The dummy variable approach

On the basis of contemporary accounts in the press, Ramey and Shapiro (1998) identified three episodes of military buildups that could reasonably be interpreted as exogenous and unforeseen: the Korean War buildup starting in 1950:3, the Vietnam War buildup starting in 1965:1, and the Carter-Reagan buildup starting in 1980:1. To this, I add a Bush dummy variable starting in 2001:4 (see also Ramey (20006)). Define the dummy variables D_{1t}, D_{2t}, D_{3t} and D_{4t} as taking the value of 1 at the start of each of the "Ramey and Shapiro" episodes, on 1950:3, 1965:1, 1980:1, and 2001:4 respectively, and let $D_t = D_{1t} + D_{2t} + D_{3t} + D_{4t}$

The first version of the Dummy Variable approach (denoted "DV1" for brevity, and applied by Edelberg, Eichenbaum and Fisher (1999)) consists in estimating the reduced form VAR

$$X_t = A(L)X_{t-1} + B(L)D_t + U_t, \tag{1}$$

where X_t is the vector of endogenous variables, $A(L)$ is a polynomial of order n_A and $B(L)$ is a polynomial of order n_B ((i.e., the VAR includes lags 0 to $n_B - 1$ of the combined dummy variable) and $U_t \equiv [u_t^g \quad u_t^t \quad u_t^y \quad u_t^\pi \quad u_t^i)'$ is the vector of reduced form residuals. The effects of an exogenous shock to government spending can be found by tracing the dynamic effects of a unit shock to the dummy variable: i.e., the response of the endogenous variables at $t + k$ is given by the estimated coefficient on L^k in the expansion of $(I - A(L)L)^{-1} B(L)$.

This version of the DV1 approach imposes a strong constraint on the data: the shape and size of the responses of the endogenous variables to the exogenous shock are the same in the different episodes. A less stringent version of this approach (originally introduced by Burnside, Eichenbaum and Fisher (2004)) consists in allowing each episode to have a different intensity, although the shape of the responses is still assumed to be the same. In this variant of the approach ("DV2" from now on), one estimates the VAR:

$$X_t = A(L)X_{t-1} + \sum_{i=1}^{4} B(L)\theta_i D_{it} + U_t, \tag{2}$$

where the $\theta_1 = 1$ and $\theta_2, \theta_3, \theta_4$ are scalars that measure the intensity of the last three Ramey-Shapiro episodes relative to the Korean War.

Even this specification still imposes a strong constraint, namely that the shapes of the responses of a given variable are the same in each episode. Indeed, the four episodes do differ in fundamental ways: for instance, it is well known that the Korean War was all financed with tax increases, due to the strong aversion of President Truman to budget deficits; while the Vietnam War buildup was financed with debt. To accommodate this, I will also use a third variant of the Dummy Variable approach ("DV3" from now on), in which the responses to each Ramey-Shapiro episode are allowed to have a different shape and intensity, by estimating the VAR:

$$X_t = A(L)X_{t-1} + \sum_{i=1}^{4} B_i(L)D_{it} + U_t, \tag{3}$$

where each $B_i(L)$ is a n_B-order vector polynomial.

3.2 The SVAR approach

The SVAR approach starts from the reduced form specification:

$$X_t = A(L)X_{t-1} + U_t \tag{4}$$

The reduced form residuals of the g_t and t_t equations, u_t^g and u_t^t, can be thought of as linear combinations of three components. First, the *automatic response* of taxes and government spending to innovations in output, inflation and the interest rate; for instance, for given tax rates taxes increase automatically when output increases. Second, the *systematic discretionary response* of policymakers to innovations in the other endogenous variables; for instance, reductions in tax rates implemented systematically in response to recessions. Third, *random discretionary shocks* to fiscal policies; these are the "structural" fiscal shocks, which unlike the reduced form residuals are uncorrelated with all other structural shocks.[3] This is also the component one is interested in when estimating impulse responses to fiscal policy shocks.

Formally, and without loss of generality, one can write:

$$u_t^t = \alpha_{ty} u_t^y + \alpha_{t\pi} u_t^\pi + \alpha_{ti} u_t^i + \beta_{tg} e_t^g + e_t^t \tag{5}$$

$$u_t^g = \alpha_{gy} u_t^y + \alpha_{g\pi} u_t^\pi + \alpha_{gi} u_t^i + \beta_{gt} e_t^t + e_t^g \tag{6}$$

where the coefficients α_{jk} capture the first two components and e_t^g and e_t^t are the "structural" fiscal shocks, i.e. $cov(e_t^g, e_t^t) = 0$. Clearly, e_t^g and e_t^t are correlated with the reduced form residuals, hence they cannot be obtained by an OLS estimation of (5) and (6).

The key to identification is the observation that it typically takes longer than a quarter for discretionary fiscal policy to respond to, say, an output shock, hence the *systematic discretionary response* is absent in quarterly data. As a consequence, the coefficients α_{jk} in (5) and (6) capture only the *automatic response* of fiscal variables to economic activity. One can then use available external information on the elasticity of taxes and spending to GDP, inflation and interest rates to compute the appropriate values of the coefficients α_{jk} (see Appendix B);[4] with these, one can then construct the cyclically adjusted fiscal shocks:

$$u_t^{t,CA} \equiv u_t^t - (\alpha_{ty} u_t^y + \alpha_{t\pi} u_t^\pi + \alpha_{ti} u_t^i) = \beta_{tg} e_t^g + e_t^t \tag{7}$$

$$u_t^{g,CA} \equiv u_t^g - (\alpha_{gy} u_t^y + \alpha_{g\pi} u_t^\pi + \alpha_{gi} u_t^i) = \beta_{gt} e_t^t + e_t^g \tag{8}$$

which are linear combinations of the two structural fiscal policy shocks. There is little guidance, theoretical or empirical, on how to identify the two structural shocks e_t^t and e_t^g on the r.h.s. of (7) and (8). Therefore, I try both orthogonalizations: in the first, I assume that $\beta_{gt} = 0$ and I estimate β_{tg}; in the second, I assume $\beta_{tg} = 0$ and I estimate β_{gt}. As it turns out, in all cases the correlation between the two cyclically adjusted fiscal

[3]Like all definitions, this one too has an element of arbitrariness. One could argue that, in a sense, all changes in fiscal policy are discretionary: in theory, policymakers can always undo the effects of changes in output and prices on revenues and spending. While this might be true over the long run, with quarterly data the distinction appears meaningful.

[4]Importantly, these values of the elasticities of government revenues and transfers are not estimated, but computed from institutional information on statutory tax brackets, the distribution of taxpayers by income classes, the statutory unemployment benefit, etc.

shocks is very low, hence their ordering does not matter; as a benchmark, I will use the first orthogonalization.[5]

The two structural shocks thus estimated are orthogonal to the other structural shocks of the economy, hence they can be used as instruments in the remaining equations. For instance, assuming that GDP is ordered first among the other variables, one can estimate the "GDP" equation $u_t^y = \gamma_{yt} u_t^t + \gamma_{yg} u_t^g + e_t^y$, using e_t^g and e_t^t as instruments for u_t^t and u_t^g, and similarly for the other equations.[6] Once the structural shocks are identified, the impulse responses are constructed using the average elasticities over the relevant sample periods.

4 Discussion

The advantage of the Dummy Variable approach is that it does not require any further assumption to identify fiscal shocks. It suffers from two potential problems. First, the estimated responses might simply reflect a combination of events, like past policy shocks or contemporaneous non-policy shocks. Table 2 lists all the quarters in the sample when the percentage change in government spending or the change in the average marginal income tax rate on labor income[7] exceeded two standard deviations. Clearly, the Korean War episode was preceded and accompanied by large increases in the tax rate in 1950, 1951 and 1952 (the average marginal tax rate is an annual variable); in contrast, the onset of the Carter-Reagan buildup was preceded by a large tax cut in 1979, followed by a large tax increase in 1981 and by another large tax cut in 1982.

A second related question is also well illustrated by the Korean War dummy variable. The table shows that this episode consisted of a string of large increases in government spending starting in the fourth quarter of 1950, raising the issue whether these were anticipated or not as of the beginning of the episode.

