Volume Title: NBER Macroeconomics Annual 2007, Volume 22

Volume Author/Editor: Daron Acemoglu, Kenneth Rogoff and Michael Woodford, editors

Volume Publisher: University of Chicago Press

Volume ISBN: 978-0-226-00202-6

Volume URL: http://www.nber.org/books/acem07-1

Conference Date: March 30-31, 2007

Publication Date: June 2008

Chapter Title: In Search of the Transmission Mechanism of Fiscal Policy

Chapter Author: Roberto Perotti

Chapter URL: http://www.nber.org/chapters/c4084

Chapter pages in book: (p. 169 - 226)

3

In Search of the Transmission Mechanism of Fiscal Policy

Roberto Perotti, *IGIER—Università Bocconi, NBER, and CEPR*

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 probably agree that a large body of empirical research is consistent with this view, although the timing and size of the effect is subject to debate. In contrast, perfectly reasonable economists can and do disagree on the basic theoretical effects of fiscal policy and on the interpretation of the existing empirical evidence. For instance, neoclassical models predict that private consumption and the real wage should fall following a positive shock to government consumption: when government spending increases, the representative household is hit by a negative wealth effect due to the higher taxes it will have to pay, and consumption and leisure fall; the resulting outshift in labor supply causes a decline in the real wage, along a given labor demand.[1] Some models with neo-Keynesian features predict instead the opposite pattern of responses: government spending causes a shift in labor demand, for instance, because of countercyclical markups generated by nominal price rigidities or other reasons; the resulting increase in the real wage can induce higher consumption, via a substitution effect or because of the presence of credit constraints.

Also in contrast to the case of monetary policy, the existing empirical evidence can be interpreted as supporting either view, depending on the methodology used to identify the fiscal policy shocks. The dummy variable approach of Ramey and Shapiro (1998), extended to a full-fledged VAR by Edelberg, Eichenbaum, and Fisher (1999) and Burnside, Eichenbaum, and Fisher (2004), is an application of the event study methodology developed by Romer and Romer (1989) to study monetary policy. It typically finds that during episodes of large, exogenous increases in defense spending, output increases but private consumption and the real wage fall, providing support for the neoclassical model. The results from the structural vector autoregression (SVAR) approach of Fatás and Mihov (2004), Blanchard and Perotti (2002), and Perotti (2004) are typically of the opposite sign: following a government spending shock, private consumption and the real wage increase. This is consistent with some neo-Keynesian models.

This paper studies the robustness of these results and investigates their underlying methodologies. I first show that the evidence from the dummy variable approach is due to the imposition of two restrictions: first, all Ramey-Shapiro episodes have the same dynamics, up to a scale factor; second, in a version of this approach fiscal policy explains *all* the deviation from normal of *all* endogenous variables for several quarters after the start of these episodes. The second assumption runs contrary to the spirit of this approach, which is based on the notion that we can learn from these episodes because they are exogenous and big, not because they are different. Once these restrictions are removed, the results from this method are comparable to those of the SVAR approach: private consumption and the real wage increase in response to the fiscal shocks of the Ramey-Shapiro episodes, and there is little sign of the movement in opposite directions of consumption and GDP that is the hallmark of the neoclassical model. The existing differences between the four episodes can in part be explained by the different patterns of behavior of taxation and of defense versus civilian government spending in each episode: I then show that these differences are also consistent with the evidence from the SVAR approach. The latter, however, suffers from its own fundamental problem, namely the possibility that its estimated shocks are in reality anticipated by the private sector.

To overcome some of the problems of the two approaches, Ramey (2006) advocates the estimation of fiscal policy SVARs using long-run annual data. Over a sample extending back to 1889, the response of consumption to a government spending shock is again consistent with the neoclassical model, in contrast to the quarterly SVARs estimated over the post-war period. However, prior to the official Bureau of Economic Analysis (BEA) statistics, starting in 1929, several components of government spending were linearly interpolated over long intervals and had a number of other problems. When only the official BEA data from 1929 are used, the responses of consumption and of the real wage to a government spending shock again become positive and can be estimated with a good degree of precision.

Two-sector versions of the neoclassical and neo-Keynesian models also imply opposite responses of the real product wage in the sector hit by the bigger government spending shock. Hence, sectoral evidence around the Ramey-Shapiro episodes can shed light on the underlying mechanism. Using the U.S. input-output tables, I show 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. This is consistent with some neo-Keynesian two-sector models, but difficult to reconcile with neoclassical two-sector models.

I then replicate the SVAR analysis in three more countries—Australia, Canada, and the United Kingdom—for which both noninterpolated quarterly data and long-run annual data on fiscal policy exist. The results from both the quarterly and the annual SVARs are qualitatively consistent with the U.S. evidence, although in general the effects of fiscal policy shocks are smaller.

In this paper, I focus on the responses of consumption and the real wage. These variables are of independent interest to macroeconomists, but also, as we have seen, they respond very differently to government-spending shocks in different models; hence, they are useful to shed light on the underlying transmission mechanism of fiscal policy. I also present evidence on private investment, although here the predictions of alternative models are much less precise, and depend on a number of factors that are difficult to control for in a VAR. Because of space constraints, I leave a detailed analysis of the responses of the interest rate and of inflation to future work.[2]

I focus on shocks to current government spending on goods and services (government spending) because this is the largest part of nontransfer spending, and the mechanisms driving its effects in the different models are clearly identifiable. Government investment introduces an entirely different effect—the externality on private sector productivity in the long run—that is also largely common to all models.[3] I also do not study the effects of tax shocks: these are more difficult to identify in a SVAR,[4] and when taxation is distortionary, their theoretical effects depend crucially on the time profile of the tax response.[5]

This paper has several antecedents: some of the exercises that I perform here can be found in Blanchard and Perotti (2002), Fatás and Mihov (2001), Pappa (2005), and Ramey (2006). Of course, several other papers estimate impulse responses to fiscal shocks: these will be acknowledged.

The structure of the paper is as follows: section 2 presents the two empirical approaches introduced earlier. Section 3 briefly discusses the data and the specification of the models to be estimated. Section 4 presents the effects of fiscal shocks on GDP, private consumption, and investment in the two approaches. Section 5 discusses alternative explanations of the differences between the Ramey-Shapiro episodes, mainly the tax policies accompanying the government-spending shocks and the composition of government spending. Section 6 presents evidence from estimates that use long-run annual data. Section 7 discusses the responses of labor market variables, namely hours and the real wage in the business sector and in manufacturing. Section 8 discusses the evidence on labor market outcomes from input-output tables around the Vietnam War and the Reagan buildup. Section 9 presents SVAR evidence from Australia, Canada, and the United Kingdom. Section 10 discusses some recent models of fiscal policy and their key testable predictions. The last section concludes.

2 Two Approaches to the Identification of Fiscal Shocks

I now briefly describe the two approaches to identifying fiscal policy shocks that will be compared in this paper. A third approach (at least) has been used in the literature, based on sign restrictions, as in Mountford and Uhlig (2002) and Pappa (2005). For lack of space I do not discuss this methodology here; however, Pappa (2005) and Caldara and Kamps (2006) show that it delivers responses of private consumption that are close to those estimated in the SVAR approach that follows: in particular, private consumption typically rises after a government-spending shock.

2.1 *The Dummy Variable Approach*

How to disentangle the exogenous, unanticipated component of fiscal policy changes? The narrative or dummy variable approach tries to isolate the typical deviation from the normal path of the endogenous variables caused by a series of post-war abnormal fiscal events, namely military buildups driven by foreign policy. On the basis of contemporary accounts in the press, Ramey and Shapiro (1998) identified three episodes of expansionary defense spending that could reasonably be interpreted as exogenous and unforeseen: the Korean War, the Vietnam War, and the Carter-Reagan buildup; following Eichenbaum and Fisher (2004) and Ramey (2006), I add the Bush buildup that started at the end of 2001.

2.1.1 The DV1 Methodology Define the Ramey-Shapiro 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-Shapiro episodes, on 1950:3, 1965:1, 1980:1, and 2001:4, respectively. Define the combined Ramey-Shapiro dummy variable as $D_t = D_{1t} + D_{2t} + D_{3t} + D_{4t}$.

Let X_t be the vector of endogenous variables, whose first three elements are government spending g_t, taxes t_t, and output y_t. The first version of the dummy variable approach (DV1) was introduced in a univariate context by Ramey and Shapiro (1998) and applied in a multivariate context by Edelberg, Eichenbaum, and Fisher (1999). It consists of estimating the reduced-form VAR

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

where $A(L)$ is a polynomial of order n_A, $B(L)$ is a polynomial of order $n_B + 1$, and U_t is the vector of reduced-form residuals. The typical effect of these fiscal shocks can be found by tracing the dynamic effects of a unit shock to the dummy variable: that is, the response of the endogenous variables at $t + k$ is given by the estimated coefficient on L^k in the expansion of $[I - A(L)L]^{-1}B(L)$.

Outside these Ramey-Shapiro episodes, the dynamic response of the economy to a shock to government spending is governed by the polynomial $[I - A(L)L]^{-1}$; thus the response to a shock to the Ramey-Shapiro dummy variable represents the typical deviation of the economy from its normal behavior when a Ramey-Shapiro episode occurs. Because the dummy variable appears in all equations of the system, this methodology assumes that during a Ramey-Shapiro episode not only the fiscal variables deviate from normal, but also that the dynamic response of all variables to the fiscal variables can change.

2.1.2 The DV2 Methodology The DV1 approach imposes a strong restriction on the data: the shape and size of the responses of all variables to the shock are the same in each Ramey-Shapiro episode. A less stringent version of this approach (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 DV2 variant of the approach, 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 $\theta_1 = 1$ and θ_2, θ_3, θ_4 are scalars that measure the intensity of the last three Ramey-Shapiro episodes relative to the Korean War.

2.1.3 The DV3 Methodology The DV2 methodology still imposes the constraint that the shapes of the responses of a given variable must be the same in each episode. However, each episode might consist of different policies, like a tax cut in one episode and a tax increase in another. Table 3.1 lists all the quarters in the sample when the percentage change in government spending or the change in the Barro-Shasakul average marginal income tax rate on labor income exceeded two standard deviations.[6] It is clear that each episode had its own specific fiscal action. For instance, taxes increased repeatedly during the Korean War, in 1950, 1951, and 1952, while the Vietnam War was accompanied by tax cuts. Building on Fatás and Mihov (2001), who point out the differences between the individual Ramey-Shapiro episodes, in the DV3 variant I allow the responses to each Ramey-Shapiro episode to have a different intensity *and* shape:

Table 3.1
Large Changes in Fiscal Variables in the United States

Standard deviation of $\Delta g = 0.02$				Standard deviation of $\Delta t = 0.55$			
$\left\lvert \frac{\Delta g}{sd} \right\rvert \geq 3$		$2 < \left\lvert \frac{\Delta g}{sd} \right\rvert < 3$		$\left\lvert \frac{\Delta t}{sd} \right\rvert \geq 3$		$2 < \left\lvert \frac{\Delta t}{sd} \right\rvert < 3$	
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	0.11	52:2	0.04	52:1	1.7	70:1	−1.3
51:3	0.10	54:1	−0.05	54:1	−2.4	83:1	−1.6
		54:2	−0.04	64:1	−2.3	02:1	−1.2
		67:1	0.04	78:1	2.1	03:1	−1.3
				79:1	−1.8		
				81:1	2.4		
				82:1	−1.8		

Note: gt = log of government spending on goods and services, excluding nondefense capital spending. T = average marginal income tax rate on labor income.

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

where each $B_i(L)$ is an $n_B + 1$-order vector polynomial.

2.1.4 The Modified DV Methodology Quite apart from the possible loss of precision in estimation, the DV3 approach suffers from an extreme version of a problem already present in the DV1 and DV2 approaches: since each dummy appears separately in *all* equations, the residuals of each equation at the onset of each Ramey-Shapiro event and during the following n_B quarters are set to zero; In other words, the method assumes that the abnormal fiscal events are entirely responsible for *all* the deviation from normal of *all* variables for $n_B + 1$ quarters.

But the logic of the method is that we learn from the Ramey-Shapiro episodes because they are exogenous and big, thus highly informative on the working of fiscal policy, not because the economy behaves differently in some fundamental way.[7] Thus, a better interpretation of this logic consists in isolating the abnormal fiscal events and estimating the normal dynamic response of the nonfiscal endogenous variables to these events.

This interpretation can be formalized by including lags 0 to n_B of the dummy variables in the government spending and tax equations, and only lag 0 in the other equations. This can be done for the combined dummy variable (thus obtaining the modified DV1 and the modified DV2 methods) or for each Ramey-Shapiro variable (the modified DV3 approach). In these specifications, after the impact effect the behavior of the nonfiscal variables is explained by their *normal* dynamics in response to the deviations from normal of the fiscal variables.

2.2 *The SVAR Approach*

The SVAR approach starts from the reduced form specification:

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

where X_t is the vector of endogenous variables; for simplicity, in this section I assume that it consists of output y_t, government spending g_t, and taxes t_t. 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 government spending and taxes to innovations in output, inflation, and the interest rate. Second, the *systematic discretion-*

ary response of policymakers to innovations in the other endogenous variables; for instance, reductions in tax rates systematically implemented 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.[8] This is also the component one is interested in when estimating impulse responses to fiscal policy shocks.

Formally, and assuming for illustrative purposes the vector X_t includes only three variables, one can posit the following relation between reduced-form residuals and structural shocks:

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

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

where the coefficients α_{ty} and α_{gy} capture the first two components and e_t^g and e_t^t are the structural fiscal shocks, with $cov(e_t^g, e_t^t) = 0$. Clearly, e_t^g and e_t^t are correlated with the reduced-form residuals; hence, they cannot be obtained by an ordinary least squared (OLS) estimation of equations (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 second component, the *systematic discretionary response,* is absent in quarterly data. As a consequence, the coefficients α_{ty} and α_{gy} in equations (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 these elasticities (see section 3.3),[9] with these, one can then construct the cyclically adjusted fiscal shocks:

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

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

which are linear combinations of the two structural fiscal policy shocks. The estimate of e_t^t and e_t^g can be obtained by orthogonalization, that is, by assuming $\beta_{gt} = 0$ or $\beta_{tg} = 0$; since the correlation between $u_t^{t,CA}$ and $u_t^{g,CA}$ is always very low, the actual ordering does not matter; as a benchmark, I will use the first orthogonalization.

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: thus, 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. If there is another variable, like inflation, its residual is first subtracted from the g_t and t_t residuals—using an external elasticity—to obtain the cyclically adjusted fiscal shocks, as in equations (7) and (8); then the equivalent of the previous GDP equation for inflation can be estimated, adding u_t^y to the rhs and using e_t^g, e_t^t, and e_t^y as instruments.[10] Once the structural shocks are identified, the impulse responses are constructed using the average elasticities over the relevant sample periods.

2.3 *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. The first is an extreme case of the small sample problem: obviously the identifying assumption of the method is that the dummy variable should be uncorrelated with the residuals of each equation contemporaneously and up to n_B lags; but with such a small number of episodes (in the case of the DV3 method, just one for each polynomial $B_i[L]$), how does one know if the Ramey-Shapiro dummy captures the onset of the Korean War or, say, the delayed effect of the 1948 tax cut (according to the classification of Romer and Romer [2006], the largest in U.S. history), or other nonfiscal shocks?

A second question is again well illustrated by the Korean War dummy variable. Table 3.1 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: does the path of private consumption from 1950:3 on represent the dynamic response to an unanticipated, one-off wealth effect occurring in 1950:3, which takes into account the whole increase in government spending during the episode, or does it represent the result of many small-wealth shocks that occur each quarter after 1950:3?

More generally, one can interpret the deviation from normal behavior following the onset of an episode at time t_0 in two ways: it could describe the predictable typical deviations from normal after these abnormal events, or it could capture a sequence of new fiscal shocks after t_0. In the former case, the response of consumption at t_0 reflects the wealth effect caused by the entire subsequent path of government spending; in the latter, the response of consumption in each period would reflect the new fiscal shocks.

