Are all the fiscal policy shocks identical? Analysing the effects on private consumption of civilian and military spending shocks

Luca, Pieroni and Lorusso, Marco

University of Perugia, Heriot-Watt University

December 2015

Are All The Fiscal Policy Shocks Identical? Analysing the Effects on Private Consumption of Civilian and Military Spending Shocks

Luca Pieroni*
University of Perugia

Marco Lorusso†
Heriot-Watt University

December 2015

Abstract

In this paper, we show that civilian and military government spending have specific characteristics that can affect differently private consumption. Our VAR estimates for the US economy show that civilian expenditure induces a positive and significant response on private consumption whereas military spending has a negative impact.

We adopt a new Keynesian approach and develop a DSGE model in order to simulate the empirical evidence. Both the larger persistence of shocks in military spending and the different financing mechanisms, which accounts for the propensity of policy-makers to use budget deficits to finance wars, mimic the differences in the empirical responses of private consumption. Simulated impulse response functions of alternative specification models prove the robustness of our analysis.

Keywords: Military and Civilian Spending, SVAR, DSGE Model.
JEL classification: E32, E62.

*E-mail: lpieroni@unipg.it, Department of Economics, Finance and Statistics, University of Perugia, Via Pascoli 20, 06123 Perugia, Tel: +39 0755855281.

†Corresponding author: Email: marco.lorusso@pet.hw.ac.uk, Institute of Petroleum Engineering, Centre for Energy Economics Research and Policy, Conoco Centre, Edinburgh EH14 4AS, Tel: +44 (0)131 4514578.

1 Introduction

In the recent period US public opinion showed renewed interest about the economic impact of fiscal policy. At the end of 2013, an intense debate and media coverage concerned the US federal government shutdown. The tensions that ultimately produced this shutdown began because of the different perspectives of policy-makers concerning the deficit reduction through a simultaneous increase in tax rates and decrease in government spending. One motivation of this debate is that the economic literature did not provide conclusive results of how public expenditure and its financing mechanism can affect the economic performance of private sector, because it mainly depends on the theoretical perspective and the empirical methodology used (Cogan et al., 2010).

The neoclassical approach suggests a strategic explanation to account for the economic effects of large cyclical rises in government spending. Based on major unexpected political events, it assumes that the periods of increased military spending correspond to the dates of war or the threat of war. Ramey and Shapiro (1998), later extended by Ramey's recent work (2011), proposed a so-called "narrative" approach, which selected the start of the three wars in which the US actively intervened, Korean, Vietnam and the Soviet invasion of Afghanistan and the 2001 terroristic attack, to identify large exogenous increases in the US defense spending empirically. Edelberg et al. (1999), Burnside et al. (2004) and Barro (2011) produced closely related follow-ups of the work by Ramey and Shapiro (1998). The significant criticism of this approach is that other substantial fiscal shocks may have occurred at around the same time, thus interfering with identification of the military build-up shocks and inferences on the effects of fiscal policy[1].

Following the seminal paper of Blanchard and Perotti (2002), the economic literature has proposed an alternative approach to test the effects of fiscal policy on economy. In particular, a large set of studies has focused on vector autoregressive (VAR) models with differences in the identification issues of fiscal shocks. A very large body of empirical literature includes structural restrictions of impulse response functions (Uhlig, 2005; Mountford and Uhlig, 2005; Canova and Pappa, 2007; Enders et al., 2008), relations among variables and error terms in the structural form (Marcellino, 2006; Beetsma et al., 2006; Beetsma, 2008; Benetrix and Lane, 2009; Corsetti et al., 2012), or the inclusion of external and institutional information which tends to exploit the quarterly nature of data and fiscal policy decision lags (Blanchard and Perotti, 2002; Perotti, 2005; Muller, 2008; Monacelli and Perotti, 2008).

This paper reviews the empirical economic consequences of changes in US fiscal policy following a baseline structural VAR (SVAR) model extended for the fiscal components of military sector and civilian government purchases. We mostly focus on the short-run consequences of government spending, because the main question of interest is to what extent unexpected military and non-military expenditures produce effects on private

[1] As an example of this debate, Perotti (2005) argues that "Ramey and Shapiro date the start of the Korean war shock in 1950:3, based on the large observed increase in military spending; but in four quarters between 1948:2 and 1950:3, government spending increased by between two and three standard deviations. It is not obvious how to disentangle the effects of the Korean dummy variable from the delayed effects of these large fiscal shocks".

consumption, that accounts for more than 60% of US GDP. Our main contribution is to show that differences on private consumption effects are based on how the shocks on these government components are driven by their persistence and types of financing mechanisms.