The key question of the SVAR approach concerns the forecastability of its estimated shocks. While decision lags help to identify the fiscal shocks, implementation lags could imply that the latter were actually anticipated by the private sector; the resulting impulse responses would be biased.

This is essentially an empirical questions. Following Ramey (2006), a first obvious candidate as a predictor of the estimated SVAR shocks is the RS dummy variable itself.[8]

[5] Although I consider only the two Choleski orderings, one should recognize that, lacking a theory, really any *rotation* of the two shocks could be assumed. Canova and Pappa (2003) and Mountford and Uhlig (2002) develop an alternative approach based on this idea.

[6] The ordering of the remaining variables is immaterial if one is only interested in estimating the effects of fiscal policy shocks, as it is the case in this paper.

[7] I use the average marginal income tax rate as calculated by Barro and Sahasakul (1983), and updated by Stephenson (1998) up to 1996 and by myself afterwards.

[8] The SVAR shocks are estimated from the benchmark 6-variable VAR with private consumption

Table 2: **Large changes in fiscal policy**

sd of $\Delta g = 0.02$				sd of $\Delta\ T = 0.55$			
$\frac{\Delta g}{sd}$>=3		$2 < \frac{\Delta g}{sd} < 3$		$\frac{\Delta\ T}{sd} >= 3$		$2 < \frac{\Delta\ T}{sd} < 3$	
50:4	0.08	48:2	0.04	48:1	-3.2	50:1	1.2
51:1	0.09	50:3	-0.04	51:1	3.3	68:1	1.6
51:2	0.12	52:2	0.04	52:1	1.7	70:1	-1.3
51:3	0.11	54:1	-0.05	54:1	-2.4	83:1	-1.6
		54:2	-0.04	64:1	-2.3	02:1	-1.2
				78:1	2.1	03:1	-1.3
				79:1	-1.8		
				81:1	2.4		
				82:1	-1.8		

g: log of government spending on goods and services, excluding non-defense capital spending. T: average marginal income tax rate on labor income. See definitions in section 5.

Table 3: **Forecastability of RS dummy and SVAR shocks**

	Prediction equations of SVAR g shock and RS dummy	Full sample	Short sample
1	OLS: SVAR shock on 4 lags of RS dummy	0.08	0.90
2	OLS: RS dummy on 4 lags of g and y SVAR shocks	0.05	0.43
3	Probit: RS dummy on 4 lags of SVAR shock, prob. of 1950:3	0.48	

The last two columns indicate the p-value of a test of the exclusion of all regressors in the equation. "Full sample": 1947:1-2005:4; "Short sample": 1954:1-2005:4.

The first row of Table 3 shows that over the full sample 1947:1-2005:4 the RS dummy does indeed Granger cause the government spending SVAR shock at the 10 percent level, as Ramey (2006) finds. However, Row 2 shows that in a OLS regression past government spending and GDP shocks also help predict the RS dummy at the 5 percent significance level. [9] A further examination of the OLS prediction equation for the government spending shock also reveals that the predictive power of the RS dummy comes exclusively from the Korean War episode (by far the largest of all the RS episodes), and it is of limited economic significance. In fact, over the shorter sample starting in 1954:1, now the 4 lags of the RS dummy and the 4 lags of the g and y shocks are totally jointly insignificant in the two prediction equations.

As Leeper argues, a probit regression may be more appropriate than a linear one to predict a dummy variable; row 3 of Table 3 shows that in this case the past GDP and government spending SVAR shocks are not jointly significant in predicting the RS dummy. However, the regression predicts the Korean event of 1950:3 with a probability of 48 percent (not shown).

Table 4: **SVAR innovations during RS episodes**

coeff. of lagged		Estimated SVAR g shock							
RS dummy		Korea		Vietnam		Reagan		Bush	
lag 1	.21	50:4	.66	65:2	.05	80:2	.15	02:1	-.06
lag 2	.14	51:1	.64	65:3	.33	80:3	-.45	02:2	.01
lag 3	.23	51:2	.91	65:4	.05	80:4	-.15	02:3	.06
lag 4	.12	51:3	.52	66:1	-.14	81:1	-.05	02:4	.10

Column 2: estimated coefficients on the lags of the RS dummy indicated in column 1 , from a OLS regression of SVAR g innovation on four lags of RS dummy.

In addition, the predictive power for the SVAR shock of the Korean episode is of limited economic significance. Table 4 lists the government spending shocks in the four quarters after the beginning of each episode, with the estimated coefficients of a regression of the SVAR g shock on the four lags of the RS dummy. The average SVAR g shock in the four quarters after 1950:3 was about .7 percentage points of GDP each quarter, while the largest coefficient on the four lags of the RS dummy is .2.[10] An individual standing in

described in section 6.

[9] Ramey (2006) finds that the government spending shock does not Granger cause the Ramey-Shapiro dummy. However, to assess whether the latter is forecastable there is no reason to limit oneself to the government spending shock as a predictor; in fact, the estimated GDP shock is an equally plausible candidate, and turns out to have far more forecasting power.

[10] To facilitate the interpretation, in these regressions I multiply the government spending shock by the average ratio of government spending to GDP. Thus, the government spending shock is expressed in percentage points of GDP.

1950:3 and using this equation would have been able to predict about 40 of the smallest shock, in 1951:3, and less than 30 percent of the other shocks. It is also apparent that this equation would have been of little use to predict the SVAR shocks during the other episodes.

A second candidate to assess the predictability of the estimated SVAR shocks is independent assessments of the fiscal stance.Since 1984, the *Congressional Budget Office* publishes twice a year in *The Economic and Budget Outlook* (usually in February-March and August-September) revisions of changes of government spending and revenues during the year of the forecast, and up to 5 year thereafter, relative to the previous forecasts.[11] These changes are divided in three categories: technical, legislative, and economic (the latter are those that are due to changes in the economic environment).

Table 5: **Forecastability of SVAR shocks using CBO revisions**

	Regression of SVAR g shock on CBO forecasts	Full sample	Short sample
1	OLS, quarterly: SVAR shock on lagged CBO forecast revisions	0.33	.20
2	OLS, biannual: SVAR shock on lagged CBO forecast revisions	0.67	.68
3	OLS, quarterly: SVAR shock on contemp. CBO forecast revisions	0.14	.05
4	OLS, biannual: SVAR shock on contemp. CBO forecast revisions	0.01	.01

The last two columns indicate the p-value of a test of the exclusion of all regressors in the equation. "Full sample": 1947:1-2005:4; "Short sample": 1954:1-2005:4.

I regress the quarterly government spending SVAR shock on the sum of the technical and legislative forecast changes for the same year (as shares of potential output) available the previous quarter; row 1 of Table 5 shows that the coefficients is insignificant in both samples. Because it is not exactly obvious when the information used in the CBO forecasts becomes widely used, and because these forecasts are only biannual, I then take the average of the SVAR shocks in the first and second quarters, and in the third and fourth quarters, and regress them on the CBO forecasts of the previous semester for that year; again I find that the coefficient of the latter is entirely insignificant in both samples(row 2).

Thus, there is little evidence that the SVAR shocks are predictable: but do they make sense? When the SVAR government spending shock is regressed on the most recent value of the sum of the CBO technical and legislative forecast revisions, with the marginal exception of quarterly data in the full sample the coefficient is statistically significant; in particular, with bi-annual data, it has a p-value of .01 in both samples. Thus, the data do suggest that the SVAR shocks are contemporaneously correlated with the information contained in CBO forecasts.

[11] I thank Alan Auerbach for providing me with the data.

5 The data

The benchmark specification includes 5 variables: the log of government spending on goods and services g_t, the log of real GDP per capita y_t, the log or real per capita net taxes t_t, the GDP deflator inflation rate π_t, and the 3-months nominal interest rate i_t.[12] Other variables of interest (private consumption, the real wage, etc.) will be added in turn to this core set of variables.

In a second specification, taken from Burnside, Eichenbaum and Fisher (2004), the core set of variables includes g_t, y_t, the average tax rate on labor tl_t, and the average tax rate on capital tk_t. In order not to clutter the exposition, I will not present results from this specification; when they arise, I will only point out any substantial discrepancies with the benchmark specification.

In the benchmark case, the variables are in level, with a constant, a linear trend, and a quadratic trend. The sample starts in 1947:1 and ends in 2005:4. Appendix A describes the data in greater detail. Appendix B describes the construction of the elasticities in the SVAR approach.