It will come as no surprise to anyone that the overall costs of wars are difficult to predict. It is instructive to see by how much. On April 22, 2003, one month after the start of Operation Iraqi Freedom, a Congressional Research Service Report for Congress contained a range of estimates of the war on Iraq and of the ensuing occupation. The price tag on a two-month war, plus the occupation for FY 2003, ranged from $54bn to $98.6bn. The cost of occupation per year was estimated at $45.6bn for 200,000 troops. The Center for Strategic and Budgetary Assessment (CSBA) estimated the total cost of a five-year occupation from $25bn to $105bn. Although the administration did not release estimates, the press reported an administration estimate of $20bn per year, for two years. Thus, in April 2003 the highest possible price tag for the years 2003 through 2006 that a (very) well-informed individual could have gathered from the debate was $98.6bn + $45.6bn × 3 = $235.4bn; and this assuming that there would still be a very substantial military presence in 2006—an event not many would have considered likely at the time. Using, for instance, the CSBA median estimate would have put the price tag at $98.6bn + $13bn × 3 = $138.7bn.

The most recent Congressional Research Service Report on the war, issued September 22, 2006, estimates cumulated appropriations through 2006, of which $287.6bn for Department of Defense (DoD) alone. In 2005, the average troop level in Iraq was 202,000, yet the DoD obligations were $70.9bn, against the $45.6bn predicted in 2003 for an occupation force of 200,000 troops. The Congressional Budget Office (CBO) now estimates that the cumulative cost of the global war on terror will be $634bn in 2010 and $808bn in 2016. It is hard to believe that the 2001:4 dummy captures anything remotely close to a wealth effect of $808bn.[11]

The key question of the SVAR approach concerns the predictability of its estimated shocks. While decision lags help identify the fiscal shocks, implementation lags could cause the latter to be anticipated by the private sector; the resulting impulse responses would be biased. This is a legitimate and important concern. Suppose that the data are generated by the neoclassical model with lump-sum taxation, but the government spending shocks estimated by the econometrician are in reality anticipated by the private sector by one period; as Ramey (2006) shows, the econometrician will find a positive response of consumption to her estimated government spending shock. The intuition is simple: in the neoclassical model, at the time the true temporary shock consumption falls on impact, to return back to the steady state slowly as capital accumulates; the econometrician would then just capture the increasing part of the consumption path, after the impact effect. The first panel of figure

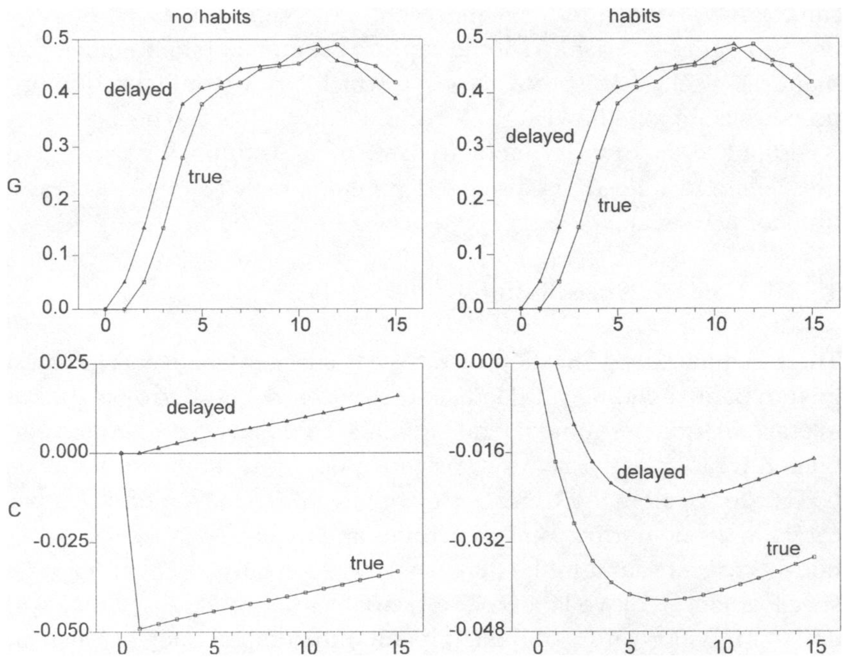

Figure 3.1
The Effects of Missing the Timing with and without Habit Formation

3.1, which replicates a figure in Ramey (2006), displays the true and estimated responses of consumption to a government spending shock that is announced one quarter in advance, in a simple model like Baxter and King (1993) with a Cobb-Douglas production function and utility of the form $U_t = \log(C_t) + \log(500 - H_t)$ where H is quarterly hours.

The same intuition suggests, however, that with habit persistence in consumption the model would still exhibit a negative consumption response. In the second panel, the utility function has been modified to $U_t = \log(C_t - \gamma C_{t-1}) + \log(500 - H_t)$ where $\gamma = .65$, as in Christiano, Eichenbaum, and Evans (2005). Now the estimated response still exhibits a decline in consumption. Of course, if the shock were anticipated by more than one quarter the estimated decline in consumption would be smaller.

Ultimately, how much the estimated SVAR fiscal shocks are anticipated and how much this matters is an empirical question. I will provide some clues in section 3.4.3, after presenting the evidence from the dummy variable (DV) and SVAR approaches. Note, however, that the same issue arises in the DV approach. Strictly speaking, the Ramey-Shapiro dummy variables should capture the moment the wealth effect manifests itself, that is, the quarter in which a future military buildup becomes common knowledge. Assuming such a date can be defined, it is certainly easy for the econometrician to miss its timing by one or two quarters; and indeed, as discussed previously, there might not be a unique such shock.

3 The Data and Specifications

The benchmark specification of the VAR consists of seven variables: government spending on goods and services g_t, the Barro-Sahasakul average marginal income tax rate t_t, real GDP y_t, private consumption on nondurables and services c_t, private gross fixed capital formation k_t (except for t_t, all in log of real, per capita values), the log of hours per capita in the nonfarm business sector e_t. and the log of the real product hourly compensation in the nonfarm business sector w_t. In alternative specifications, the two labor market variables are replaced by the GDP deflator inflation rate π_t and the three-month nominal interest rate i_t; in yet a different specification, t_t is represented by the log of real per capita net taxes.[12] I also experiment with a smaller, four-variable VAR that includes g_t, y_t, c_t, and k_t.

The average marginal income tax rate is the same variable used by Edelberg, Eichenbaum, and Fisher (1999) and Burnside, Eichenbaum, and Fisher (2004), and proxies for the distortionary effects of taxation; net taxes, used by Blanchard and Perotti (2002), capture the net flow of resources from the private sector to the government—an important variable in a model with credit constraints. The interest rate controls for monetary policy. The small VAR is meant to facilitate comparisons with historical SVARs with annual data, which, because of the smaller sample size, will be based on this specification. In general, all these alternative specifications generate nearly identical results, hence I will focus on the benchmark seven-variable specification.

An important recent debate has focused on the robustness of SVARs estimates of the effects of technology shocks, depending on the method used to induce stationarity. I will discuss all results from two alternative variants of the previous specifications, with a constant and a linear trend (LT specification), and with all variables in first differences (I1 specification).

Each equation includes four lags of the endogenous variables; the Ramey-Shapiro dummy variables are entered with lags 0 to 6.

All fiscal variables are defined at the level of the general government (in the United States this consists of the federal, state, and local governments, plus social security funds). Government spending on goods and services includes government consumption plus defense investment in machinery and equipment.[13] Private consumption includes nondurables and services and private investment does not include the change in inventories. The sample starts in 1947:1 and ends in 2003:4 (the binding constraint is the average marginal income tax rate, that at the time the paper was written could only be constructed up to 2003:4; the other variables were available up to 2006:2). Appendix A (available on the author's web site) describes the data in greater detail.

The elasticities of government revenues are constructed from the annual elasticities computed by Giorno, Richardson, Roseveare and Van den Noord (1995) and updated by Van den Noord (2002), based on the actual tax codes and the distribution of incomes across households; these have been adjusted to convert them into quarterly elasticities and to take into account possible collection lags.[14] Appendix B (available on the author's web site) describes the construction of the tax elasticities. Note that the Barro-Shasakul average marginal income tax rate is a policy variable; hence by assumption it does not respond to shocks to the nonfiscal endogenous variables within a given quarter; thus, in specifications that use this variable, government spending shocks are identified via a simple Choleski ordering.[15]

4 Output and Its Components

4.1 The DV Approach

Figure 3.2 begins with the DV1 and DV3 approaches on each column (results from the DV2 approach are nearly identical to those from the DV1 approach, and everything I will say about the DV1 approach also applies to the DV2 approach). It displays the responses of government spending, the average marginal income tax rate, GDP, private consumption, and private investment, from the benchmark seven-variable VAR. All equations contain a constant and a linear trend. All endogenous variables are entered with four lags; the Ramey-Shapiro dummy variables with lags 0 to 6. The first five rows display the responses in the

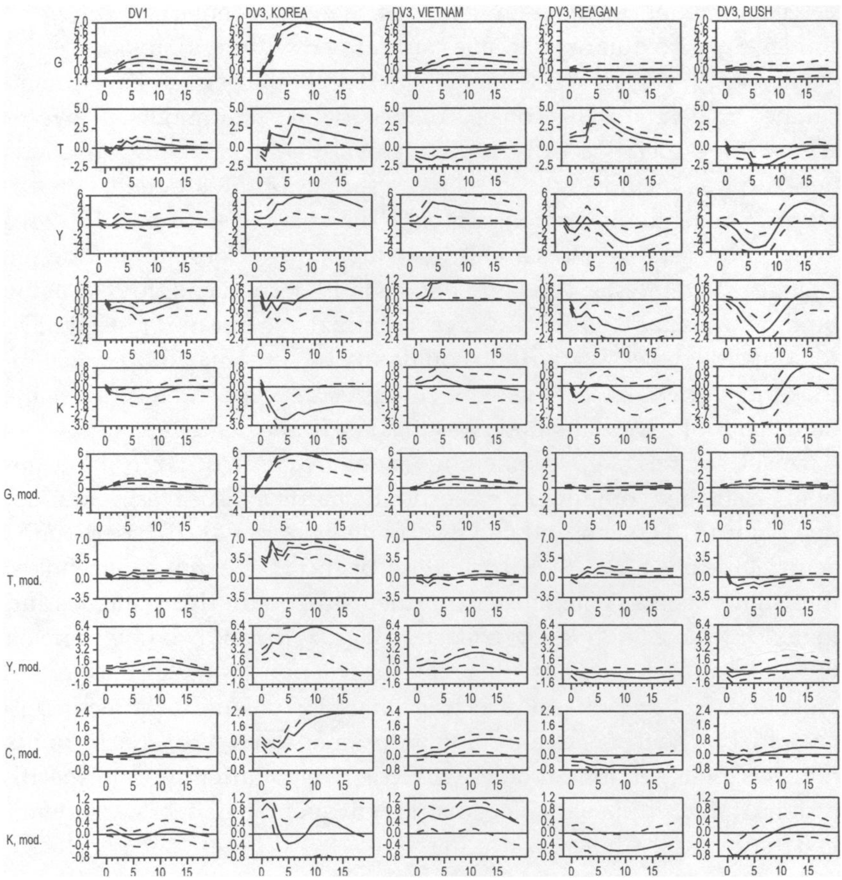

Figure 3.2
Responses to Ramey-Shapiro Dummy Variables

DV1 approach and in the individual episodes of the DV3 approach: the next five rows display the responses in the modified DV1 and DV3 approaches. Each panel displays the point estimate of the variable indicated on the row, with the 16th and 84th percentiles of the responses based on 500 Monte Carlo simulations (on bootstrapping in the modified DV approaches). The responses of government spending, consumption, and investment are expressed in percentage points of GDP by multiplying the log response by one hundred times the average share of each variable in GDP.

The Korean War is by far the largest episode in terms of government spending, with a peak increase after two years of almost 7 percent of

GDP above trend, followed by the Vietnam War, with a peak of 1.5 percent after the same interval. The other two episodes exhibit no increase in government spending (the military expansion was compensated by a reduction in civilian spending of the same size).

It is well known that, largely due to an ideological aversion of President Truman to budget deficits, the Korean War buildup was mostly financed with taxes: in fact, row 2 shows that the average marginal tax rate on labor increases by 3 percentage points above trend six quarters after the start of the episode. The tax rate increased also, with a lag, in the Reagan buildup,[16] while it fell in the Vietnam and Bush buildups.

Output increases in the DV1 approach and also in the Korean and Vietnam wars; it falls in the Reagan and Bush buildups. In the two quarters after the start of the Reagan buildup, quarterly GDP growth was –7.8 and –.7 percent, then recovered to 7.6 and 8.4 percent, then fell to negative values for another six quarters; this pattern is captured clearly by the GDP response in the DV3 approach, since the latter attributes all the residual of the GDP regression to the buildup. A similar story holds for the Bush buildup, which displays a large recession immediately after its onset despite a flat government spending response and a tax cut: the unmodified DV3 approach attributes all of it to the Ramey-Shapiro fiscal shock.

In the DV1 approach, consumption declines significantly, by almost 1 percent of GDP after six quarters. This result is similar to Edelberg, Eichenbaum, and Fisher (1999), who, however, find a more modest and insignificant decline. Thus, the DV1 approach shows rising output and declining consumption, the typical neoclassical pattern after a government spending shock. However, when one separates the four episodes in the DV3 approach, it becomes clear that, because of the constraints it imposes, the DV1 approach cannot capture the typical patterns of comovements between government spending and GDP on one hand, and consumption on the other, that occur in the individual episodes. Except for Korea, where consumption is flat, in the other episodes the response of consumption has the same sign and even the same shape as that of GDP. The DV1 approach captures mostly the large increases in government spending and GDP in the first two episodes, and the large decline in consumption in the last two. Similarly, in the DV1 approach private investment (row 5) falls; but among the individual episodes, it is only in Korea that investment moves in the opposite direction to GDP; in the others, it closely follows the GDP response. Estimation in first differences generates the same results (not shown).

The last five rows display the responses of the same variables in the modified DV1 and DV3 approaches. In contrast to the DV3 method in row 3, the modified method in row 8 does not attribute all the large post-Vietnam expansion to the Ramey-Shapiro episodes, but only the normal GDP response (taking into account possibly different patterns of the tax rate response in the various episodes). Note also that now the methodology does not attribute the recession of 1982 to the Bush fiscal episode; hence GDP rises above trend: one possible reason is the tax cut that accompanied this episode.[17] But GDP still falls in response to the Reagan episode: government spending is flat, but the tax rate increases.

Now consumption rises significantly above trend, even during the Korean War; thus, it increases in all episodes except the Reagan buildup, when GDP fell. Hence, in the modified approach the consumption response has the same sign as the GDP in the DV1 approach, and in all individual episodes.

Conditional on a Ramey-Shapiro shock, the response of investment also mostly reflects that of GDP in the modified DV approaches, too.

4.2 *The SVAR Approach*

Figure 3.3 displays impulse responses from the SVAR approach. The shock to government spending is normalized to 1 percentage point of GDP.

In the first column, each equation in the VAR includes a linear trend, and the sample starts in 1947:1. Both GDP and consumption exhibit a hump-shaped response, with peaks of about 1.2 and .4 percentage points of GDP, respectively, after about two years. Thus, the SVAR evidence on consumption appears consistent with the DV3 evidence: conditional on a government spending shock, the response of consumption largely mimics that of GDP.

Quantitatively, however, in this sample the SVAR approach delivers a small response of consumption. Not surprisingly, it turns out that this depends strongly on the role of the Korean War. When the sample omits the fiscally turbulent late 1940s and early 1950s and starts in 1954:1 (column 2), the positive response of consumption rises to a peak of about .9 percent of GDP after three years.[18] This is consistent with the evidence from the DV approach, since the sample now omits the Korean War with its large increases in government spending and in the tax rate. In fact, the tax rate rises in the long sample, and it is flat in the shorter sample.