We base our hypotheses on the findings of Galì's et al. (2007) that a positive government spending shock leads to a significant increase in private consumption when military spending is excluded by the data[2], to infer the hypothesis that military spending has a negligible or negative impact on consumption. However, the literature found conflicting empirical results. For example, Hall's (1986) analysis using annual data back to 1920, and identifying government spending shocks through shifts in military spending, finds a slightly negative effect of government purchases on consumption.

Similarly to Blanchard and Perotti (2002), who estimate output fiscal effects, we report a comparison of the VAR effects of military and civilian spending shocks of consumption for the US: while we find a negative effect of military expenditure on consumption, this does not exclude reconciling this result within the new Keynesian prediction for fiscal effect in aggregate, since our results show that civilian government purchases have a large effect on private consumption.

In this paper, following the most recent literature (see among the others, Canzoneri et al. 2012; Zubairy, 2014; Jacob, 2015), we develop a new Keynesian model to mimic the empirical results. This framework offers the advantage to take into account forward looking expectations of households and firms, and encompasses many ingredients of recent dynamic optimizing sticky price models, although it is modified by allowing for the presence of consumers subject to credit constraints[3]. In fact, the basic intertemporal model upon representative agents predicts the negative wealth effect associated with an increase in the tax burden, which lowers households disposable income and, in turn, their consumption expenditures. Despite this negative wealth effect, the response of consumption to a spending shock can be positive under the presence of non-Ricardian consumers (Galì et al., 2007).

In our theoretical model, we extend the original framework of Bilbiie et al., (2008) by disentangling civilian and military spending shocks. We motivate our framework according to two main findings of our empirical estimates. Firstly, we observed a stronger persistence of military spending shock than civilian spending shock. In particular, the high persistence of the military spending shock increases the negative wealth effect on Ricardian households and further lowers their consumption spending. As a consequence, we observe a "crowding-out" effect on total private consumption. Secondly, our empirical estimates show the effects of a different financing mechanism of civilian and military expenditures. The former is financed by the increase in taxation rate contrarily to the latter that is mainly related government budget deficit. In our view, the heterogeneity of consumers also implies different spreads through which fiscal policy transmits the effects to the economy

[2]This result is also in accordance with the recent paper of Caldara and Kamps (2012), showing that private consumption increases following a positive aggregate government spending shock.

[3]See, Campbell and Mankiw (1989), for the original description of the economic behavior of non-Ricardian consumers, and Cogan et al. (2010) for a clear discussion between New Keynesian and old Keynesian government spending multipliers.

and it is made explicit by the financing mechanism of deficit and of current government spending. This issue is particularly important in our analysis, when we examine the effects of military spending with respect a civilian spending because, for example, differences in the taxation propensity (or other forms of financing) lead to heterogeneous responses in private consumption. Differently from Favero and Giavazzi (2007), who explicitly include the long run government budget constraint, the new Keynesian model presented below comprises, along with a taxation rule, a deficit financing rule.

Our simulated results of the baseline new Keynesian model show that private consumption responds positively to civilian spending whereas military expenditure affect negatively private consumption. Both the model results seem to be at work in explaining the empirical results of aggreagate government spending in private consumption. Then, some robustness tests are presented comparing the dynamic responses of private consumption to different persistences and financing mechanisms of civilian and military spending shocks. We also analyze the impact of the these two components of government spending on private consumption in the cases of different shares of Ricardian households and degrees of price rigidites.

The rest of this paper is organized as follows. Section 2 discusses the basic literature and some stylized facts of how the US finances government spending, in particular within the identified war dates. Section 3 presents our empirical specifications showing the data and discussing the identification procedure. Here, estimation results are shown with particular regard to the reaction of private consumption to different kinds of government expenditure shocks. Section 4 presents our theoretical framework and the model calibration. Section 5 examines the simulated impulse response of consumption to the different government spending shocks, focusing on its consistency with the empirical evidence. Section 6 concludes.