6 Private consumption

I start from a VAR where the log of real per capita consumption of nondurables and services, c_t, is added to the core set of variables. Figure 1 displays the point estimate and the median response (out of 500 replications) of g_t, y_t, and c_t, with 68-percent confidence interval bands based on Montecarlo simulations. The responses of government spending and private consumption are expressed in percentage points of GDP by multiplying the log response by hundred times the average share of government spending and private consumption, respectively, in GDP. The figure highlights four points.

First, in the DV1 approach (row 1) government spending and GDP have a positive, hump-shaped response, while there is some evidence of a small decline in private consumption, although insignificant. Private consumption declines significantly in the DV2 approach as well in row 2, which presents the case of Korea.. These results are qualitatively consistent with Burnside, Eichenbaum and Fisher (2004) and Edelberg, Eichenbaum and Fisher (2003).[13] However, when one separates the four episodes in the DV3 approach

[12] Government spending on goods and services is defined as all general government consumption plus defense investment. Thus, it includes all purchases of goods and services by the local, state and federal governments except non-defense investment.

Net taxes are defined as all non-interest revenues by the general government, less curren non-interest spending except government consumption.

[13] Note however that this is the most favorable result to the neoclassical theory in the literature. BEF and EEF never find a significant negative response of consumption of nondurables and services in the DV1 and DV2 approaches.

(rows 3 to 6) it is clear that the DV1 and especially the DV2 approaches are largely influenced by the Korean episode, which dominates the others quantitatively. In fact, only Korea displays a decline on consumption despite the increase in government spending and GDP. In all other episodes, and conditional on a government spending shock, the consumption response has the same sign and shape as that of GDP. In the Vietnam episode government spending, GDP and private consumption all increase significantly; in the Reagan episode government spending hardly moves[14] but GDP and consumption fall; in the Bush episode government spending increases considerably, by up to 2 percent of GDP, but GDP and private consumption fall slightly, although insignificantly.[15]

These patterns explain why the private consumption response has the opposite sign to that of government spending and GDP in the DV1 and DV2 approaches; due to the strong restrictions they impose, these two methods capture mostly the increases in government spending in all episodes except the third one, and the decline in private consumption in the first and third episodes.

Second, in the SVAR approach (row 7) government spending and GDP increase, and so does private consumption, again with a response that largely mimics that of GDP.[16] Thus, the SVAR evidence appears largely consistent with the DV evidence, once the strong restrictions imposed in the DV1 and DV2 approaches are relaxed. Quantitatively, however, the SVAR approach delivers a small response of private consumption in this full sample, with a peak of little more than .2 percentage points of GDP.

Third, this last result is again influenced heavily by the Korean War episode. When the sample omits the fiscally turbulent late forties and early fifties and starts in 1954, the positive response of private consumption rises to a peak of about .6 percent of GDP (row 8).[17] This is consistent with the evidence from the DV approach, since the sample now omits Korea, with its large increase in spending and large decline in private consumption.

Fourth, these results are quite robust: they persist under different assumption about the underlying statistical properties of the data: in first differences (row 9), in levels with no trend, or with only a linear trend (not shown). The results also change little when the list of variables includes the price of crude fuel, the average marginal income tax rate from Barro and Shashakul, or private investment, or omits the inflation rate, the interest rate, and the tax variables. Finally, they change little in the alternative BEF specification.

[14] During this episode the increase in defense spending is compensated by an equivalent decline in non-defense spending (see section 7.2).

[15] In fact, this result raises the issue of the exogeneity of the government spending hike during the Bush episode.

[16] The shock to government spending is normalized to 1 percentage point of GDP; government spending and net taxes are ordered first and second, respectively.

[17] Galí, López-Salido and Vallés (2006) also start the sample in 1954, and find similarly higher responses of private consumption.

7 Explaining the difference between the Ramey-Shapiro episodes

Thus, the Korean War episode seems crucial in understanding the discrepancies between the different approaches. But what accounts for this difference? Beyond the change in total government spending, fiscal policies during the four episodes differed markedly both in terms of the accompanying tax policies and in terms of the composition of government spending. I show below that this might go a long way in explaining the difference between episodes.

7.1 The role of taxes

Figure 2 displays the path of the average labor and capital tax rates (computed as in Burnside, Eichenbaum and Fisher (2004)) and of the Barro-Sahsakul average marginal tax rate on labor income during the RS episodes. Figure 3 displays the responses of these variables to the four RS dummies.[18] It is well known that, largely due to an ideological aversion of President Truman to budget deficits, the Korean war buildup was entirely funded by taxes: in fact, the average marginal tax rate on labor increases by 3.5 percentage points above trend 2 years after the start of the episode; the average tax rates on labor and, especially, capital also rise - the latter by almost 10 percentage points. In contrast, in the other episodes the tax rates move in the opposite direction to government spending: the average marginal tax rate on labor declines by about 1.5 percentage points one year into the Vietnam War episode; it increases by 3.5 percentage points 2 years after the start of the Carter-Reagan episode; and it declines by 2.5 percentage points after 1 year in the Bush episode.

Figure 4 displays historical decompositions of private consumption in the four episodes. For each episode, three series are displayed. First, the percentage deviation from the actual consumption path of the baseline forecast of consumption, based on information up to the quarter preceding the beginning of each episode (“C_U”, where “U” stands for “unconditional”). Second, the percentage deviation from the actual consumption path of the consumption forecast, based on the same information as before, plus the sequence of government spending shocks during five year horizon of the forecast (“C_G”). This variable describes what the deviation from the actual consumption would have been if only the government spending shocks had occurred after the beginning of each episode. Third, the prcentage deviation of the consumption forecast based on the sequence of tax shocks only (“C_T”), constructed in a similar way.

[18] The responses of the average tax rates on labor and capital are taken from the BEF specification; the response of the average marginal tax rate on labor is taken from a benchmark VAR in which this variable replaces the log of real per capita net taxes.

In the Korean War episode, the large government spending increase makes a very small positive contribution to private consumption relative to the baseline forecast; but the large tax increase had a large negative effect, accounting for up to 4 percentage points fall of GDP at the end of 1952, the peak of the tax increase. The sequence of tax cuts was important also in the Vietnam War episode, where it had a positive effect on private consumption by up to 1.5 percentage points; the spending increase also had a similar effect up to 1968. In the Carter-Reagan expansion, the small spending decline had a very negligible effect on private consumption, while the tax increase had a non-negligible negative effect after 1982, again the peak of the tax increase; the tax cuts under Bush had a significant effect on private consumption after 2002, while the government spending hike did not contribute much.

Thus, in each episode the tax shocks appear to have been more important than the spending shocks. In particular, they explain why private consumption fell during the Korean War despite the large government spending increase.

7.2 The composition of government spending

The composition of the government spending changes in the four episodes was also different. Figure 5 displays impulse responses from a 7-variable VAR, where government spending has been split into defense and civilian spending. The first columns displays the response of total government spending, while the next two columns display the responses of defense and civilian spending (the sum of these two is total government spending). Because the DV2 approach delivers very similar responses to the DV1 approach and the Korean episode, from now on I will drop the DV2 responses from the Figures.

The important point from the DV analysis (first 5 rows) is that in each episode the response of private consumption has the same sign as the response of civilian government spending. In the Korean War episode, the large defense expansion was accompanied by a smaller, but still substantial, decline in civilian government spending; in the Vietnam episode, in contrast, civilian government spending also increased. In the Carter-Reagan episode, defense government spending increased by less than .5 percentage points of GDP, while civilian spending declined by a similar amount - explaining the flat response of total government spending. A similar pattern holds in the Bush episode, but defense spending now increases more, explaining the increase in total government spending.

In a SVAR, one must distinguish between shocks to defense and civilian government spending. Row 6 displays the response to a defense shock in the full sample SVAR, the next row displays the response to a civilian shock of equal initial intensity, 1 percent of GDP. In response to a defense spending shock, civilian spending declines by a small amount, while in response to a civilian spending shock defense spending declines by more than .5 percentage points of GDP. As a result, in the case of a civilian spending shock the response of total government spending is much more intensive in civilian spending, but it is also much less persistent. Yet, private consumption responds much more to a civilian spending shock (almost .9 percentage points of GDP after 2 years) than to a defense spending shock (almost no change). The same conclusions hold in the shorter sample, starting in 1954 (rows 8 and 9) and in the same sample, but with all variables in first differences (rows 10 and 11).