In the I1 specification, the results are similar: a small positive response

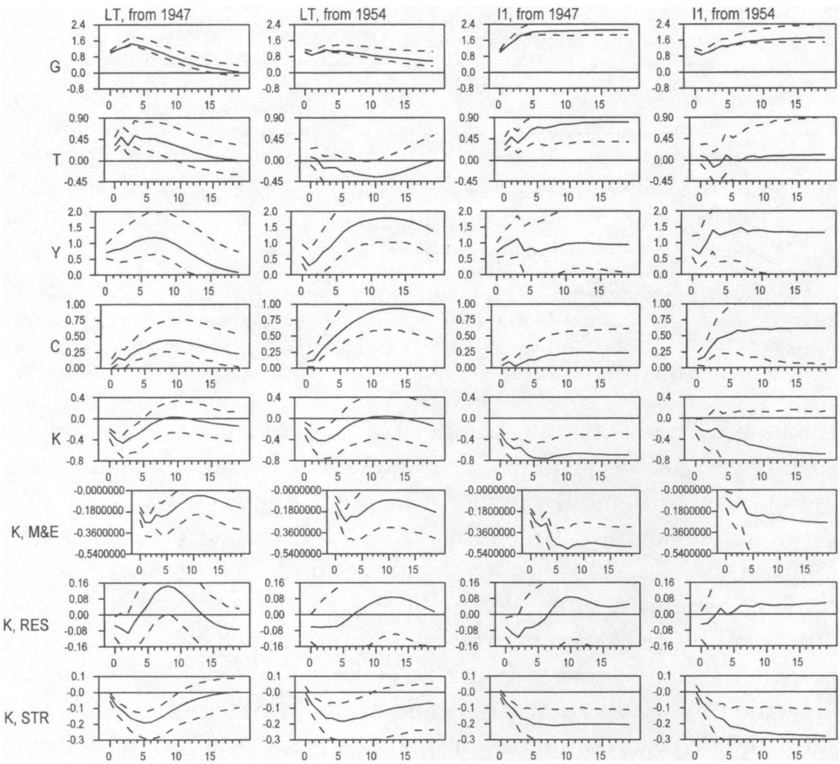

Figure 3.3
SVAR Responses to Government Spending Shocks

of GDP and private consumption in the longer sample, and a larger and significant response in the shorter sample; the peak effects, however, are smaller than in the LT specification.

Investment falls, typically by between .4 and .8 percentage points of GDP. This is due in almost equal parts to machinery and equipment and to residential investment; investment in structures is flat.[19] All these results extend to the I1 specification.

4.3 *Predictability of the SVAR Fiscal Shocks*

Are the SVAR government spending shocks predictable?

Following Ramey (2006), a first obvious candidate as a predictor is the Ramey-Shapiro dummy variable itself. The first row of table 3.2 shows that, like in Ramey (2006), over the full sample starting in 1947:1 the

Table 3.2
Forecastability of R-S Dummy and SVAR Shocks

		Full sample	Short sample
1	OLS: SVAR g shock on 4 lags of the R-S combined dummy	0.03	0.85
2	OLS: SVAR g shock on 4 lags of each R-S dummy	0.00	0.52
3	OLS: Ramey-Shapiro dummy on 4 lags of g, t, and y shock	0.02	0.01
4	Probit: Ramey-Shapiro dummy on 4 lags of g, t, and y shock	0.58	

Notes: In rows 1 to 3, the last two columns display the p-value of a test of the exclusion of all regressors in the equation. In row 4, the second-to-last column indicates the probability of 1950:3. Full sample = 1947:1–2003:4: Short sample = 1954:1–2003:4.

combined Ramey-Shapiro dummy Granger causes the government spending SVAR shock; the next row shows that the individual dummies are even more (jointly) significant in predicting the SVAR spending shock. However, row 3 shows that in a OLS regression, the lagged government spending, tax, and GDP shocks also predict the Ramey-Shapiro combined dummy, with a p-value of 2 percent.[20] As Leeper (1997) argues, a probit regression may be more appropriate than a linear one to predict a dummy variable; in this case, the lagged SVAR shocks are no longer jointly significant in predicting the Ramey-Shapiro dummy (not shown); however, the regression predicts the Korean event of 1950:3 with a probability of 58 percent (row 4).

A further examination of the OLS prediction equations for the government spending shock in rows 1 and 2 also reveals that the predictive power of the Ramey-Shapiro dummy comes mostly from the Korean War (by far the largest of all the episodes): the last column of table 3.2 shows that over the shorter sample, starting in 1954:1, the four lags of the Ramey-Shapiro dummy (or dummies) do not help predict the SVAR shocks. However, the SVAR shocks still predict the Ramey-Shapiro dummy, with a p-value of .01.

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, 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 five years thereafter, relative to the previous forecasts.[21] 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 3.3
Forecastability of SVAR Shocks Using CBO Revisions

	OLS regression of SVAR g shock on CBO forecasts	Full sample	Short sample
1	SVAR shock on lagged CBO forecast revisions	0.62	.21
2	SVAR shock on contemporary CBO forecast revisions	0.15	.05

Notes: The last two columns display the p-value of a test of the exclusion of the regressor in the equation. Full sample = 1947:1–2003:4: Short sample = 1954:1–2003:4. The fiscal shocks are obtained from quarterly VARs estimated over these two samples. The p-values are obtained from a regression of these fiscal shocks on the CBO forecast, over the sample starting in the first semester of 1984:1.

In row 1 of table 3.3 I take the average of the SVAR government spending shock (estimated over the 1954:1–2003:4 sample, and expressed as share of GDP by multiplication by the average spending/GDP ratio) in the first and second quarters and in the third and fourth quarters of year t, and regress this half-yearly variable on the sum of the legislative and technical CBO forecast revisions (normalized by potential output) for year t, made in the previous semester. In both samples, the coefficient of the CBO forecast is insignificant.[22]

Thus, there is little evidence that the SVAR shocks are predictable—but do they make sense? When the half-yearly SVAR government spending shock is regressed not on the lagged value, but on the contemporaneous value of the sum of the CBO legislative and technical forecast revisions, the p-value is .15 in the long sample and .05 in the short sample (row 2 of table 3.3). Thus, the data suggest that the SVAR government spending shocks estimated over the shorter sample are contemporaneously correlated with the information contained in the CBO forecasts.

5 Explaining the Difference in the Ramey-Shapiro Episodes

Besides the change in total government spending , fiscal policies during the four Ramey-Shapiro episodes differed markedly both in terms of the accompanying tax policies and in terms of the composition of government spending. The DV3 approach, in both its unmodified and modified versions, already provided some evidence for the role of the tax response in shaping the GDP and consumption responses. Further evidence can be provided by historical decompositions.

5.1 *The Role of Taxes*

Figures 3.4 and 3.5 display historical decompositions of consumption in the four episodes.[23] For each episode, two series are displayed. First, the deviation from the actual consumption path of the consumption forecast, based on information up to the start of the episode plus the sequence of government spending shocks during the five years of the forecast horizon ("g_shocks"). This variable describes what the deviation from the actual consumption would have been if only the SVAR government spending shocks had occurred after the beginning of each episode. Second, the deviation of the consumption forecast from the actual consumption path, based on the sequence of net tax shocks only ("t_shocks"), constructed in a similar manner. Both series are expressed as shares of GDP by multiplying the log response by the average consumption/GDP ratio.

The first panel is based on the VAR estimated over the long sample, starting in 1947:1. Except in the Reagan buildup, government spending shocks make a positive contribution to consumption, and were only slightly larger in the Korean War than in the Vietnam War or the Bush

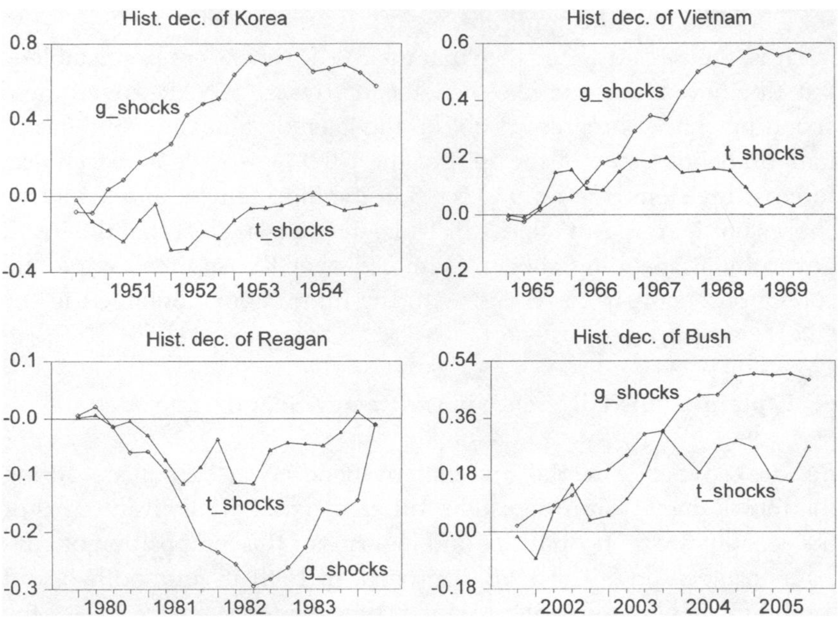

Figure 3.4
Historical decomposition of Consumption, 1947:1–2005:4

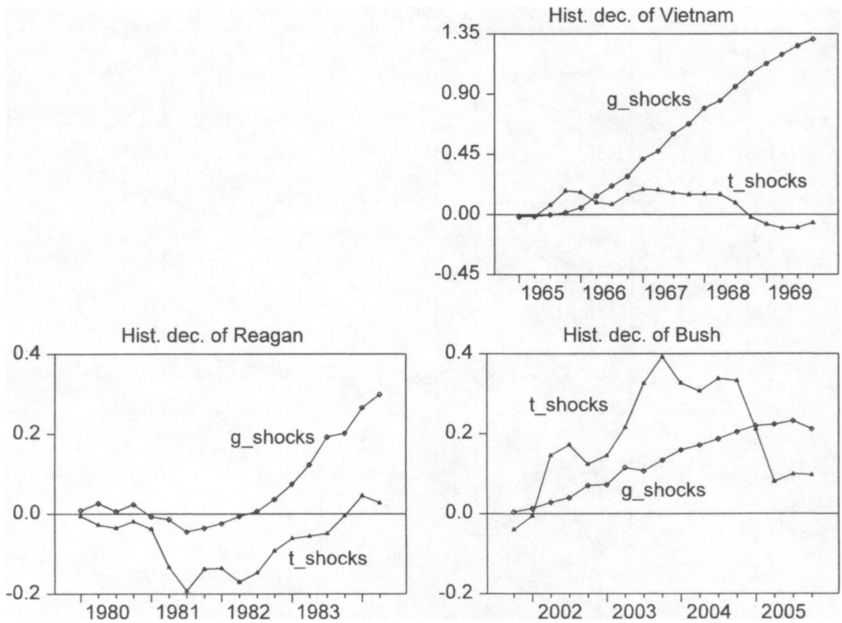

Figure 3.5
Historical Decomposition of Consumption, 1954:1–2005:4

buildup. Tax shocks make a negative contribution in the Korean War and the Reagan buildup, when taxes increased, and a positive contribution in the Vietnam and Bush buildups, when taxes fell. The contribution of tax shocks is generally smaller than that of government spending shocks.

The second panel is based on the shorter sample. The estimated contribution of government spending shocks in the Vietnam War increases considerably, to about 1.5 percent of GDP. In fact, the contribution of government spending by itself accounts for all the deviation of consumption from trend estimated by the DV3 approach during this episode.

5.2 *The Composition of Government Spending*

The composition of the government spending changes in the four episodes was also different. Figure 3.6 displays impulse responses to the Ramey-Shapiro dummy variables, from the benchmark VAR, where government spending has been split into its defense and nondefense

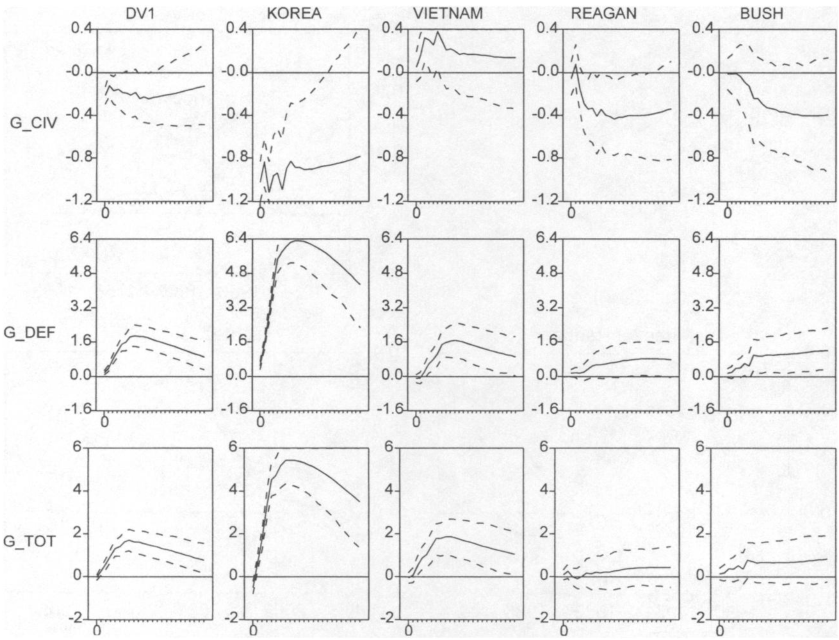

Figure 3.6
Response of Civilian and Defense Spending to Ramey-Shapiro Dummy Variables

components. The first row displays the response of civilian spending, the second displays defense spending, and the third displays their sum, total government spending. In all episodes, defense spending increases, and, except in Vietnam, civilian spending falls; and in the Reagan and Bush buildups, the change in civilian spending is almost the same size (in absolute value) as the change in defense spending, explaining the limited change in total government spending.

In a SVAR, one must distinguish between shocks to defense and to civilian government spending. Columns 1 and 2 of figure 3.7 display responses to a civilian and defense spending shock, respectively, from the same eight-variable VAR with civilian and defense spending instead of total government spending. In both columns the initial shock is renormalized so that total government spending increases by 1 percent of GDP. To derive the responses, civilian spending is ordered before defense spending, but the opposite ordering produces nearly identical results.

The response of total government spending to a civilian shock is much more intensive in civilian expenditure, but it is also much less persistent; however, the positive response of consumption to a civilian spending

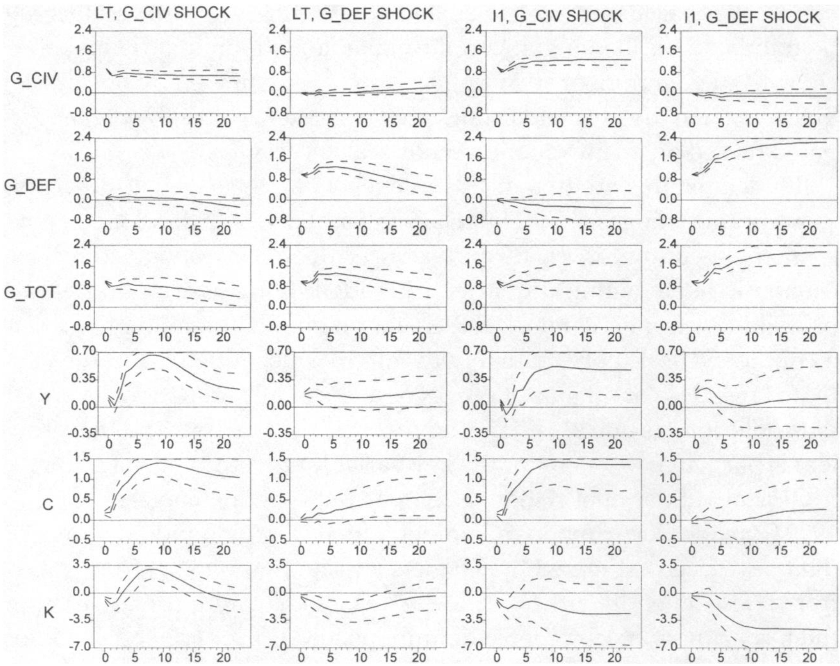

Figure 3.7
Responses to Civilian and Defense Spending Shocks, SVAR

shock is much larger—more than 1 percent of GDP after two years, against .5 percentage points after a defense shock. The same considerations also hold in the I1 specification (columns 3 and 4); in fact, now the difference in the persistence of total government spending after the two shocks is larger, yet so is the difference in the response of consumption.