2 Private consumption and the financing mechanism of government spending components

Barro (1974, 1979, 1981) conducted several studies highlighting the economic effects of government spending and the alternative methods and impacts of financing this expenditure. In particular, Barro (1981) stressed the fact that government expenditures can provide direct welfare to economic agents, and that variations in the level of government expenditure may have an impact on the consumption decisions of households. On the other hand, part of the literature built on this argument showing that different sources of financing of the public sector components led to a different impact on private consumption when consumers were constrained in their asset purchases.

Here, we focus on the different mechanisms used to finance it in the US. Table 1 shows the financing sources of government outlays (e.g., military and civilian) under the direct control of the fiscal policy[4]. We also stress that our interest focuses on shocks near war

[4]Note that this difference between revenue and expenditure is not matched by changes in money supply.

time (including times in threat of war) to account for more unanticipated expenditure and financing behavior. As a link with the literature, we refer to the US war episodes described by Ramey (2011) except for the Korean War, which is outside our sample. This choice does not meaningfully affect the results since the variation in military spending was important during the 1960's and the 1970's (Bilbiie et al., 2008; Pieroni, 2009).

From Table 1 we can observe that, at the peak of the war episodes, the percentage of budget deficit in GDP was around 4-6%. However, the tax revenue did not change at the onset of war episodes, except during the Carter-Reagan military build-up, when taxation was cut. This "conservative policy" also produced a reduction in taxation during the Afghanistan and the second Iraq campaign, leaving almost the whole burden of military outlay on borrowing from the public. Similarly, the data do not provide evidence that reductions in other government spending represent military outlay financing course, although we note that there is a significant reduction in civilian outlay in the Carter-Reagan military build-up[5].

We motivate our paper's contribution stating that the effects of military spending on private consumption also depend on the financing mechanisms of government outlay, recognizing that unplanned episodes like wars are generally financed by budget deficits. Thus, from the Keynesian perspective, wars typically determine a short-term economic boom boosting aggregate demand and consumption, since greater military outlay is not offset by the contraction caused by higher taxes. It is within this policy debate that Feldstein (2008) suggested that any Department of Defense (DoD) budget cuts may be misguided. He also argued that in the recent downturn cycle, the US government should have recognized the need to increase government spending to offset the decline in consumer demand in the economy, and argued that a rise in military spending would be the best way to provide this stimulus.

The latter predictions are not in line with empirical results in defense economics. Boulding (1973), Edelstein (1990) and Pieroni (2009) have shown that private consumption responds negatively to military expenditure increases - even if not always statistically significant - a result similar to those obtained for private investments (Smith, 1980). These results may be in line with the neoclassical hypothesis of the diversion of government resources. The data shown above seem to emphasize the complexity of the effects in the transmission channel toward private consumption, at least, because the financing of the defense sector - and its shocks - may be related to those of civilian spending. Thus, by analyzing government spending effects between these components, one aim is to capture explicitly the different persistence of the spending shocks. We extend these arguments by a new Keynesian DSGE framework to find an explanation for the possible sources of the crowding-out effect in military consumption observed in some empirical evidence. We incorporate into our model a share of households who do not have access to the bond market and who consume their current disposable income at each date. We show the

[5]This result is not in contrast with the findings of Beetsma et al. (2007) who identified "within" substitutions between military and civilian spending since the positive trend of civilian spending is associated with a stable pattern of military spending, excluding war episodes.

co-existence of sticky prices and a different rule of financing mechanisms for military and civilian spending. The next section illustrates the estimated impulse response analysis of the components of fiscal policy for the US.

[Table 1 about here.]

3 Empirical Evidence

In this section, we provide evidence of the above-mentioned discussion by estimating the impulse response functions (IRFs). We compare the results of the fiscal policy shocks of the expenditure of military and civilian components in private consumption to explain how contrasting theoretical models may rationalize the heterogeneity of the effects upon them.

3.1 Specification and Identification

The strategy adopted here to identify the VAR model is based on the assumptions discussed in Bilbiie et al. (2008) that are consistent with the solution of the log-linearized theoretical model presented in next Section[6]. In addition, the use of quarterly data supports the exogenous changes of civilian and military spending, respectively. This is in line with the new Keynesian perspective which sustains that a discretionary fiscal policy plausibly does not respond within a quarter to a change in the economy[7].

As a baseline specification of our model we adopt a SVAR, the reduced form of which is defined by the following dynamic equation:

$$Y_t = c + A(L)\, Y_{t-1} + U_t \tag{1}$$

where Y_t indicates the vector of variables specified below, $A(L)$ is an auto-regressive lag polynomial, c a constant term, and U_t the vector of reduced-form innovations. We focus our analysis on the US and use a dataset from 1960:Q1 to 2010:Q4. The reasons for choosing the US were based on the data availability making this economy the main case study of the effects of fiscal policy.