Thus, the evidence from both the DV and the SVAR approaches seems to be that civilian government spending is more effective in stimulating GDP and private consumption, although perhaps with a longer lag.

8 The labor market

8.1 The response of the real product wage, hours and employment

Virtually all models predict a positive effect of government spending shocks on hours. But, as argued by Pappa (2005), probably the most robust difference - in the sense that it survives in a very wide range of parameter configurations - between alternative models concerns the sign of the response of the real wage to government spending. In all models with forward looking liquidity unconstrained individuals the labor supply curve shifts out due to the negative wealth effect. If this is the only effect on the labor market, as in the benchmark neoclassical model or in the non-separable model, the real product wage must fall. But if the labor demand also shifts out, as in the remaining three models, then the real product wage can increase. This insight is at the heart of the analysis of Rotemberg and Woodford (1992), probably the earliest empirical investigation of the effects of government spending shocks on the real wage using VAR techniques.

In the literature on the effects of technological shocks, several measures of hours, employment, earnings and compensation have been used; as Chari, Kehoe and McGrattan (2005) note, the results are somewhat sensitive to the definition. I use two measures of employment: total and private employees in the non-farm business sector (for brevity, I will drop the "non-farm" qualification from now on), and three measures of hours: manufacturing hours (the product of average weekly hours times maufacturing employment), business sector hours, and total hours (following Galí et al. (2006), this is computed as the product of total civilian employment sixteen years and older times average weekly hours in manufacturing). I use two measures of the product wage: average weekly earnings in manufacturing, and average weekly compensation in the business sector, each divided by its own sectoral price index. The precise definitions and sources are given in Appendix A.

I then form three pairs of wage-hours variables: manufacturing weekly earnings and hours, business sector compensation and hours, business sector compensation and total hours; and two pairs of wage-employment pairs: business sector compensation and total employment, and business sector compensation and private employment. Each pair of variables is added in turn to the benchmark 5-variable VAR; the main results are displayed in Figure 6, which displays three employment and three wage variables. A number of conclusions can be drawn.

First, in the DV1 approach, and in each of the four episodes separately, the response of employment or hours follows closely that of GDP, and it is typically significant; it is also much stronger for manufacturing hours than for business sector hours or private employment. In the SVAR approach, the response is positive in the full and in the shorter sample, but significant only in the former. In first differences, the response becomes mostly negative, although the standard errors are large.

Second, manufacturing real earnings increase both in the DV1 approach and in each epsiode individually, although in Korea only after a significant decline of up to 6 percent;[19] however, only in the Vietnam episode there is a clear positive comovement between the real manufacturing earnings and hours, conditional on the government spending shock. Compensation in the business sector moves little. In the SVAR approach manufacturing earnings increase significantly in all specifications. Business sector compensation increases significantly only in the specification in first differences.

Thus, contrary to the case of private consumption, the evidence on the response of the real product wage is more mixed. It is true that it is hard to make a case for a significant decline, but at a minimum now there is some qualitative discrepancies between the DV and SVAR approaches. Note however that, because we are looking at the product wage, the deviations from the benchmark neoclassical paradigm displayed by the Vietnam and the Reagan episodes (the latter in particular if one looks at business sector compensation) are unlikely to be explained by the responses of the distortionary tax rate documented in section 7. An increase in the real *product* wage can occur if individuals anticipate much lower taxes in the future, causing intertemporal substitution away from current work into leisure. But the time path of the tax responses documented in Figure 3 appears inconsistent with this explanation: the labor tax rate falls at the beginning of the Vietnam episode and then increases slowly, while it increases during the Reagan episode.

[19] Using a BLS series of producer prices in manufacturing (now discontinued) to deflate nominal manufacturing earnings, Edelberg, Eichenbaum and Fisher (2003) and Burnside, Eichenbaum and Fisher (2004) find a persistent decline in real product earnings in the DV1 and DV2 approaches, respectively. When I use this series, kindly provided to me by Jonas Fisher, I also find a decline in manufacturing earnings in the DV1 and DV2 approaches, and a much smaller (algebraically) response in each of the episodes. Also, now even the SVAR approach shows evidence of a large and significant decline in the shorter sample.

8.2 The real consumption wage

In a two sector model there is a meaningful distinction between the product wage and the consumption wage. Ramey and Shapiro (1997) present a two-sector neoclassical model with government spending, in which in general the real consumption wage falls due to the wealth effect. I am not aware of two-sector models with government spending and nominal rigidities or credit constraints. However, it is clear that in the neo-keynesian model with credit constraints the real consumption wage must increase if private consumption is to increase.

The last column of Figure 6 displays the response of the real consumption compensation in the business sector. As one can see, it differs little from the response of the product compensation.

8.3 Government employment shocks and the labor market

As Mary Finn (1996) emphasizes, the neoclassical model implies an important but neglected distinction between the effects of a shock to government employment and to the non-wage component of government spending. Both have a negative wealth effect on the consumer, and for this reason both imply an outward shift in the labor supply curve of the private sector. But for plausible parameter values, in the case of a government employment shock the rise in labor supply is less than the increase in government employment: hence, private employment falls, and the real wage in the private sector increases. The opposite occurs in the case of a non-wage shock. The distinction between the two types of government spending is thus important when testing the relation between fiscal policy and the labor market.

I split the log government spending variable into its two components of log real spending on wages and of log real spending on goods. As a measure of real spending on wages, I take the log of total government employment. In Figure 7, the 8-variable VAR includes also the logs of manufacturing earnings and hours.[20] The figure displays the SVAR response of wage spending, of goods (or non-wage) spending, and of their sum total spending, all as shares of GDP,[21] in addition to the responses of log real earnings and hours in manufacturing.

Distinguishing the two spending components allows one to construct two shocks that imply very different persistence of the total spending response, and a very different relative intensity of the two components. In all specifications, the non-wage shock generates virtually no response of the wage component, and a much smaller persistence of total spending;

[20] Linnemann (2996) also presents responses to public employment shocks, but does not distinguish between the two types of government spending shocks.

[21] The response of wage spending as share of GDP is computed by multiplying the response of log government employment by the share of wage government spending in GDP.

in contrast, the government employment shock generates a very persistent response of the wage component, and a sizable response of the non-wage component.

The responses of manufacturing wages and hours are also very different. Hours decline slightly after a non-wage shock, but increase by a very large amount (more than 10 percent after about 1 year) after a government employment shock;[22] more importantly, manufacturing earnings increase by very little in the formert case, and by very large amount in the latter. This is true in all specification, and also in the business sector (not shown). This pattern of response thus appears inconsistent with the neoclassical model studied by Finn (1996), which does predict a positive response of real earnings, but only if hours decline. Linnemann (2006) presents a model where a government employment shock generates an increase in private employment, based on complementarity between private and public consumption.

9 Evidence from the input output tables of the US

As we have seen, in contrast to the case of private consumption, the evidence is more mixed on the effects of fiscal policy on teh labor market. The manufacturing earnings and the business sector compensation might be noisy variables to test the effects of government spending on the labor market, as both are composed of many sectors, only a few of which were the target of a substantial increase in government spending during the Ramey-Shapiro episodes. An alternative approach to VAR analysis could shed new light.

The US input-output tables provide information on government purchases by sector, at 4- and 6-digit levels, on dates that are almost exactly equally spaced about the starts of two Ramey and Shapiro episodes: in 1963 and 1967, and in 1977 and 1982. The *NBER Manufacturing Productivity Database* contains annual information on wages, employment, output and producer prices in 450 manufacturing industries at the 4-digit level between 1958 and 1991. These two datasets can be combined to obtain information on changes in real government purchases, real output, hours, employment, and the real product wage, by manufacturing industry, during the last two Ramey-Shapiro episodes.

Let G_i denote all defense and civilian purchases by the general government in sector i.[23] Let $\frac{\Delta G_{i,67/63}}{Y_{i,63}}$ and $\frac{\Delta G_{i,82/77}}{Y_{i,77}}$ denote the changes in G_i over the Vietnam War and the

[22] To put this response in perspective, note that a shock to the wage component of 1 percent of GDP is equivalent to a shock of 10 percent to government employment, given government wages.