In response to a defense spending shock, investment (row 6) always falls, while in response to a civilian shock it rises in the LT specification, and it is basically flat in the I1 specification.

Thus, the evidence from the SVAR approach is that civilian government spending shocks appear to be associated with stronger responses of GDP and its components, and that this played a role in explaining the differences between Ramey-Shapiro episodes.

6 Evidence from Long-Run Annual Data

To overcome the problems of both the DV and the SVAR approaches, Ramey (2006) advocates estimating an SVAR with annual data. The DV approach is based on very few episodes with different features; this can be mitigated by the longer sample available with annual data. And if changes in government spending are mostly anticipated by one or two quarters, then the estimated shocks have a better chance to be unanticipated (based on an information set of yearly variables).

But against this are two disadvantages. First, the SVAR approach to identification hinges on decision lags in fiscal policy: by and large, government spending on goods and services does not respond to macroeconomic news within a quarter. This identifying assumption is less plausible with annual data, but then, if government spending is used as a countercyclical tool, it is likely to impart a negative bias to the estimated response of consumption. Second, the quality of national account data deteriorates quickly as one moves backward in time, and this problem is particularly severe for the key variable, government spending.

Official U.S. annual national account data are available starting in 1929 from the Department of Commerce; between 1889 and 1929, annual data have been estimated by Kuznets and revised by Kendrick. Aside from a few amendments to make Kuznets' series more consistent with the Department of Commerce definitions, used from 1929 onward, for the purposes of this paper a major contribution of Kendrick's work consists in adding an estimate of government spending on goods and services. However, one should be aware of a few problems with this series. For instance, between 1890 and 1902, state and local purchases, other than compensation of public school employees and new construction, are interpolated by a straight line; and straight-line interpolation (albeit at shorter intervals) is frequent for several other items. Also, as Kendrick acknowledges, the estimates of the government spending deflators are often speculative.[24]

With this in mind, figure 3.8 displays responses from a small, five-variable VAR that includes government spending, GDP in the business sector,[25] total private consumption,[26] full-time-equivalent employment in the business sector, and wage and salary accruals per full-time equivalent employee in the business sector. This last variable starts in 1929, the others in 1889; hence, when estimated over the longer sample, the system consists of the first four variables only (also, employment is not in full-time equivalent terms in this case). As usual, the system is estimated in levels with a constant and a time trend, or in first differences with a constant.

This specification is similar to that of Ramey (2006) and, like there, the response of consumption initially drops slightly but significantly, by a

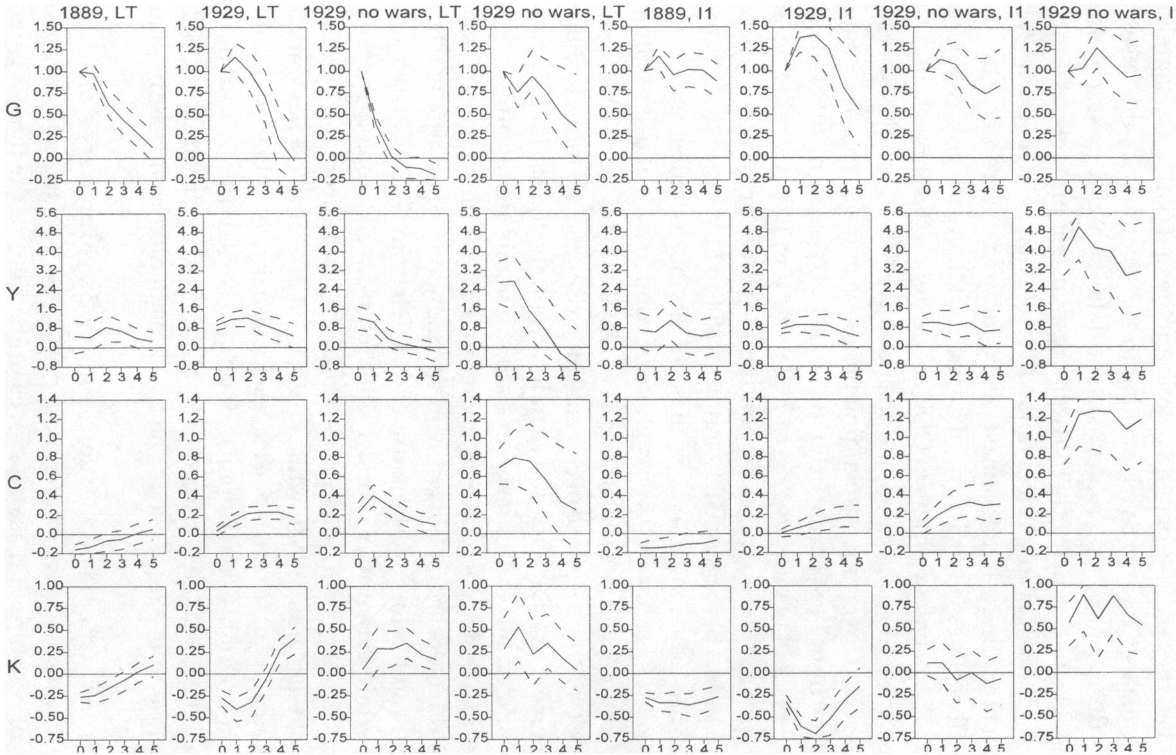

Figure 3.8
Responses to Government Spending Shocks, Annual Historical Data, SVAR

similar amount to Ramey (2006), less than .2 percentage points of GDP. If one excludes the years 1941–1947 (not shown), the initial drop remains, but then consumption rises slightly (but significantly) above trend.

However, these results depend heavily on the first part of the sample. If one estimates the same SVAR starting in 1929 (column 2), thus using only the BEA data based on a consistent definition and no interpolations, just like in the quarterly SVAR the response of private consumption of nondurables and services follows closely that of GDP (except for the initial jump in the latter, caused by the jump in government spending): it still declines very slightly on impact, but then increases to a peak of about .25 percentage points of GDP above trend after three years.

In this type of investigation, the treatment of WWII and the Korean War is crucial. Government spending on goods and services as a share of GDP rose from 14.8 percent of GDP in 1940 to 47.9 percent in 1944, and from 15.9 percent of GDP in 1950 to 23.9 percent in 1953; over the same periods, private consumption of nondurables and services decreased from 62.6 to 46.4 percent of GDP, and from 55 to 52.8 percent of GDP, respectively. As usual in these cases, it is not obvious whether one wants to treat wars as outliers or as episodes that contain a lot of useful information; column 3 shows that, if one does leave out the years 1941–1945 and 1950–1953, the response of consumption rises considerably, to more than .4 percent of GDP after one year: Interestingly, the standard errors are still quite small, and all responses are still highly significant.

However, what is perhaps even more unusual about wars is the dramatic, sudden decline in government spending once they are over: between 1944 and 1946, government spending fell from 47.9 to 17.8 percent of GDP, while between 1953 and 1955 it fell from 23.9 to 20.8 percent; consumption of nondurables and services increased from 46.4 to 57.8 percent of GDP after WWII, while it remained at around 53 percent after the Korean War. In fact, if one leaves out also the years 1946–1947 and 1954–1955 (column 4), the response of private consumption about doubles, reaching a peak of .8 percentage points of GDP after one year: this is very close to the response of the SVAR estimated in quarterly data from 1954:1.

The results in the I1 specification (columns 5 to 8) are very similar: in particular, one observes the same progression toward stronger responses of consumption as one moves to the right of the figure. Thus, once reliable data are used, the historical SVAR evidence on consumption with annual data delivers results that are very similar to those of the quarterly SVARs and to the DV3 approach.

Investment, too, displays stronger responses as one moves to the right. In the entire sample starting in 1889 the response is negative, and remains so for the first three years if the sample starts in 1929. When the war and postwar periods are excluded, it becomes positive and significant. This is different from the quarterly SVAR, where investment tends to fall after a government spending shock. Thus, the behavior of investment is more difficult to pin down than the response of consumption, and is less consistent with the quarterly evidence.

7 The Labor Market

7.1 The Response of Hours and the Real Product Wage

With lump-sum taxation, virtually all models predict a positive effect of shocks to government spending on private and total hours. However, while the neoclassical model predicts a decline in the real wage, some neo-Keynesian models with price stickiness (like Galí, López-Salido, and Vallés (2007) or Linnemann and Schabert (2003)[27] or other reasons for countercyclical markups (like Rotemberg and Woodford (1992) or Ravn, Schmitt-Grohé, and Uribe (2006) predict the opposite.

It is important to be clear on the definition of the real wage. Obviously, in a one-sector model there is no distinction between the real consumption wage and the real product wage. But the logics of the different predictions of the neoclassical and neo-Keynesian models also survive with more than one sector. In a neoclassical model with frictions in reallocating capital between sectors, like Ramey and Shapiro (1998), the sector that experiences the larger increase in government demand also displays the larger fall in the product wage, as employment shifts from one sector to the other along the sectoral labor demand curves. In contrast, in a two-sector neo-Keynesian model with nominal price rigidities and some costs of labor reallocation across sectors, like Monacelli and Perotti (2007), the sector that receives the larger share of the government spending shock also exhibits the larger increase in the real product wage, as the markup falls more in that sector. Thus, sectoral evidence can shed light on the underlying transmission mechanism for fiscal policy.

Manufacturing plausibly receives a disproportionate share of the shocks to government spending on goods, hence the importance of this sector in testing alternative transmission mechanisms. On the other hand, a rise in the real consumption wage is the precondition for private consumption to increase in neo-Keynesian models (see section 10), hence the importance of checking the response of this variable, too.

Figure 3.9 presents responses of hours and various definitions of the real wage from the benchmark seven-variable specification, which includes government spending, the average marginal income tax rate, GDP, consumption, and investment, plus an employment/hour variable and a wage variable. In the literature on the effects of technological shocks, several different employment and real wage variables have been used; as Chari, Kehoe, and McGrattan (2005) note, the results are somewhat sensitive to the variable used. I use non-farm business sector hours per capita and average weekly compensation (deflated by the value-added deflator in the non-farm business sector), or manufacturing hours per capita and hourly earnings (deflated by the manufacturing producer price index [PPI]). I also experiment with private and total employment per capita, but these behave very much like business sector employment, hence I will not report their responses. For brevity, I

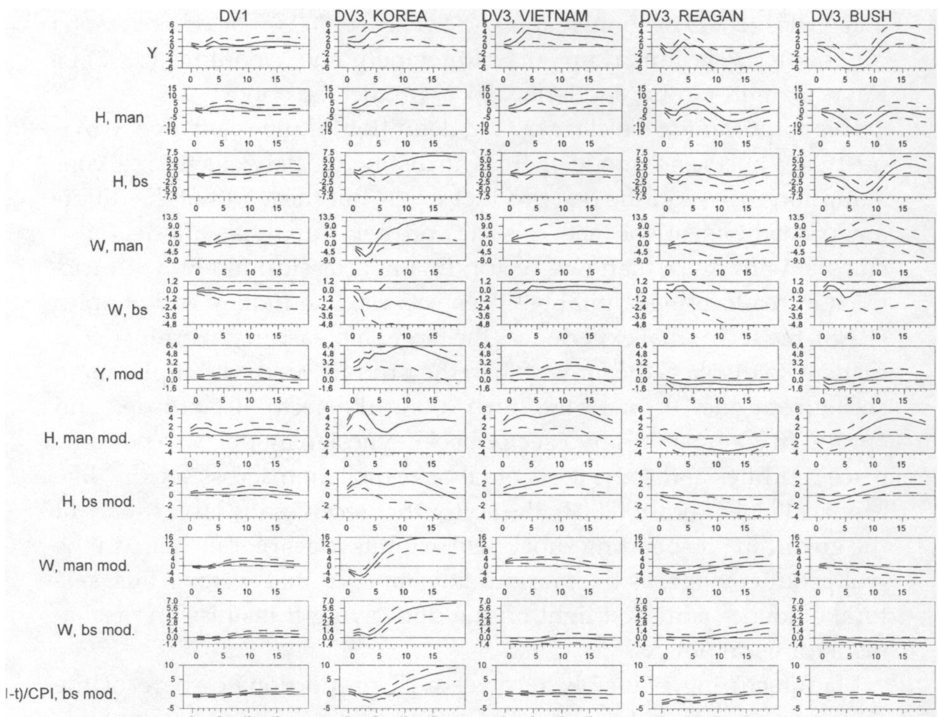

Figure 3.9
Responses of Labor Market Variables to Ramey-Shapiro Dummy Variables

will refer to both business sector compensation and manufacturing earnings as "real product wage," or "real wage." The first four rows display the DV1 and DV3 approaches, the next four rows their modified versions.

In the DV1 case, and in each of the four episodes separately, the responses of hours follow closely that of GDP. Only in the Korean and Vietnam wars do hours increase, and they do so in manufacturing more than in the business sector. The real wage in manufacturing falls in the Korean episode and increases in the Vietnam War. As in hours, it is flat in the Reagan buildup and increases in the Bush buildup, despite the decline in manufacturing hours. In the business sector, the real wage does not significantly move.

The picture is similar in the modified DV approaches, except that now manufacturing hours, like GDP, decline in the Reagan buildup and increase (with a delay) in the Bush buildup. The manufacturing real wage also declines in the former episode but increases with a lag in the latter. Thus, in the modified approach, the manufacturing real wage moves in the same direction as hours. The responses of business sector hours are similar; so are those of the business sector real wage, except in the Vietnam episode.

The last row displays the real after-tax consumption wage in the business sector.[28] For neo-Keynesian models it is the real consumption wage that is of particular interest, since only if it increases can private consumption also increase. The last row shows that there is a close correspondence between the response of this variable and that of consumption. The real after-tax consumption wage is flat initially during the Korean War, due to the increase in taxation, then picks up; it increases during the Vietnam War, even if the pre-tax product wage falls; it falls during the Reagan episode, and it is nearly flat during the Bush buildup due to the decline in taxation.

Figure 3.10 displays SVAR responses to a government spending shock. In the LT specification, hours rise in both sectors, and more in the shorter sample starting in 1954, although in the case of manufacturing, only after a sharp but brief decline. The real wage increases in both sectors, and much more in manufacturing (a peak of between 3 and 4 percent after about two years). In the I1 specification, hours are flat, but the real wage still increases in both sectors. These findings are consistent with those of Fatas and Milhov (2001), who identify government spending shocks via a Choleski decomposition , and of Pappa (2005), who uses a sign-restriction approach.[29]

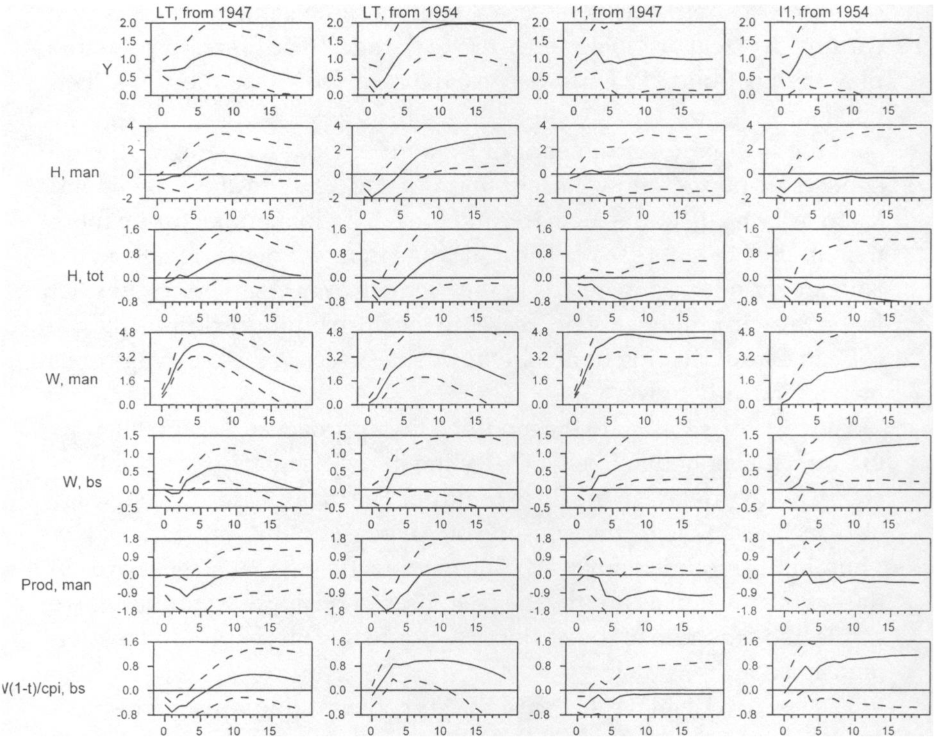

Figure 3.10
Responses of Labor Market Variables, SVAR

In the LT specification hourly labor productivity in manufacturing is flat in the long sample and declines in the long run in the short sample (this is derived from a VAR that includes real manufacturing value added besides the other seven variables). The increase in the manufacturing real wage, combined with a fall in productivity, seems inconsistent with the benchmark neoclassical model with perfectly competitive goods and labor markets. It is consistent with some neo-Keynesian models with price stickiness or other reasons for countercyclical markups (although in general not with models with wage rigidity), where the fall in the markup allows the real product wage to rise despite the decline in productivity. Note, however, that manufacturing productivity increases briefly initially in the short sample in the I1 specification.