[23] The input-output tables do not provide separate information on the fixed capital formation component of non-defense spending, which was excluded from the definition of the government spending variable in the VARs estimated so far.

The input-output tables contain data on both direct and total government purchases, but for the 1977 and 1982 tables only the latter information is available by industry (as opposed to commodities). Thus, in this section the expression "government purchases" refers to direct plus indirect purchases.

The real values are computed deflating the nominal quantities provided by the input-output tables by

Carter-Reagan buildup, as shares of the initial year's industry output. Table 6 lists the first ten industries in the Vietnam War and the Carter-Reagan buildup, by the value of this variable, together with the share of real government spending in real industry output in the initial year of each episode, $\frac{G_{i,63}}{Y_{i,63}}$ and $\frac{G_{i,77}}{Y_{i,77}}$. The next columns of the table display the percentage change of real industry output, hours, and the real hourly product wage of production workers.[24]

Not surprisingly, all these industries experienced a large increase in output and hours. More interestingly, in both episodes the real product wage increased in 8 industries out of 10.

Table 6: **Top 10 industries by change in government purchases**

Vietnam War							
Industry	IO63	SIC72	$\frac{\Delta G_{i,67/63}}{Y_{i,63}}$	$\frac{G_{i,63}}{Y_{i,63}}$	$\frac{\Delta Y_{i,67/63}}{Y_{i,63}}$	$\frac{\Delta H_{i,67/63}}{H_{i,63}}$	$\frac{\Delta W_{i,67/63}}{W_{i,63}}$
Ammunition, exc. small arms, nec.	1302	3483	347.62	80.97	240.66	187.52	-6.83
Small arms ammunition	1306	3482	167.75	43.35	182.95	181.40	19.63
Other ordnance and accessories	1307	3489	116.70	85.83	108.42	90.84	-9.78
Small arms	1305	3484	49.50	41.04	149.61	99.72	2.98
Semiconductors	5702	3674	43.75	41.67	133.58	84.90	57.51
Electromic components, nec	5703	3675	40.92	43.92	135.41	71.12	22.15
Watches and clocks and parts	6207	3873	29.59	11.72	59.17	31.48	17.32
Paving mixtures and blocks	3102	2951	29.19	50.36	34.16	4.80	17.10
Architectural metal work	4008	3446	25.11	28.37	21.56	-4.37	10.30
Misc. chemical products	2704	2861	24.98	16.77	50.36	34.00	26.18
Carter-Reagan							
Industry	IO77	SIC72	$\frac{\Delta G_{i,82/77}}{Y_{i,77}}$	$\frac{G_{i,77}}{Y_{i,77}}$	$\frac{\Delta Y_{i,82/77}}{Y_{i,77}}$	$\frac{\Delta H_{i,82/77}}{H_{i,77}}$	$\frac{\Delta W_{i,82/77}}{W_{i,77}}$
Semiconductors	570200	3674	81.26	25.42	108.23	6.69	83.18
Electronic computing equipm.	510101	3573	60.23	12.53	31.34	1.39	28.75
Ammunition, exc. small arms, nec.	130200	3483	57.44	68.62	201.44	38.10	136.39
Aircraft and missile equipm., nec	600400	3728	47.04	43.22	52.68	33.52	5.61
Aircraft and missile engines and parts	600200	3724	43.87	52.37	47.56	-5.82	31.16
Radio and TV communication equipm.	560400	3662	33.48	41.35	64.52	24.88	21.65
Electrical industrial apparatus, nec	530800	3629	30.56	12.88	11.49	-39.00	12.29
Guided missiles and space vehicles	130100	3761	30.53	82.44	12.01	14.53	-39.99
Other ordnance and accessories	130700	3489	27.28	62.05	32.98	5.09	27.81
Surgical appliances and supplies	620500	3842	24.79	22.03	-33.22	-18.54	-5.16

Source: see text. IO63, IO77: input-output industry classification, 1963 and 1977 editions respectively. SIC72: Standard Industry Classification, 1972 edition. G: total government spending on the sector; Y: real output of the sector; H: hours of production workers in the sector. W: real hourly product wage of production workers in the sector.

the industry's price index of shipments in the *NBER Manufacturing Productivity Database*.

[24]The hourly wage is obtained by dividing total production worker wages by the total number of hours of production workers.

Table 7: **Average changes, by industry**

(1)	(2)	(3)	(4)	(5)	(6)	(7)
	top 20	mid 20	bot 20	top-mid	mid-bot	top-bot
Vietnam War						
$\frac{\Delta G_{i,67/63}}{Y_{i,63}}$	53.14	3.46	-4.55	0.00	0.24	0.00
Actual percentage changes						
$\frac{\Delta Y_{i,67/63}}{Y_{i,63}}$	83.86	30.32	28.33	0.00	0.89	0.00
$\frac{\Delta H_{i,67/63}}{H_{i,63}}$	55.31	16.07	17.50	0.00	0.90	0.00
$\frac{\Delta W_{i,67/63}}{W_{i,63}}$	14.86	10.35	9.91	0.37	0.93	0.33
Percentage changes, deviations from linear and quadratic trend						
$\frac{\Delta Y_{i,67/63}}{Y_{i,63}}$	55.80	15.32	5.30	0.00	0.29	0.00
$\frac{\Delta H_{i,67/63}}{H_{i,63}}$	48.75	20.04	16.81	0.00	0.72	0.00
$\frac{\Delta W_{i,67/63}}{W_{i,63}}$	2.30	-0.01	-3.68	0.52	0.30	0.09
Carter-Reagan						
$\frac{\Delta G_{i,82/77}}{Y_{i,77}}$	31.13	0.05	-9.03	0.00	0.00	0.00
Actual percentage changes						
$\frac{\Delta Y_{i,82/77}}{Y_{i,77}}$	32.91	-16.41	-36.14	0.00	0.12	0.00
$\frac{\Delta H_{i,82/77}}{H_{i,77}}$	-1.72	-26.23	-44.44	0.05	0.15	0.00
$\frac{\Delta W_{i,82/77}}{W_{i,77}}$	19.82	5.61	4.43	0.05	0.87	0.04
Percentage changes, deviations from linear and quadratic trend						
$\frac{\Delta Y_{i,82/77}}{Y_{i,77}}$	26.27	-24.32	-48.46	0.00	0.05	0.00
$\frac{\Delta H_{i,82/77}}{H_{i,77}}$	5.42	-18.46	-33.82	0.04	0.18	0.00
$\frac{\Delta W_{i,82/77}}{W_{i,77}}$	12.58	-1.28	-13.40	0.03	0.05	0.00

Source: see text.

The first row of Table 7, columns 2 to 4, displays the (unweighted) average of $\frac{\Delta G_{i,67/63}}{Y_{i,63}}$ in the top 20 industries, in the middle 20 industries, and in the bottom 20 industries, respectively, by the value of this variable; columns 4 to 6 of the same row display the significance level of their differences. The next rows show that the order of average changes in output, hours and the real wage in the three groups is the same as that of the average change in government spending. This holds whether one considers the actual changes in these variables or the changes of their detrended values. In particular, the average change in the real product wage is always highest in the top 20 industries and lowest in the bottom 20 industries; the p-value of the difference between the top and middle industries or between the top and bottom industries is always below .05 in the Carter-Reagan buildup, while it is usually higher in the Vietnam War episode.