The last row of the figure shows that the after-tax real consumption wage in the business sector behaves very much like the pre-tax product wage; it only displays an initial decline, by almost 1 percent, in the longer sample; this is consistent with the positive response of the tax rate (in turn influenced by the Korean War) documented in figure 3.3.

7.2 Government Employment Shocks and the Labor Market

All of the discussion so far has implicitly assumed that government spending on goods and services falls entirely on goods produced by the private sector; in reality, typically about half of it consists of government wages, that is, of services produced by the government sector itself. As Finn (1998) and Cavallo (2005)emphasize, in the neoclassical model the distinction between government employment and spending on goods has important implications. Both types of spending have a negative wealth effect on the consumer, but for plausible parameter values a government employment shock *raises* the real private product wage and *reduces* private employment: the reason is that the higher labor supply caused by the negative wealth effect is less than the increase in government employment. Hence, private employment falls, and the real product wage in the private sector increases. As shown in Pappa (2005), a government employment shock has similar effects on private employment and the real product wage in the private sector in a neo-Keynesian model with price stickiness.

I estimate the same benchmark VARs as previously described, but now government spending is split into its two components: real spending on goods and real spending on government employment. As a measure of the latter I take the log of total government employment, divided by population.[30] Figure 3.11 shows that the Ramey-Shapiro episodes were overwhelmingly on goods expenditure (in fact, government wage expenditure declined in the Reagan and Bush episodes).

In an SVAR, distinguishing the two spending components allows one to construct two government spending shocks that turn out to have very different properties. Column 1 of figure 3.12 displays the responses to a government employment shock of government spending on wages, goods spending, and their sum total government spending, then of GDP, consumption, and hours and the real wage in the business sector and manufacturing; column 2 displays the responses of the same variables, but to a goods spending shock. In all cases, the shocks are normalized so that the impact response of total government spending is equal to 1 percent of GDP. In the figure, the government employment and goods spending shocks are orthogonalized in this order; the results with the alternative ordering are nearly identical. The sample starts in 1954:1.

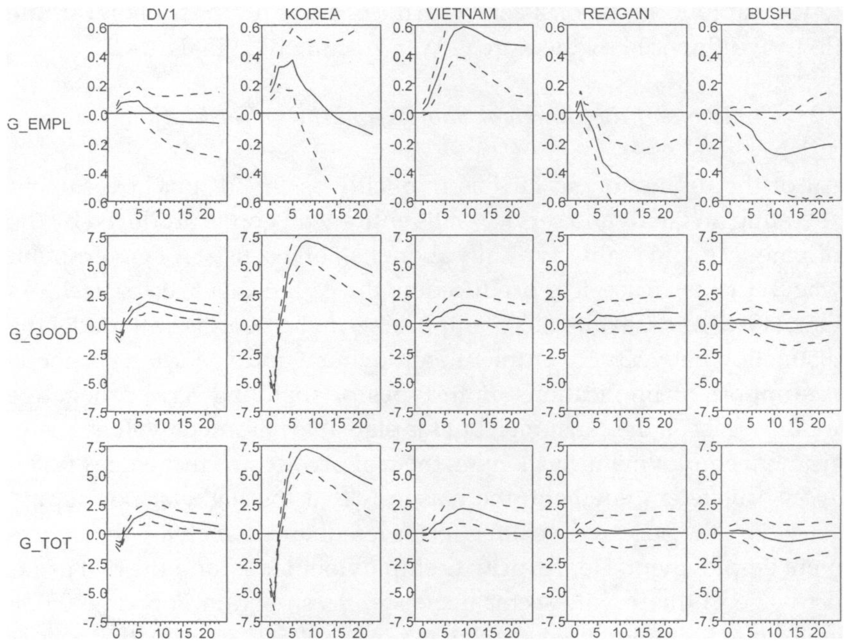

Figure 3.11
Responses of Government Spending on Wages and on Goods to Ramey-Shapiro Dummy Variables

In all specifications, the government employment shock generates a highly persistent response of government employment itself, and a sizeable response of goods spending; in contrast, the goods spending shock generates virtually no response of government employment and much less persistence in total spending. Thus, the government employment shock is much more persistent and more wage intensive.

The gross domestic product and consumption increase much more in response to a government employment shock: for GDP, a peak of 4 percent against about .7 percent in response to a goods spending shock; for consumption, more than 1.5 percent against .4 percent. The responses of hours are also very different: both increase in response to a government employment shock, and both are flat in response to a goods spending shock. As usual, the response is stronger in manufacturing, with a peak of about 6 percent after one year.[31] The product wage in manufacturing also responds much more strongly to a government employment shock; the business sector real wage, instead, is flat in both cases. In the I1 specification, the picture is similar, except that business sector hours do not increase after a gov-

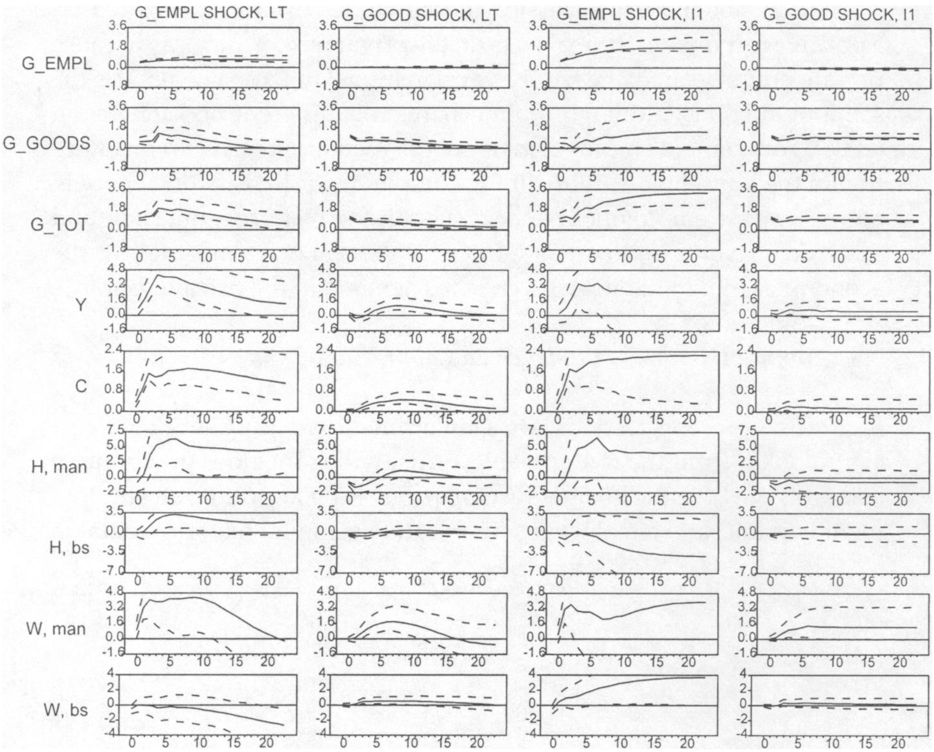

Figure 3.12
Responses to Government Employment and Goods Expenditure Shocks, SVAR

ernment employment shock, and now even the business sector real wage responds positively to the same shock. The standard errors in the responses to the government employment shock, however, become large.

These results are in line with Pappa (2005), who finds positive responses of the real wage and, less sharply, of private employment to a government employment shock using a sign-restriction approach; with Linnemann (2006), who estimates a trivariate VAR with government and private employment and GDP, and finds similar positive responses of private employment to a government employment shock; and with Rotemberg and Woodford (1992), who find a positive response of private hours and the real wage to a shock to military employment.

This pattern of responses thus appears to be inconsistent with virtually all models we have of the effects of government employment shocks; in fact, it is very difficult to obtain a positive response of *both* private employment *and* the real private wage in either a neoclassical or a neo-

Keynesian model. The neoclassical model studied by Finn (1998) predicts a positive response of the real wage in the private sector, but only because private hours decline; the neo-Keynesian model of Pappa (2005) has the same predictions, although the mechanism is different. In Linnemann (2006), government employment is complementary to private consumption in the household's utility: if the complementarity is strong enough, a government employment shock can raise private consumption and therefore private employment—but now the real wage must fall, as the economy is moving down a given labor demand in the private sector.

7.3 *Annual Historical Evidence on Labor Markets*

Figure 3.13 presents responses to a government spending shock of 1 percent of GDP from the five-variable VARs, which includes government spending, GDP in the business sector, private consumption, an employment variable, and a real wage variable, using annual historical data. In

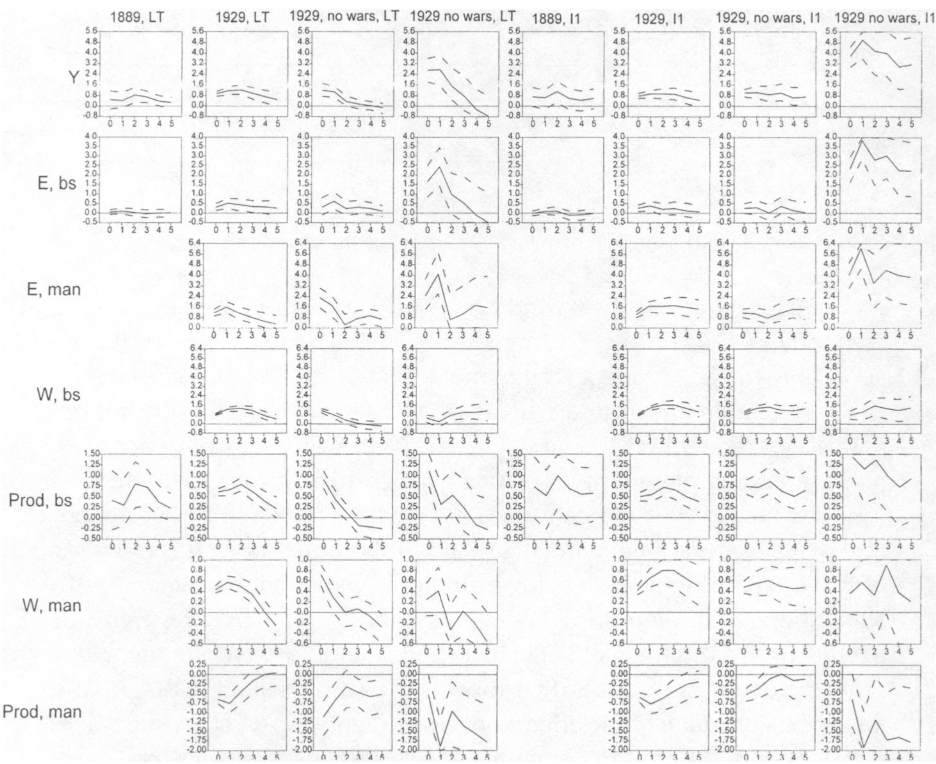

Figure 3.13
Response of Labor Market Variables, Annual Historical Data, SVAR

the first specification, the employment variable is full-time equivalent employees in the business sector (employees when the sample starts in 1889); the real wage variable is total wage and salary accruals in the business sector divided by full-time equivalent employees in the business sector and deflated by the business sector deflator. In the second specification, the employment variable is full-time equivalent employees in manufacturing the real wage variable is total wages and salaries in manufacturing divided by full-time equivalent employees and deflated by the price index of goods: this specification can be estimated only from 1929. In column 1, the sample starts in 1889; in column 2, in 1929; in column 3, in 1929, but the years 1941–1945 and 1950–1953 are excluded; in column 4, 1946–1947 and 1954–1955 are also excluded.

Both employment variables respond positively to a government spending shock, and again the response gets stronger as one moves rightward in the figure. Like before, manufacturing employment responds more strongly than business sector employment.

The real wage response is also positive, although now it is stronger in the business sector and ceases to be significant in manufacturing when the major wars and their aftermaths are excluded. The I1 specification gives a very similar picture.

The last two rows display the paths of productivity per full-time equivalent employee (in the case of manufacturing, this is derived from a VAR that includes real manufacturing value added in addition to the other five variables). Labor productivity increases in the business sector, while it falls in manufacturing. Ramey (2006) finds a similar result but does not look at the behavior of the real wage. As she argues, the pattern of the productivity responses in the two sectors is consistent with a movement down a given labor demand in manufacturing, with a perfectly competitive goods market; it could reflect a sectoral shift toward manufacturing industries, with higher returns to scale than the average, although each individually has decreasing returns to scale.

However, the increase in the manufacturing real wage does not seem to square with this interpretation; as argued in the discussion of the quarterly SVAR, it is instead consistent with a model with countercyclical markups.

8 Evidence from the Input-Output Tables of the United States

As previously observed, because manufacturing receives a disproportionate share of the increase in governments spending around the Ramey-Shapiro episodes, the evidence on this sector is likely to be key to our understanding of the effects of fiscal policy. However, manufacturing consists of many industries, only a few of which were the target of substantial increases in government spending during the Ramey-Shapiro episodes. An alternative approach to VAR analysis could shed new light.

The U.S. 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 hourly product wage, by manufacturing industry, during the last two Ramey-Shapiro episodes.[32]

Let G_i denote all defense and civilian purchases by the general government in sector i.[33] Let $\Delta G_{i,67/63}/Y_{i,63}$ and $\Delta G_{i,82,77}/Y_{i,77}$ denote the changes in G_i during the Vietnam War and the Carter-Reagan buildup, as shares of the initial year's industry output. Column 3 of table 3.4 lists the first ten industries in the Vietnam War and the Carter-Reagan buildup by the value of this variable; for each of these industries, column 4 shows the share of real government spending in output in the initial year of each episode, $G_{i,63}/Y_{i,63}$ and $G_{i,77}/Y_{i,77}$. This list appears to make intuitive sense: most industries in it are clearly defense related. The next columns of the table display the percentage changes of real output, of hours, and of the real hourly product wage of production workers. The percentage changes are calculated between the averages during the last two years of the episodes (1966–1967 or 1981–1982, respectively) and the averages during the first two years (1963–1964 or 1977–1978).

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

In the first row of table 3.5, columns 2 to 4 display the unweighted average of $\Delta G_{i,67/63}/Y_{i,63}$ in the top, middle, and bottom 20 industries, respectively, by the value of this variable; columns 4 to 6 display the significance level of their differences. The next rows show that the order of the average changes in output, hours, and the real wage (all in deviations from trend) in the three groups is the same as that of the average change in government spending.[34] The same applies to the Carter-

Table 3.4
Top Ten Industries by Change in Government Purchases

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Industry	IO63	SIC72	$\frac{\Delta G_{i,67/63}}{Y_{i,63}}$	$\frac{G_{i,63}}{Y_{i,63}}$	$\frac{\Delta Y_{i67/63}}{Y_{i,63}}$	$\frac{\Delta H_{i,67/63}}{H_{i,63}}$	$\frac{\Delta W_{i,67/63}}{W_{i,63}}$
Vietnam War							
Ammunition, exc. small arms, nec.	1302	3483	347.62	80.97	260.83	170.01	–3.35
Small arms ammunition	1306	3482	167.75	43.35	151.06	147.81	10.32
Other ordnance and accessories	1307	3489	116.70	85.83	72.14	57.52	–4.79
Small arms	1305	3484	49.50	41.04	113.19	64.86	1.43
Semiconductors	5702	3674	43.75	41.67	94.73	52.88	33.58
Electronic components, nec.	5703	3675	40.92	43.92	97.51	42.70	11.72
Watches and clocks and parts	6207	3873	29.59	11.72	34.33	17.08	9.02
Paving mixtures and blocks	3102	2951	29.19	50.36	23.88	8.94	20.24
Architectural metal work	4008	3446	25.11	28.37	42.28	20.55	8.21
Misc. chemical products	2704	2861	24.98	16.77	31.88	11.99	13.18

(continued)

Table 3.4
Continued

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Industry	IO77	SIC72	$\frac{\Delta G_{i,82/77}}{Y_{i,77}}$	$\frac{G_{i,77}}{Y_{i,77}}$	$\frac{\Delta Y_{i82/77}}{Y_{i,77}}$	$\frac{\Delta H_{i,82/77}}{H_{i,77}}$	$\frac{\Delta W_{i,82/77}}{W_{i,77}}$
		Carter-Reagan					
Semiconductors	570200	3674	81.26	25.42	25.76	2.57	1.03
Electronic computing equipm.	510101	3573	60.23	12.53	36.26	–1.12	12.32
Ammunition, exc. small arms, nec.	130200	3483	57.44	68.62	–18.80	3.94	–36.28
Aircraft and missile equip., nec.	600400	3728	47.04	43.22	–11.69	–1.41	–9.55
Aircraft and missile engines and parts	600200	3724	43.87	52.37	26.48	–5.56	15.41
Radio and TV communication equip.	560400	3662	33.48	41.35	27.47	9.94	14.55
Electrical industrial apparatus, nec.	530800	3629	30.56	12.88	3.04	–7.33	1.82
Guided missiles and space vehicles	130100	3761	30.53	82.44	–0.35	–3.13	2.39
Other ordnance and accessories	130700	3489	27.28	62.05	41.45	18.94	34.16
Surgical appliances and supplies	620500	3842	24.79	22.03	54.12	21.09	33.40

Source: see text.

Notes: Column 1: Input-Output Industry Classification, 1963 and 1977 editions, respectively Column 2: Standard Industry Classification, 1972 edition (used in the *NBER Manufacturing Productivity Database.* Column 3: change in real government spending in industry i between 1967 and 1963, as a share of output of industry i in 1963. Column 4: government spending on industry i in 1963, as a share of output of industry i in 1963. Column 5: percentage change in output in industry i, average of 1966–1967 relative to average of 1963–1964. Column 6: percentage change in hours in industry i, average of 1966–1967 relative to average of 1963–1964. Column 7: percentage change in real hourly product wage in industry i, average of 1966–1967 relative to average of 1963–1964. Similar definitions apply to the second panel. The initial and end years are 1977 and 1982. The averages are taken over the years 1977–1978 and 1981–1982. 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. In the Vietnam War panel, IO63 sector 5703 includes the SIC72 sectors 3675, 3676, 3677, 3678, 3679, IO63 sector 2704 includes SIC72 sectors 2861, 2891, 2892, 2893, 2895, 2899. In the Carter-Reagan buildup panel, IO77 sector 600400 includes SIC72 sectors 3728, 3769; IO77 sector 6002000 includes SIC72 sectors 3724, 3764.

Table 3.5
Average Changes, by Industry

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Top 20	Mid 20	Bottom 20	Top-Middle	Top-Bottom	Mid-Bottom
				Vietnam War			
(1)	$\frac{\Delta G_{i,67/63}}{Y_{i,63}}$	53.14	3.46	–4.55	0.00	0.00	0.24
				Average log changes, deviations from trend			
(5)	$\frac{\Delta Y_{i,67/63}}{Y_{i,63}}$	71.23	22.17	10.96	0.00	0.00	0.33
(6)	$\frac{\Delta H_{i,67/63}}{H_{i,63}}$	62.28	23.92	22.93	0.00	0.00	0.93
(7)	$\frac{\Delta W_{i,67/63}}{W_{i,63}}$	5.74	3.69	–1.53	0.64	0.09	0.23
				Carter-Reagan			
(8)	$\frac{\Delta G_{i,82/77}}{Y_{i,77}}$	31.13	0.05	-9.03	0.00	0.00	0.00
				Average log changes, deviations from trend			
(12)	$\frac{\Delta Y_{i,82/77}}{Y_{i,77}}$	39.86	–26.98	–48.78	0.00	0.00	0.10
(13)	$\frac{\Delta H_{i,82/77}}{H_{i,77}}$	20.39	–14.81	–28.08	0.00	0.00	0.25
(14)	$\frac{\Delta W_{i,82/77}}{W_{i,77}}$	10.86	–8.15	–17.18	0.01	0.00	0.20

Source: see text. Definition of variables: see previous table.

Reagan buildup (rows 8 to 14). 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. For hours and output the difference between the top and middle and between the top and bottom groups is always significant: for the product wage, it is always significant in the Carter-Reagan buildup; in the Vietnam War, only the difference between the top and bottom groups in the detrended case is significant.

Note also that the average changes in output and hours imply that productivity on average rises in the top 20 industries, which experience an increase in government purchases, and declines or is stagnant in the bottom 20 industries, which experience a decline in government purchases.

Thus, the sectoral evidence provides independent confirmation of the main conclusions of the SVAR evidence on labor markets: the sectors that experienced the largest government spending shocks are also the sectors that experienced the largest positive changes in the real product wage. This result is consistent with two-sector neo-Keynesian models but not with two-sector neoclassical models.

9 Outside the United States

9.1 *Quarterly Data*

The key constraint in estimating fiscal policy VARs in countries other than the United States is the existence of noninterpolated quarterly data on government spending spanning a long enough period. I have assembled the relevant data for Australia (1959:3–2006:2), Canada (1961:1–2006:3) and the United Kingdom (1963:1–2006:2). As much as possible, the definitions are the same as in the United States: all fiscal variables cover the general government, government spending on goods and services excludes government capital formation but, following the National Account guidelines, includes most expenditure on military equipment; private consumption includes nondurables and services, except in Australia, where it is total private consumption. I use the same benchmark seven-variable specification estimated for the United States, except that, since the average marginal income tax rate is not available for these countries, it is replaced by the log of real net taxes per capita.[35] Like in the United States, the alternative specifications give nearly identical results.

Row 1 of figure 3.14 displays the response of government spending, GDP, consumption, and investment. To facilitate comparison, the first column displays anew the U.S. responses in the LT specification over the shorter sample starting in 1954:1, the following columns display Australia, Canada, the United Kingdom; columns 5 to 8 do the same for the I1 specification.

There are two key messages from this table: the responses of GDP and consumption tend to be positive in all countries and all specifications, but they are also smaller than in the United States, and in a few cases insignificantly different from 0.

In the LT specification, the responses of GDP and consumption are positive and significant in all countries (although they turn negative in the United Kingdom after six quarters), but outside the United States the

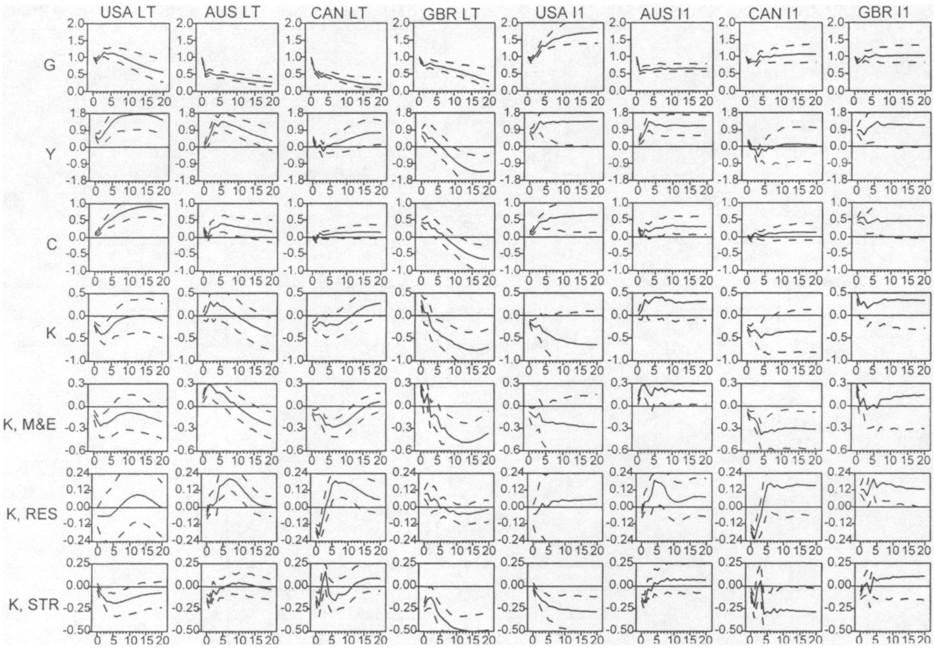

Figure 3.14
Responses to Government Spending Shocks, All Countries, SVAR

consumption response is rarely larger than .5 percentage points of GDP, against a peak of more than 1 percent in the United States. A similar pattern is displayed by the I1 specification, except that now GDP and consumption in Canada are insignificant, while in the United Kingdom they are now positive and significant over the whole horizon.

There is slightly less regularity across countries in the response of investment: in the LT specification, it is negative in the United States, Canada, and the United Kingdom (after a small and brief positive impact response), and positive in Australia. As in the United States, this response is driven by machinery and equipment investment and, to a lesser extent, by structures; outside the United States, private residential investment tends to increase slightly, by between .1 and .2 percent of GDP, after a government spending shock.

9.2 Historical Evidence with Annual Data

Figure 3.15 displays impulse responses from a small, four-variable SVAR in government spending, GDP, private consumption, and investment,

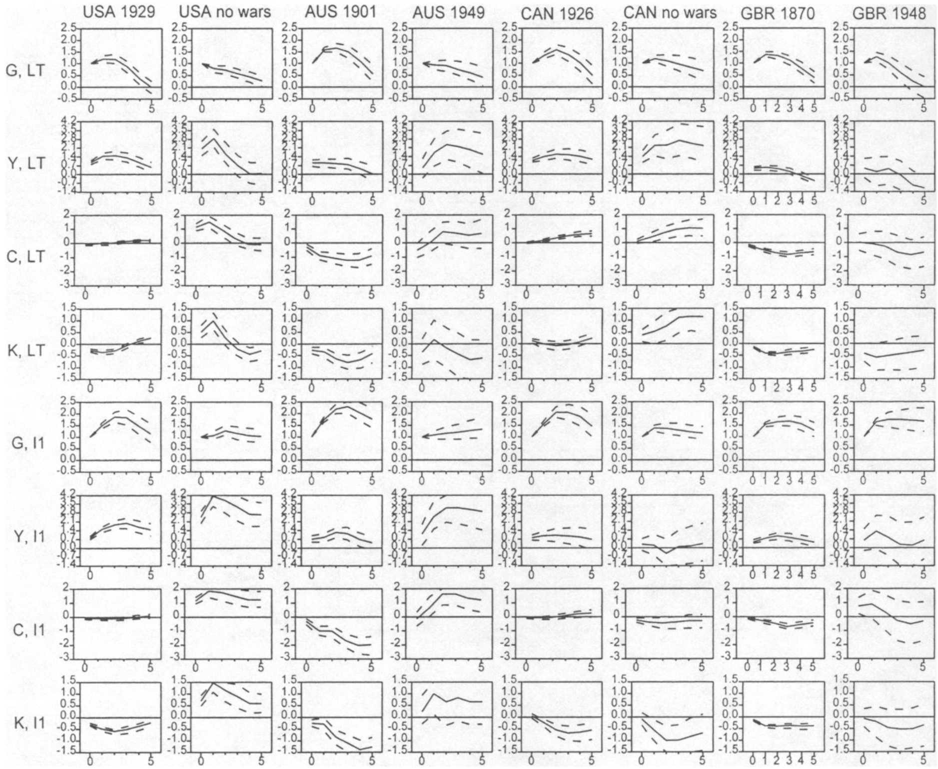

Figure 3.15
Responses to Government Spending Shocks, Annual Historical Data, All Countries, SVAR

estimated using long-run annual data in Australia, Canada, and the United Kingdom, plus the United States as a comparison.[36] Over these long samples, outside the United States only total private consumption is available. The first four rows display the responses of the four variables in the LT specification, the next four rows of the I1 specification,

For Australia, Butlin (1977) has assembled yearly data covering the period 1901–1948. However, until 1939 private consumption was computed residually from estimates of GDP and its other components, and is thus unusable; and most data for the war years are considered unreliable by the author himself. The Australian Bureau of Statistics now publishes thoroughly revised annual data on a number of variables going back to 1949, with a consistent definition.[37] When the long sample—combining the Butlin data up to 1948 and the ABA data from 1949—is used (column 3), the response of consumption is significantly negative; this is consistent with the mechanical negative correlation between government and private consumption due to the residual nature of the latter. When the VAR is estimated from 1949, thus using only the consistent Australian Bankers Association (ABA) data (column 4), the response of consumption is now positive (after a small initial decline), sizeable (just below 1 percent of GDP), and significant at two years.

Statistics Canada publishes historical annual series with a consistent definition going back to 1926. Over the whole sample (column 5), the response of consumption is significantly positive, with a peak of .6 percentage points of GDP after five years. This is robust to the exclusion of WWII (column 6), although not in first differences (row 7).

In the United Kingdom, annual data on the variables of interest are published in the *Blue Book* from 1948, using a consistent definition; Feinstein (1972) provides data going back to 1870. But up to about 1920 many series are considered unreliable: GDP, depending on the decade gross fixed capital formation, consumers' expenditure and central government spending get subjective reliability assessments of B or C (on a declining scale from A to C). For the period 1900–1938 "little information on actual expenditure or retail sales is available" (Feinstein, 45); and importantly, the results of the government expenditure deflation "are very rough, and especially for the war years are best treated with extreme scepticism" (p. 78).

Column 7 of figure 3.15 shows that over the whole sample, starting in 1870, consumption drops significantly, to about –.8 percentage points of GDP after three years. These results are robust to the exclusion of WWI (WWII is not in the sample because there are no data on private investment between 1938 and 1946). But again, if one starts with the official data in 1948 (column 8), the decline in consumption is smaller, and is insignificantly different from 0.[38] In first differences (row 7), consumption rises significantly above 0.

As usual, it is more difficult to identify a clear pattern in the investment responses, but outside the United States investment increases only in Australia in the I1 specification and in Canada in the LT specification when wars are excluded.

Thus, when data of good quality are used (in particular, noninterpolated, nonresidual government spending and consumption data), out of the eight country-specification pairs that exclude wars, the response of consumption is significantly negative (but small) in one case, flat in another, and significantly positive in the remaining six cases. As in quar-

Table 3.6
Cumulative Multipliers of Government Spending at Two Years

	USA	AUS	CAN	GBR	USA	AUS	CAN	GBR
	Quarterly, LT				Quarterly, I1			
GDP	0.98*	1.33*	–0.34	0.57	0.73*	1.26*	–0.46	0.66
CONS	0.42*	0.35	0.06	0.35	0.27*	0.23	–0.02	0.35*
	Annual, LT				Annual, I1			
GDP	2.69*	1.13*	1.47*	0.28	3.10*	1.72*	0.21	0.69
CONS	0.96*	–0.28	0.21*	–0.03	1.01*	–0.24	–0.26*	0.62*

Notes: First panel-cumulative GDP and consumption multipliers from four-variable VAR estimated on quarterly data. Second panel-cumulative GDP and consumption multipliers from the same four-variable VAR, estimated on annual data. Samples for annual VARs-USA: from 1929, WWII and Korean War excluded: Australia: from 1949; Canada: from 1926, WWII excluded; United Kingdom: from 1948. An asterisk indicates that 0 is outside the region between the two one-standard error bands at that horizon.

terly data, the consumption response tends to be smaller than in the United States.