10 Conclusions

To be written

References

Alesina, Alberto, Silvia Ardagna, Roberto Perotti, and Fabio Schiantarelli (2002): "Fiscal Policy, Profits, and Investment", *American Economic Review,* June, pp. *571-89*

Basu, Susantu, and Miles. Kimball (2003): "Investment Planning Costs and the Effects of Fiscal and Monetary Policy", mimeo, University of Michigan

Baxter, Marianne and Robert King (1993): "Fiscal Policy in General Equilibrium", *American Economic Review*, June

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*

Bouakez, Hafedh and Norman Rebel (2003): "Why Does Private Consumption Rise After a Government Spending Shock?", Bank of Canada Working Paper 2003-48;

Bureau of Economic Analysis and U.S. Department of Commerce (1988): *Government Transactions,* Methodology Papers: U.S. National Income and Product Accounts series, Washington, D.C

Burnside, Craig, Martin Eichenbaum, and Jonas D.M. Fisher (2004): "Fiscal Shocks and Their Consequences", *Journal of Economic Theory* 115, pp. 89–117

Canova, Fabio and Evi Pappa (2003): "Price Dispersions in Monetary Unions: The Role of Fiscal Shocks," CEPR Discussion Paper Series, No. 3746

Canzoneri, Matthew B., Robert E. Cumby and Behzad T. Diba (2002): "Should the European Central Bank and the Federal Reserve Be Concerned About Fiscal Policy", paper presented at the Federal Reserve Bank of Kansas City's symposium on "Rethinking Stabilization Policy", Jackson Hole, August 29-31 2002

Chari, V.V., Patrick Kehoe, and Ellen McGrattan (2005): "A Critique of Structural VARs Using Real Business Cycle Theory", Federal Reserve Bank of Minneapolis-Working Paper 631

Christiano, Lawrence J., Martin Eichenbaum, and Charles L. Evans (1999): "Monetary Policy Shocks: What Have We Learned and to What End?", in: Taylor, John B. and Michael Woodford, eds.: *Handbook of Macroeconomics.* Volume 1A. Handbooks in Economics, vol. 15. Amsterdam; New York and Oxford: Elsevier Science, North Holland, 65-148

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), May, pp. 233-54

Edelberg, Wendy, Martin Eichenbaum, and Jonas D.M. Fisher (1999): ”Understanding the Effects of a Shock to Government Purchases”, *Review of Economics Dynamics*, pp. 166-206

Fatás, Antonio and Ilian Mihov (2001): ”The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence”, mimeo, INSEAD

Galí, Jordi, J. David López-Salido and Javier Vallés (2006): “Understanding the Effects of Government Spending on Consumption”, forthcoming, *Journal of the European Economic Association*

Giorno, Claude, Pete Richardson, Deborah Roseveare, and Paul van den Noord (1995): ”Estimating Potential Output, Output Gaps, and Structural Budget Deficits”, *Economic Department Working Paper* 152, OECD, Paris

Jappelli, Tullio and Marco Pagano (1994): “Savings, Growth, and Liquidity Constraints”, *Quarterly Journal of Economics*, 109(1), pp. 83-110

Linnemann, Ludger and Andreas Schabert (2003): “Fiscal Policy in the New Neoclassical Synthesis”, *Journal of Money, Credit and Banking*, Vol. 35, No. 6, pp. 911-929

Linnemann, Ludger (2005): “The Effects of Government Spending on Private Consumption: A Puzzle? ”, mimeo, University of Bonn;

Mountford, Andrew and Harald Uhlig (2002): ”What Are the Effcets of Fiscal Policy Shocks?” CEPR Discussion Paper 3338

Ohanian, Lee E. (1997): “The Macroeconomic Effects of War Finance in the United States: World War II and the Korean War”, *American Economic Review*, March;

Perotti, Roberto (2004): ”Estimating the Effects of Fiscal Policy in OECD Countries”, mimeo, Bocconi University

Ramey, Valerie A. and Matthew D. Shapiro (1997): ”Costly Capital Reallocation and the Effects of Government Spending”, *Carnegie Rochester Conference on Public Policy*

Ravn, Morten, Stephanie Schmitt-Grohé, and Martín Uribe (2006): “Deep Habits”, *Review of Economic Studies*, January

Romer, Christina D. and David H. Romer (1989): "Does Monetary Policy Matter? A New Test in the Spirit of Friedman and Schwartz",in Olivier J. Blanchard and Stanley Fischer, eds.: *NBER macroeconomics annual: 1989.* Cambridge, Mass. and London: MIT Press, 121 70

Romer, Christina and David H. Romer (1994): "What Ends Recessions?"

Rotemberg, Julio and Michael Woodford (1992): "Oligopolistic Pricing and the Effects of Aggregate Demand on Economic Activity", *Journal of Political Economy*, 100, 1153-1297.

Uhlig, Harald (1999): "What are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure", Centre for Economic Policy Research Discussion Paper: 2137

van den Noord, Paul (2002): "Automatic Stabilizers in the 1990s and Beyond", in: Marco Buti, Jurgen von Hagen, and Carlos Martinez-Mongay, eds.: *The Behavior of Fiscal Authorities: Stabilization, Growth and Institutions*, Palgrave

Legend for the graphs

S1: short sample (starting in 1954:1)
D1: first differences
G: total government spending;
GE: government employment;
GG: goods government spending
E: hours (manufacturing or business sector) or private employment
W: wage, manufacturing or business sector
sh.: shock