Table 3.6 displays the cumulative GDP and consumption multipliers of government spending at two years from the quarterly SVARs (first panel) and from the annual SVARs (second panel), both in the LT and in the I1 specifications. In quarterly data, the consumption multiplier is nearly 0 in Canada; it is positive and quite similar (between .35 and .45) in the other countries, although in Australia it is not significant. In all cases, the multipliers in the LT and I1 specifications are very close.

In annual data, in the United States the consumption multiplier is large and nearly double the quarterly multiplier, while in the other countries there is more dispersion.

9.3 *The Labor Market*

Figure 3.16 displays the results for labor market variables in the United States, Canada, and the United Kingdom (in Australia, data on wages and employment are available only from 1983). These are based on the usual benchmark seven-variable VAR also used to derive the responses of consumption and investment, which includes g, t, y, c, k, e (a measure of hours or employment), and w (a measure of earnings or compensation). The first row displays the response of GDP; the second row of the employment variable with the largest coverage available (total employment in the United States, the whole industry in Canada, and all civilian

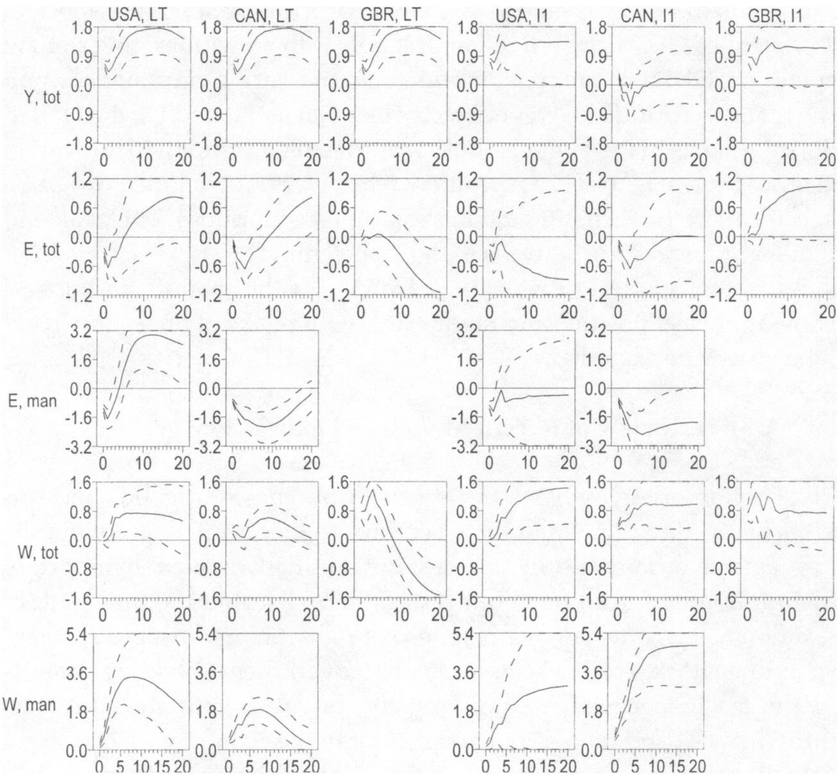

Figure 3.16
Responses of Labor Market Variables, United States, Canada, and United Kingdom, SVAR

jobs in the United Kingdom); the third row of manufacturing hours (in the United States) or employment (in Canada). The next two rows display the responses of the corresponding real product wages.[39]

Outside the United States, it is surprisingly difficult to find a positive response of employment variables to a government spending shock, despite the positive GDP response: only in the United Kingdom in the I1 specification can one find a positive response of overall employment. In all countries and specifications, the real product wage increases significantly, and again, more in manufacturing.

9.4 *Annual Historical Evidence on Labor Markets*

Outside the United States only Canada has long enough historical annual series on employment and the real wage, and only in manufacturing. Figure 3.17 displays responses to a government spending shock of 1 percent of GDP from a five-variable SVAR that includes government spending, GDP, private consumption, manufacturing employment, and the manufacturing real wage, exactly like that estimated for the United States. And as in the United States, manufacturing employment rises in Canada, except in the I1 specification, when wars are excluded (the same specification that exhibited no increase in consumption). The peak employment response is between 1 and 2 percent.

As in the quarterly SVAR, the response of the manufacturing real wage is always positive and significant, with peaks of above 2 percent when wars are excluded.

10 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 initially make the important assumption that taxation is lump sum, implying that the time path of taxation has no effect on the response of the economy to a government spending shock. I will also assume that government spending consists of purchasing goods produced by the private sector that are then thrown away, and there is only one sector in the economy.

In the standard neoclassical model studied by Baxter and King (1993), a forward-looking representative agent can freely borrow and lend at the market interest rate; the production function has constant returns to scale, all prices are flexible, all goods and factor markets are perfectly competitive, and the utility function is separable in consumption and leisure. From the intertemporal government budget constraint, an increase in government spending must be matched by an increase in taxation of the same value in present discounted value terms. Hence, the individual is poorer in lifetime terms, and reduces his or her consumption and leisure; as labor supply shifts out, output increases and the real wage falls along a given labor demand.

Thus, in this model the effects of a government spending shock on consumption and the real wage follow directly from two key features: the negative wealth effect and the separability of consumption and leisure. Two broad classes of models eliminate or counteract these two features to reach different predictions about the response of private consumption, or the real wage, or both.

In the nonseparable model of Linnemann (2006), the only difference is

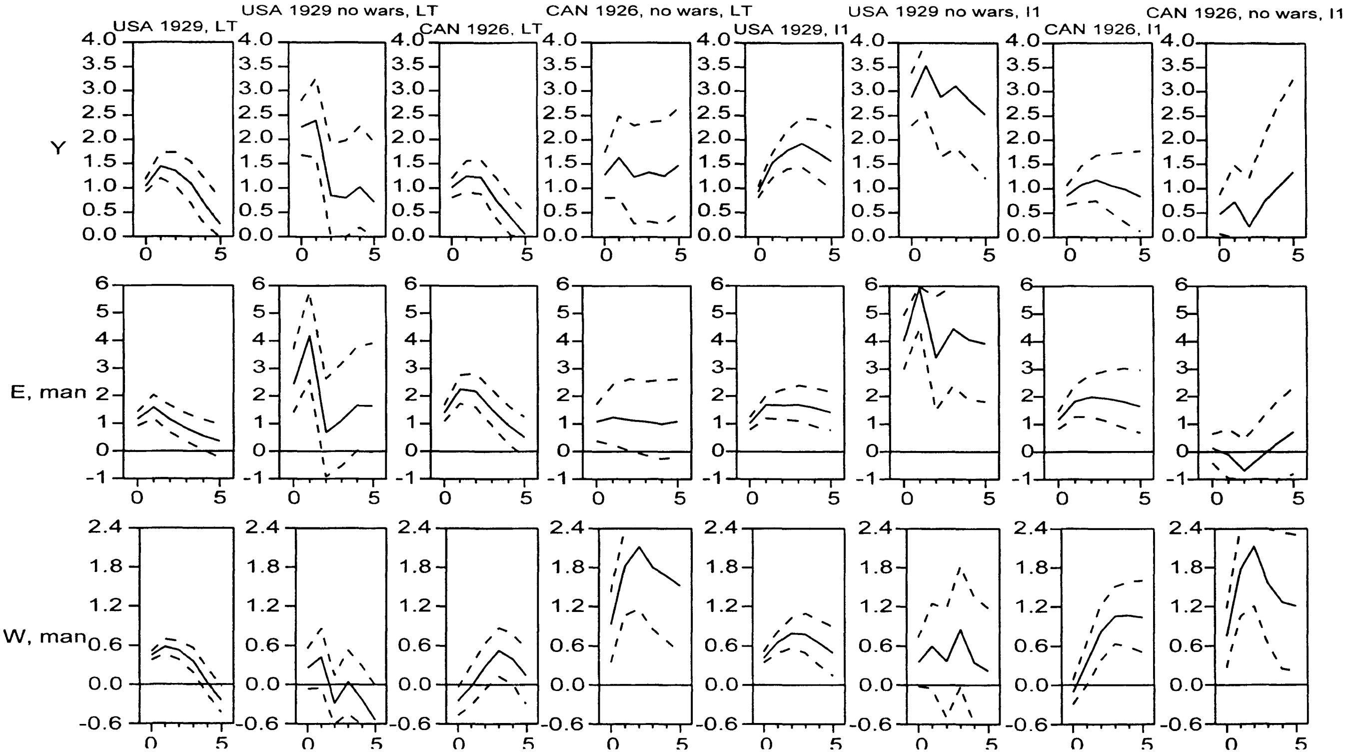

Figure 3.17
Responses of Labor Market Variables, Annual Historical Data, United States and Canada, SVAR

that the utility function is nonseparable 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. Hence, both consumption and hours increase. However, as Bilbiie (2006) shows, for consumption to increase it must be the case that it is an inferior good; and for consumption and hours to move in the same direction, one of the two must be an inferior good.

The next modification of the neoclassical mechanism consists in allowing a government spending shock to cause a rightward shift in the aggregate demand for labor. If this effect is strong enough, the real wage can increase; in turn, this can (but not necessarily does) induce a higher consumption, through two basic mechanisms: the substitution effect and credit constraints. There is more than one way to get a government spending effect on the aggregate demand for labor: for lack of a better name, I lump this class of models based on movements in labor demand that are not caused by productivity shocks under the heading of *neo-Keynesian models.*

1. *Countercyclical mark-ups.* With some monopoly power in the goods market, labor demand is defined by the first order condition for profit maximization $F_L(L_t, \ldots) = \mu_t w_t$, where F is the production function, L is labor demand, w is the real product wage, and μ is the markup. If μ_t falls when government spending increases, from $F_{LL} < 0$ labor demand will increase for a given w. In the well-known model of Rotemberg and Woodford (1992), a government spending shock increases current demand relative to future demand and therefore raises the incentives to undercut collusive pricing between oligopolistic firms. The only incentive-compatible collusive agreement is then to reduce the mark-up when aggregate demand increases.

In Ravn, Schmitt-Grohé, and Uribe (2006), the 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 producer-specific 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.

2. *Nominal rigidities.* With price stickiness, monopolistically competitive firms meet the extra demand caused by a government spending shock by supplying more output; labor demand increases as output rises (thus, these models also exhibit countercyclical markups condi-

tional on a government spending shock). As shown in Linnemann and Schabert (2003), if the interest rate rule does not put too much weight on output, the real wage can increase despite the shift in labor supply. Note that the nature of the rigidity matters: with wage rigidity, the real wage might well fall after a government spending shock.

3. *Increasing returns.* In Devereux, Head, and Lapham (1996), higher government spending raises the equilibrium number of firms that can operate in the intermediate good sectors, where there are increasing returns to specialization. Hence, the productivity of all firms in the sector increase, and despite the standard negative wealth effect on labor supply the resulting outshift in labor demand can lead to a higher equilibrium real wage. A similar mechanism operates in Bilbiie, Ghironi, and Melitz (2005).

Once the real wage rises because of one of these three mechanisms, there are basically two ways to get a rise in consumption. First, the higher real wage induces individuals to substitute from leisure into consumption, thereby inducing an increase in consumption: this is the route taken by Ravn, Schmitt-Grohé, and Uribe (2006) and Devereux, Head, and Lapham (1996). In models with nominal rigidities, in general the increase in the real wage will not be enough, by itself, to generate an increase in consumption. The second route, taken by Galí, López-Salido, and Vallés (2006), is then to appeal to credit constraints: a share of the population cannot borrow or lend, and consume all their labor income in each period. As the real wage increases, their consumption increases, too. With enough of these individuals, the model can generate a positive response of total private consumption to a government spending shock.[40]

Note that, in order to generate a positive consumption response, these models need a substantial real wage response. This runs counter to the notion that real wages tend to be acyclical (unconditionally) over the cycle. But the evidence we have seen is that they can be quite responsive to government spending shock.

Table 9.7 summarizes the key results discussed in this section.

This classification is obviously rather schematic. As we have seen, neo-Keynesian models are consistent with a wide variety of responses, depending, for instance, on the nature of the nominal rigidity and the behavior of the monetary authorities. But in one sense it remains useful: because of the wealth effect, with lump-sum taxation the neoclassical model unambiguously generates a decline in private consumption fol-

Table 3.7
Models of Government Spending

	L^s	L^d	L	Y	W/P	C
Neoclassical	↑	=	↑	↑	↓	↓
Nonseparable utility	↑	=	↑	↑	↓	↑
Neo-Keynesian	↑	↑	↑	↑	↑	↑

Note: A (↑) indicates that the real wage or consumption *can* increase if the shift in labor demand is large enough.

lowing a government spending shock. As Ricardo Reis points out in his discussion, with distortionary taxation the fiscal reaction function becomes important, and depending on its parameters one can generate any impact response of the endogenous variables in the neoclassical model; but even in this case, one would need rather extreme patterns of intertemporal substitution to generate a (temporary) increase in consumption in response to a negative wealth effect. And most importantly, the present discounted value of consumption must fall even more for a given increase in government spending, if taxation is distortionary; hence, although on impact consumption might fall and the real wage increase, at some point they must move in the neoclassical directions. It is in this sense that positive responses of private consumption and of the real wage at all horizons are inconsistent with the neoclassical model, regardless of the fiscal reaction function in place.

11 Conclusions

Are wars normal events from the point of view of fiscal policy, only bigger? If they are, it is difficult to escape the conclusion that private consumption declines in response to a shock to government spending: wars are plausibly exogenous, and during WWII the share in GDP of government spending on goods and services more than tripled in four years, from 14.8 percent in 1940 to 47.9 percent in 1944, while private consumption of nondurables and services declined from 62.6 to 46.4 percent of GDP. But even outside wars, there is fiscal action that can be exploited: the problem is how to disentangle its exogenous, unanticipated component. The narrative, or dummy variable approach tries to combine both ideas by looking at the typical deviation from the normal path of the endogenous variable caused by a series of post-war abnormal fiscal events, namely four military buildups driven by foreign policy, that can plausibly be regarded as exogenous and unanticipated. In its original version, the method assumes that these abnormal fiscal events are entirely (in the DV3 approach), or almost entirely (in the DV1 and DV2 approaches) responsible for all the deviation from normal of all the variables during a horizon that is typically assumed to be between six and eight quarters. Under these assumptions, the method delivers results that, especially in the DV1 and DV2 method, are supportive of the key neoclassical mechanism: in response to a government spending shock, private consumption and the real wage fall.

But possibly a better interpretation of the logic itself of the exercise consists in isolating the abnormal fiscal events and estimating the normal response of the nonfiscal endogenous variables to these events. Thus, this method allows for a number of nonfiscal shocks to hit the economy during the time of the abnormal fiscal event. In this case, the estimated normal response of consumption to abnormal events is now typically positive. This is consistent with the impulse responses from an approach based on a structural VAR. This last approach is subject to a different type of criticism: its estimated shocks might not be really unanticipated by the private sector. To address this problem, Ramey (2006) proposes to estimate SVARs with long-run annual data. I show that, when reliable noninterpolated data are used, the evidence again supports the notion that the responses of consumption and of the real wage to a government spending shock are positive. Independent evidence from the U.S. input-output tables also indicates that the real product wage increased more in those sectors that experience the greater increase in government spending as a share of their output.

Obviously there are many open questions, both in terms of methodology and in terms of evidence. I will indicate only two. It is frequently asserted that government spending is more effective in stimulating the economy in times of recessions and low-capacity utilization. Although I know of no model that formalizes this idea, it is easy to see how a model with occasionally binding credit constraints could generate this result. In ongoing research with Ilian Milhov, we indeed find preliminary evidence that shocks to government spending generate a higher GDP and private consumption response in times of low GDP growth.

A second open issue concerns the stability of the results across periods. The variances of output and inflation have declined considerably after about 1980, and a growing literature studies how changes in the conduct of monetary policy and in its transmission mechanism might have contributed to this decline. There is evidence (see Perotti [2004] and Romer and Romer [2006]) that both the variance of fiscal policy shocks and their effects on GDP and consumption have also declined in the last 20 years. Investigating this issue further seems important to promote our understanding of the transmission mechanism of fiscal policy.