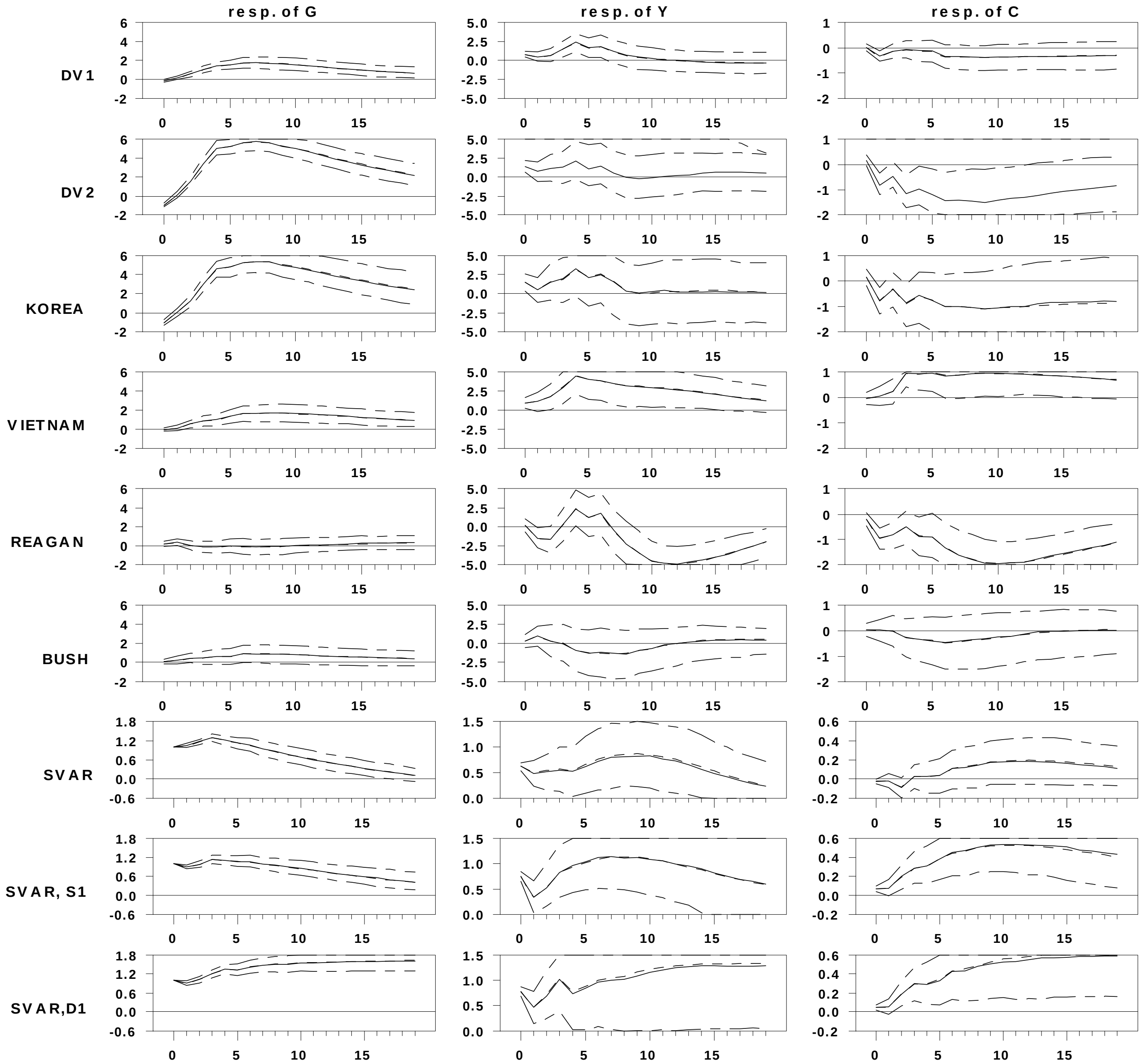

Figure 1: Impulse responses to a shock to G

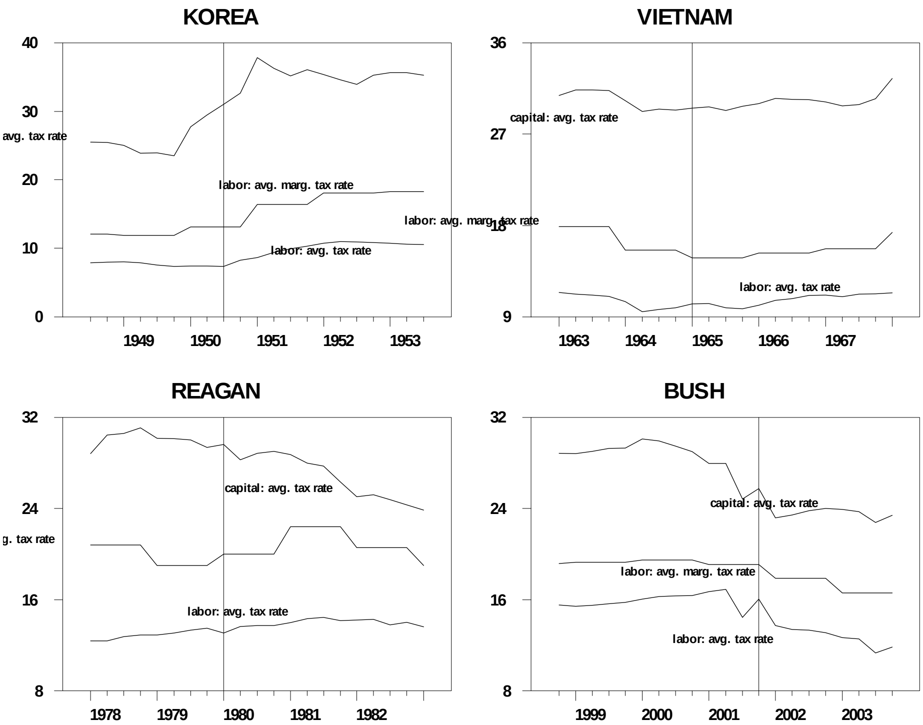

Figure 2: Tax rates around RS episodes

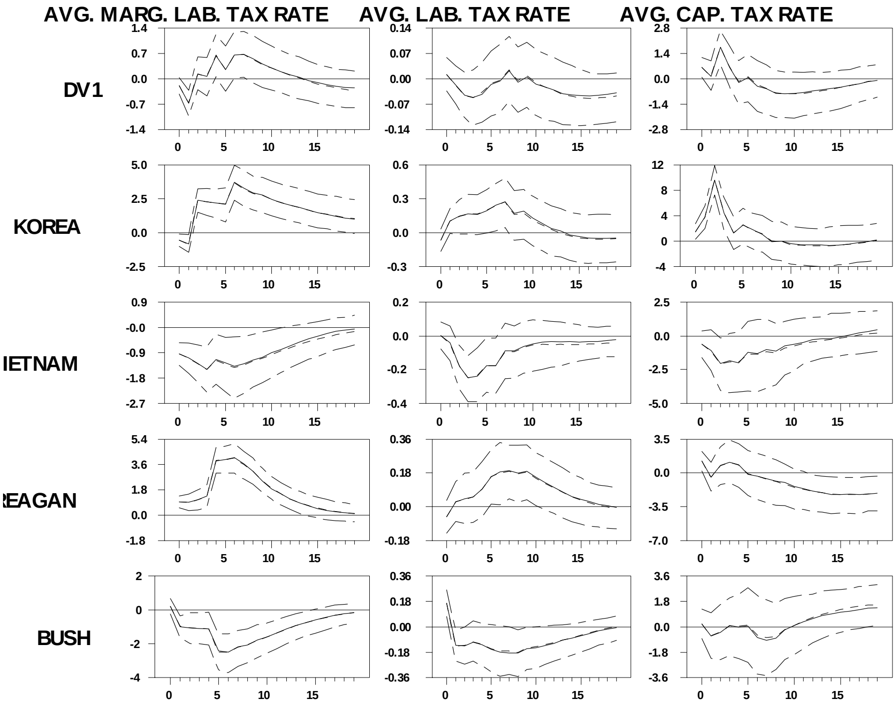

Figure 3: Responses of tax rates to shocks to RS dummies

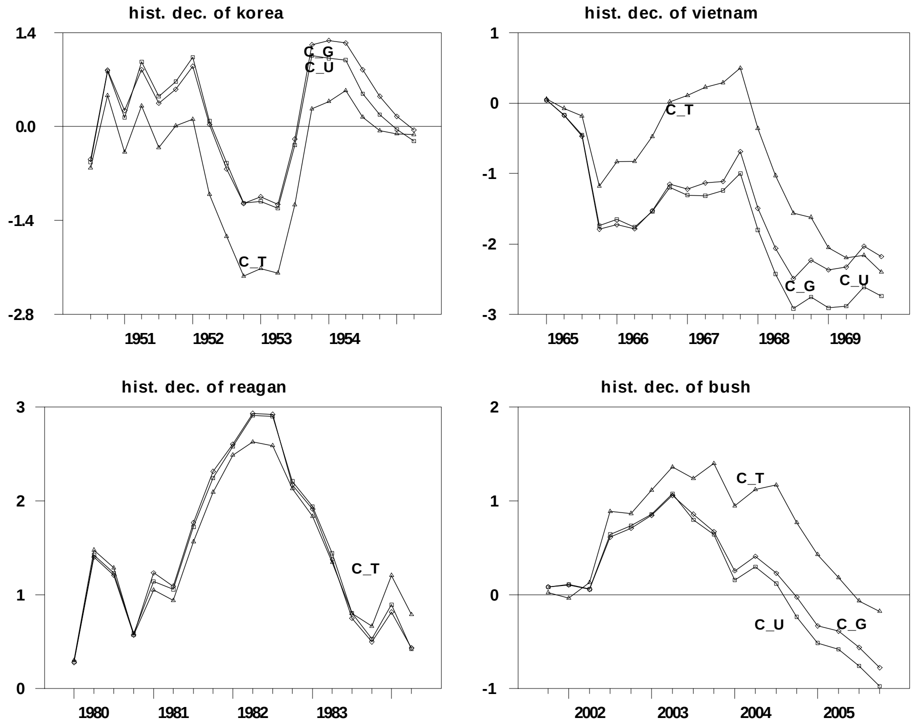