Acknowledgments

I thank the editors, my discussants Valerie Ramey and Ricardo Reis, and Olivier Blanchard, Fabio Canova, Carlo Favero, Jordi Galí, Francesco Giavazzi, Ilian Mihov, Tommaso Monacelli, Evi Pappa, and Luca Sala for discussions and suggestions. The paper also benefited from comments on an earlier version by seminar participants at the Bank of England, the London School of Economics, and Pompeu Fabra University. Valerio Ercolani provided excellent research assistance. E-mail address: roberto .perotti@unibocconi.it

Endnotes

1. All this assumes lump-sum taxation. As Ricardo Reis points out in his discussion, when taxation is distortionary intra- and inter-temporal substitution effects can generate any pattern of responses of consumption and the real wage on impact, depending on the temporal profile of the tax rate (see, e.g., Ludvigson [2007]). It remains true, however, that in present-value terms private consumption must fall, because of the negative wealth effect: hence, persistently positive responses of private consumption and of the real wage would not be consistent with the neoclassical model. See section 3.10 for a brief review of recent models of fiscal policy.

2. To estimate the effects of fiscal shocks on interest rates one probably needs to impose more structure than is present in the SVARs discussed in this paper. In fact, Favero and Giavazzi (2007) include debt and the cross-equation restrictions implied by the dynamic government budget in a Blanchard-Perotti SVAR. They show that while the responses of all other variables are unaffected, it is now possible to more precisely estimate a positive response of the interest rate to government spending shocks. Dai and Philippon (2006) also add more structure to a Blanchard-Perotti SVAR by incorporating information from a large cross-section of bond prices: again, they find a positive response of interest rates to a deficit shock.

3. For a comparison of the effects of government consumption and government investment shocks, see Creel, Monperrus-Véroni, and Saraceno (2007) and Perotti (2007).

4. In a promising recent development, Romer and Romer (2006) identify shocks to revenues in the postwar period from a detailed analysis of government documents.

5. Using a standard neoclassical model, Cooley and Ohanian (1997) and Ohanian (1997) show that the different time profiles of the tax rates during WWII versus the Korean War in the United States, and during WWII and the postwar period in the United Kingdom versus the United States had important effects on output and welfare.

6. This is an annual variable calculated by Barro and Sahasakul (1983) and (1986), updated by Stephenson (1998) up to 1996 and by myself afterward.

7. McGrattan and Ohanian (2006) emphasize this interpretation of the biggest such episode of all, WWII.

8. 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.

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

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

11. McGrattan and Ohanian (2006) estimate transition matrices for different states (i.e., levels of government spending) in each year of WWII; once fed into a standard neoclassical model, they accurately explain the behavior of consumption during WWII.

12. Net taxes are defined as tax revenues less transfers to households and subsidies.

13. According to National Income Account guidelines, defense machinery and equipment should be classified as government consumption. The United States, unlike other OECD countries, classifies a substantial part of these items as government capital formation (see Bureau of Economic Analysis and U.S. Department of Commerce [1988]).

14. The OECD estimates of these elasticities start in 1960: for 1947–1959, I have assumed the 1960 value. This is certainly a crude approximation, but note that the estimated responses to a government spending shock, on which this paper focuses, are virtually invariant to the tax elasticities. Based on the identifying assumption that discretionary government spending cannot react to output within a quarter, I have assumed a quarterly government spending output elasticity of zero. I have also assumed a quarterly contemporaneous elasticity of *real* government spending to the price level of –.5 (which would follow if half of government consumption were fixed in nominal terms within a given quarter).

The value of the elasticity of personal income taxes to income computed by the OECD displays a large discrete drop in 1992. Nothing would change if one were to use the average value of this elasticity over the sample, or a smoothed version of it.

15. For simplicity, and somewhat improperly, I will continue to use the expression "SVAR" in these cases.

16. Although the timing is not exactly right because the average marginal income tax rate is an annual variable, this increase captures the Tax Equity and Responsibility Tax Act of 1982.

17. Eichenbaum and Fisher (2004) argue precisely that the different responses of taxes in the Bush build-up, relative to the typical response estimated via the DV2 method during the Ramey-Shapiro, explains the decline in GDP.

18. Galí, López-Salido, and Vallés (2007) also start the sample in 1954:1, and find similarly higher responses of consumption.

19. The responses of the components of private investment are obtained from seven-variable SVARs in which total private investment is replaced by each component in turn.

20. 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 tax and GDP shocks are equally plausible candidates, and turn out to have more forecasting power.

21. I thank Alan Auerbach for providing the data.

22. The fiscal shocks are derived from VARs estimated on the full and shorter sample, respectively. Obviously, the p-values of table 3.3 are obtained from a regression estimated with the semiannual data that start in 1984:1.

23. Because the Barro-Sahasakul tax rate is an annual variable, to obtain tax shocks in this section I replace this variable with the log of real per capita net taxes.

24. The other key variable in this paper, private consumption expenditure, also has important problems prior to 1929. In Kendrick's work, this variable is obtained from Kuznet's "flow of goods to consumers" by subtracting government direct services to consumers, in turn proxied by personal tax and nontax payments. This is already a rough approximation; in addition, some components of this variable are interpolated by a straight line, such as state and local personal tax receipts between 1890, 1902, and 1913. Also, prior to 1919 there were no data on consumer expenditures on services; Kuznets used the ratio of expenditure on services and on commodities "from occasional family budget studies" (Kendrick, 1961, 38).

25. This uses the Kuznets-Kendrick data until 1929, ratio-linked with the BEA data afterward. Results with the Balke and Gordon (1989) GNP series are virtually identical.

26. Until 1929, consumption of nondurables and services is not separately available.

27. The nature of the friction is important here: in general, models with nominal wage rigidity do not have the same prediction.

28. The after-tax wage is computed by multiplying compensation in the business sector times 1 less the average marginal income tax rate.

29. Using a Bureau of Labor Statistics (BLS) series of producer prices in manufacturing (discontinued after 1996:1) 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 approach and in each of the episodes separately, and also in the SVAR approach.

30. The response of government employment is converted into the response of government spending on wages by multiplying the former by the average share of government wages in GDP.

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

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

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

The 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 by deflating the nominal quantities provided by the input-output tables by the industry's price index of shipments in the *NBER Manufacturing Productivity Database.*

34. In her discussion, Valerie Ramey makes the point that one should take into account total factor productivity (TFP) growth in evaluating the average responses of the real product wages. However, this response in the top group of industries in table 3.5 is positive even after the real wage has been detrended.

35. In the case of Australia, data on wages and employment are available only from 1980. Hence, these two variables are replaced by the GDP deflator inflation rate and by the three-months interest rate.

Germany also has quarterly data, but the amount of detail from the primary source is limited and the large break in 1989 makes it difficult to estimate a meaningful VAR. Heppke-Falk, Tenhofen, and Woolf (2006) estimate a SVAR on German data between 1974:1–2004:4, prolonging the data for Germany after 1991 backward using West German growth rates, and find a positive response of private consumption to a government spending shock. A few other countries, such as France and Italy, have data starting in 1980, but the amount of interpolation is unclear.

36. Long-run data for labor market variables are available only for the United States and Canada, hence the smaller four-variable specification to ensure consistency across countries.

37. On overlapping years, the discrepancy between the nominal values of these series and the earlier national account estimates, themselves more consistent with Butlin's estimates for 1901–1939, can be of the order of 100 percent for some series.

38. In addition, the decline in the post-war period is entirely due to the years 1974–1976, when government spending increased substantially in response to what was perceived as a temporary negative shock.

39. This is: in row 4, hourly business sector compensation deflated by its own deflator (United States); average weekly earnings of all employees in the industrial composite, deflated by the GDP deflator (Canada); average earnings index for the whole economy, deflated by the GDP deflator (United Kingdom). In row 5, average weekly earnings of manufacturing production workers (United States) and employees (Canada), deflated by the manufacturing PPI.

40. López-Salido and Rabanal (2006), Forni, Monteforte, and Sessa (2006), and Coenen and Straub (2005) all estimate small DSGE models with credit-constrained households.

References

Balke, Nathan S., and Robert J. Gordon. 1989. The estimation of prewar gross national product: Methodology and new evidence. *Journal of Political Economy* 97 (1): 38–92.

Barro, Robert J., and Chaipat Sahasakul. 1983. Measuring the average marginal tax rate from the individual income tax. *Journal of Business* 56 (4): 419–52.

———. 1986. Average marginal tax rates from Social Security and the individual income tax. *Journal of Business* 59 (4): 555–66.

Baxter, Marianne, and Robert King. 1993. Fiscal policy in general equilibrium. *American Economic Review* 83 (3): 315–34.

Bilbiie, Florin O. 2006. Non-separable preferences, fiscal policy "puzzles" and inferior goods. Mimeograph, University of Oxford.

Bilbiie, Florin O., Fabio Ghironi, and Marc J. Melitz. 2005. Business cycles and firm dynamics. Mimeograph, Harvard University.

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* 117 (4): 1329–68.

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

Burnside, Craig, Martin Eichenbaum, and Jonas D. M. Fisher. 2004. Fiscal shocks and their consequences. *Journal of Economic Theory* 115:89–117.

Butlin, M. W. 1977. A preliminary annual database 1900/01 to 1973/74. Reserve Bank of Australia Research Discussion Paper no. 7701, May. Sydney: Reserve Bank of Australia.

Caldara, Dario, and Cristophe Kamps. 2006. Forthcoming. What are the effects of fiscal policy shocks? A VAR-based comparative analysis. ECB Working Paper Series.

Cavallo, Michele. 2005. Government employment expenditure and the effects of fiscal policy shocks. Unpublished Working Paper. Federal Reserve Bank of San Francisco.

Chari, V. V., Patrick Kehoe, and Ellen McGrattan. 2005. A critique of structural VARs using real business cycle theory. Working Paper no. 631, Federal Reserve Bank of Minneapolis.

Cochrane, John. 1998. What do VARs mean?: Measuring the output effects of monetary policy. *Journal of Monetary Economics* 41 (2): 277–300.

Coenen, G., and R. Straub. 2005. Does government spending crowd in private consumption? Theory and empirical evidence for the Euro area. *International Finance* 8 (3): 435–70.

Cooley, Thomas F., and Lee E. Ohanian. 1997. Postwar British economic growth and the legacy of Keynes. *Journal of Political Economy* 105 (3): 439–72.

Creel, Jérôme, Paola Monperrus-Véroni, and Francesco Saraceno. 2007. Has the golden rule of public finance made a difference in the UK? OFCE Working Paper no. 2007-13. Paris: Observatoire Francais des Conjonctures Economiques.

Dai, Qiang, and Thomas Philippon. 2006. Fiscal policy and the terms structure of interest rates. CEPR Discussion Paper no. 5793. Paris: Centre for Economic Policy Research.

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): 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* 2 (1): 166–206.

Eichenbaum, Martin, and Jonas D. M. Fisher. 2004. Fiscal policy in the aftermath of 9/11. Federal Reserve Bank of Chicago Working Paper no. 2004-06. Chicago: Federal Reserve Bank.

Fatás, Antonio, and Ilian Mihov. 2001. The effects of fiscal policy on consumption and employment: Theory and evidence. Mimeograph, INSEAD.

Favero, Carlo, and Francesco Giavazzi. 2007. Debt and the effects of fiscal policy. NBER Working Paper no. 12822. Cambridge, MA: National Bureau of Economic Research.

Feinstein, C. H. 1972. *National income expenditure and output of the United Kingdom 1855–1965.* Cambridge: Cambridge University Press.

Finn, Mary G. 1998. Cyclical effects of government's employment and goods purchases. *International Economic Review* 39:635–57.

Forni, L., L. Monteforte, and L. Sessa. 2006. The estimated general equilibrium effects of fiscal policy: The case of the Euro area. Unpublished paper, Bank of Italy.

Galí, Jordi, J. David López-Salido, and Javier Vallés. 2007. Understanding the effects of government spending on consumption. *Journal of the European Economic Association* 5 (1): 227–70.

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 no. 152. Paris: OECD.

Heppke-Falk, Kirsten H., Jörn Tenhofen, and Guntram B. Wolff. 2006. The macroeconomic consequences of exogenous fiscal policy shocks in Germany: A disaggregated SVAR analysis. Deutsche Bundesbank Discussion Paper no. 41/2006. Frankfurt am Main, Germany: Deutsche Bundesbank.

Kendrick, John W. 1961. *Productivity trends in the United States.* Princeton, NJ: Princeton University Press.

Leeper, Eric M. 1997. Narrative and VAR approaches to monetary policy: Common Identification Problems. *Journal of Monetary Economics* 40:641–57.

Linnemann, Ludger. 2006a. The effects of government spending on private consumption: A puzzle? *Journal of Money, Credit and Banking* 38 (7): 1715–35.

Linnemann, Ludger. 2006b. Macroeconomic effects of shocks to public employment. Mimeograph, University of Bonn.

Linnemann, Ludger, and Andreas Schabert. 2003. Fiscal policy in the new neoclassical synthesis. *Journal of Money, Credit and Banking* 35 (6): 911–29.

López-Salido, David J., and Pau Rabanal. 2006. Government spending and consumption-hours preferences. Mimeograph, Federal Reserve Bank.

Ludvigson, Sidney. 2007. The macroeconomic effects of government debt in a stochastic growth model. *Journal of Monetary Economics* 38:25–45.

McGrattan, E. R., and L. E. Ohanian. 2006. Does neoclassical theory account for the effects of big fiscal shocks? Evidence from World War II. NBER Working Paper no. 12130. Cambridge, MA: National Bureau of Economic Research.

Mihov, Ilian, and Roberto Perotti. 2007. Forthcoming. Asymmetric effects of government spending over the cycle. Milan: Bocconi University.

Monacelli, Tommaso, and Roberto Perotti. 2007. Forthcoming. The sectoral effects of government spending: Theory and evidence. Milan: Bocconi University.

Mountford, Andrew, and Harald Uhlig. 2002. What are the effects of fiscal policy shocks? CEPR Discussion Paper no. 3338. Paris: Centre for Economic Policy Research.

Ohanian, Lee E. 1997. The macroeconomic effects of war finance in the United States: World War II and the Korean War. *American Economic Review* 87 (1): 23–40.

Pappa, Evi. 2005. New-Keynesian or RBC transmission? The effects of fiscal shocks in labour markets. CEPR Discussion Paper no. 5313. Paris: Centre for Economic Policy Research.

Perotti, Roberto. 2004. Estimating the effects of fiscal policy in OECD countries. IGIER Working Paper no. 276. Milan: Bocconi University.

———. 2007. Public investment: Another (different) look. IGIER Working Paper no. 277. Milan: Bocconi University.

Ramey, Valerie A. 2006. Identifying government spending shocks: It's all in the timing. Mimeograph. University of California at San Diego.

Ramey, Valerie A., and Matthew D. Shapiro. 1998. Costly capital reallocation and the effects of government spending. *Carnegie Rochester Conference on Public Policy* 48:145–94.

Ravn, Morten, Stephanie Schmitt-Grohé, and Martin Uribe. 2006. Deep habits. *Review of Economic Studies* 73 (1): 195–218.

Romer, Christina D., and David H. Romer. 1989. Does monetary policy matter? A new test in the spirit of Friedman and Schwartz. In *NBER Macroeconomics Annual 1989*, ed. Olivier J. Blanchard and Stanley Fischer, 120–70. Cambridge: MIT Press.

———. 2006. The macroeconomic effects of tax changes: Estimates based on a new measure of fiscal shocks. Unpublished paper, University of California, Berkeley.

Rotemberg, Julio, and Michael Woodford. 1992. Oligopolistic pricing and the effects of aggregate demand on economic activity. *Journal of Political Economy* 100:1153–1297.

Stephenson, Frank E. 1998. Average marginal tax rates revisited. *Journal of Monetary Economics* 41 (2): 389–409.

van den Noord, Paul. 2002. Automatic stabilizers in the 1990s and beyond. In *The behavior of fiscal authorities: Stabilization, growth and institutions*, ed. Marco Buti, Jurgen von Hagen, and Carlos Martinez-Mongay, 130–48. Basingstoke, UK: Palgrave.