Figure 4: Historical decomposition of private consumption, RS episodes

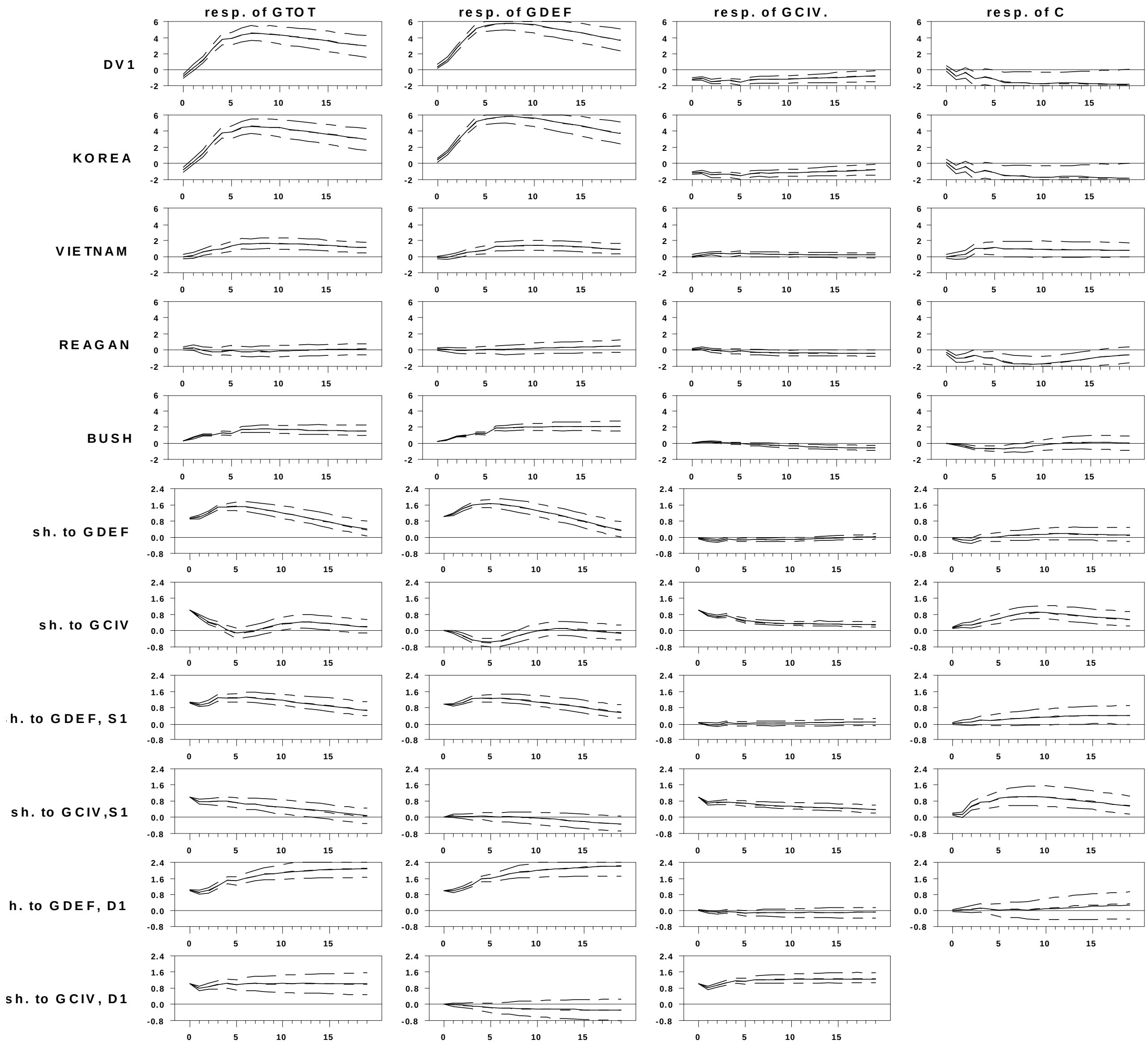

Figure 5: Responses to defense and civilian spending shock

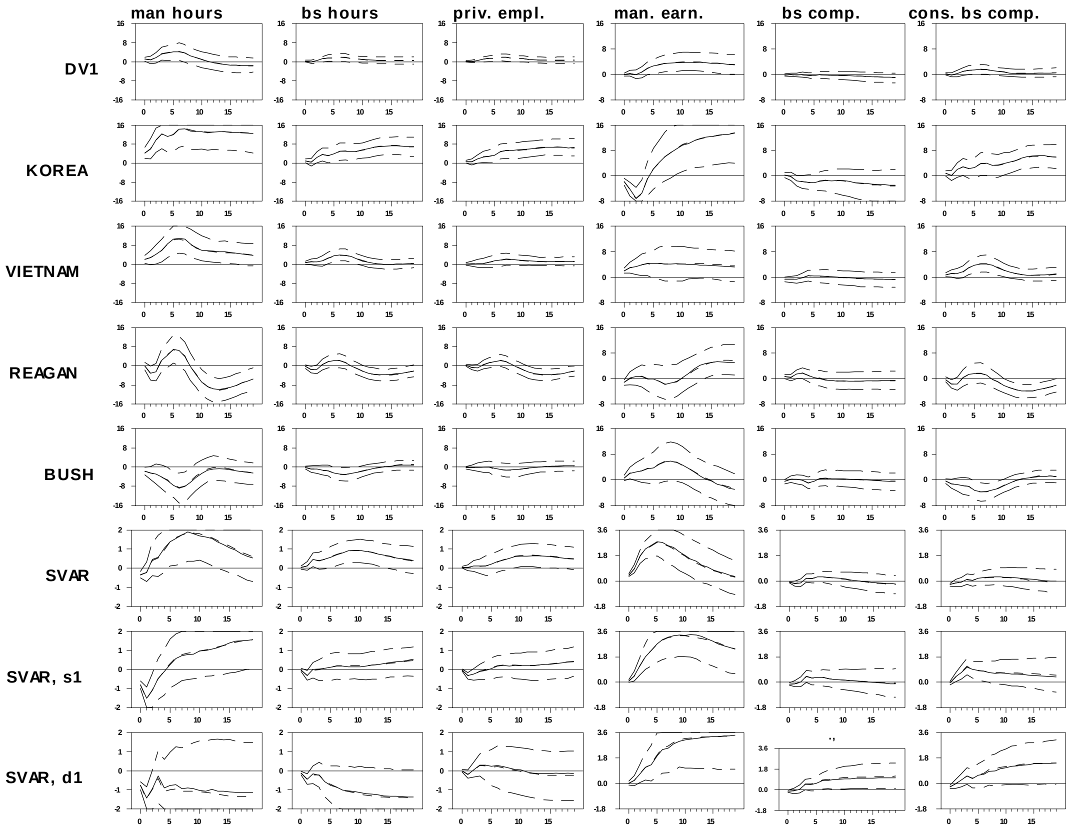

Figure 6: Responses of hours, employment and wages

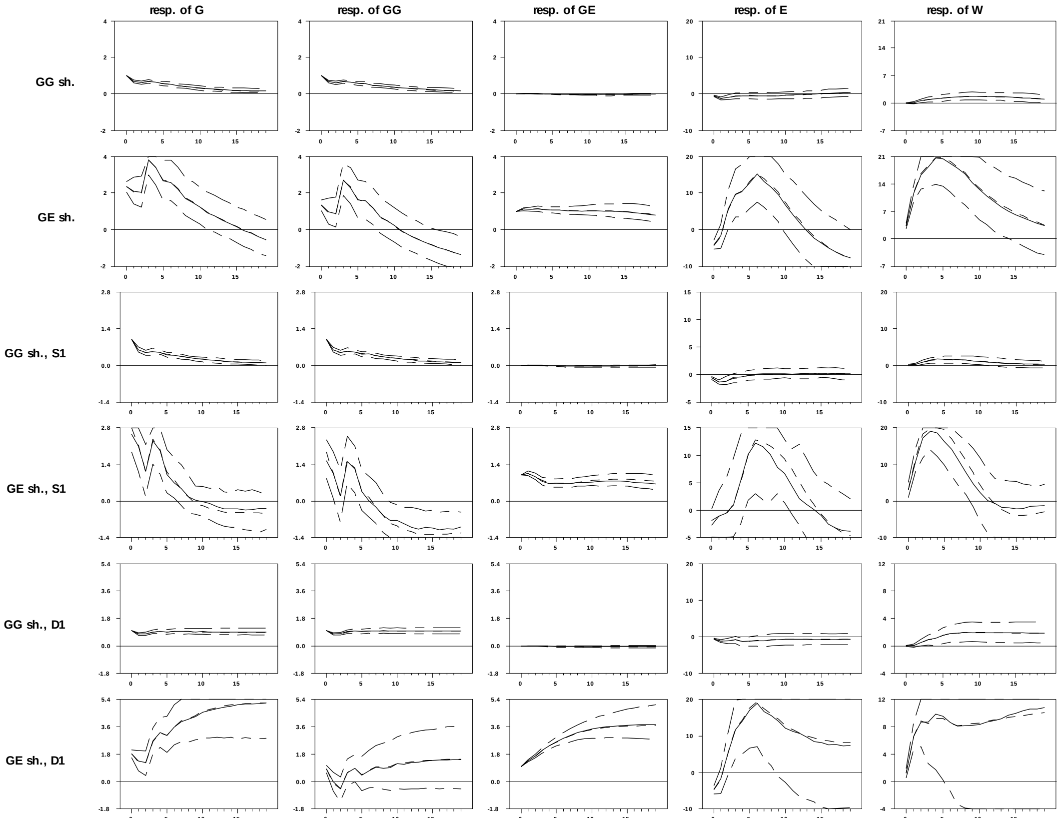

Figure 7: Government employment and non-wage spending