There is a substantial issue associated with the perspective that private agents receive signals about future changes in government spending before these changes take place, which affects the validity of the SVAR representations. In particular, the anticipation effect of the expenditure in the military sector argued by Ramey (2011) may lead to differences in the shock effects of this component on the economy. Following this literature[8], we include dummy variables in the "military" VAR system that controls for anticipation

[6] A recent review of the identification strategy in the VAR literature is discussed in Beetsma and Giulidori (2011).

[7] Following Auerbach (2000, p. 16), "there are many reasons why fiscal decisions announced in advance may not be taken at face value by the public. The yearly budget is often largely a political document, which is discounted as such by the private sector; any decision to change taxes or spending in the future may be modified before the planned implementation time arrives; and... changes in expenditure policy typically have involved not simply changes in program rules, but rather changes in future spending targets, with the ultimate details left to be worked out later and the feasibility of eventually meeting the targets uncertain."

[8] See, also Forni and Gambetti (2010), Leeper et al. (2012) and Leeper et al. (2013).

effects, corresponding to the dates which accounts to the major military news described in Ramey and Shapiro (1998). More specifically, these dates are: 1965:1, 1980:1, 2001:3[9].

We estimate separately the impulse responses of military and civilian spending shocks from a five-variable VAR because they are not significantly linked, identifying separate transmission effects on economy. Following the strategy mentioned in equation (1), we specify before the model analyzing the effects of the civilian component:

$$Y_t = [C_t, W_t, DINC_t, BD_t, NM_t] \tag{2}$$

composed of private consumption C_t, real wages W_t, disposable income $DINC_t$, the government budget deficit BD_t and the civilian spending NM_t[10]. The empirical specification includes, respectively: the log of real private final consumption expenditure per capita (C); real wages (W), corresponding to the log of real compensation of employees; disposable income ($DINC$), corresponding to real personal disposable income (obtained from the FRED-II database). Civilian spending (NM) obtained from the Bureau of Economic Analysis (National Economic Accounts) as difference between government consumption expenditure and national defense data[11]; and a measure of budget deficit (BD) corresponding to gross government fixed capital formation (IG) minus net government saving ($SAVG$). Consistently with the model developed herein, both civilian spending and the budget deficit enter the VAR as a ratio of lagged GDP. All the others real variables are deflated by the GDP deflator. The variables are then expressed in per capita terms dividing them by working-age population.

As an identification strategy for fiscal policy shocks, we adopt a Cholesky factorization, in order to recover the vector of structural shocks ϵ_t (and its variance Ω) from the reduced-form error U_t in (1). It is worthwhile noticing that the structural identification of Blanchard and Perotti (2002) of government spending shocks is identical to a Choleski decomposition, in which government spending is ordered before the other variables[12]. Here, we assume the following set of conditions. We consider civilian spending as the most exogenous variable and analyze the effects of its increase (temporary or permanent). The interaction between civilian expenditure and taxation rate influences the budget deficit: if the civilian spending increase is financed by tax rises the budget deficit may be negative. Conversely, if a civilian expenditure rise is not followed by a corresponding increase in taxation rate, the budget deficit is positive. We implicitly assume that there are heterogeneous behaviors of consumers that include in the choice set decisions in the asset. Because household demands for goods depend on the expected value of taxes (i.e., disposable income), each household subtracts its share of this present value (real wage) from the expected present value of income, in order to determine a net wealth position. Lastly, we consider private consumption as the most endogenous variable, which is therefore affected

[9]With respect to Ramey (2011) the Korean date (1950:1) is excluded because it is outside of our sample.

[10]The source for almost all the variables used is the OECD Economic Outlook No. 88.

[11]Since we are interested in short to medium-run effects of shocks to government purchases on private consumption, we omit investments from the data. As a robustness check, we include service of capital, but results obtained in the VAR-estimates were close to those presented below.

[12]As in Blanchard and Perotti (2002), the condition for identification is that the component of government spending does not respond to government or private macro-economic variables, contemporaneously.

by all contemporaneous values of all the variables in the VAR.

Since we are primarily concerned with comparison of the private consumption effects of civilian and military shocks, we repeat the same experiment substituting civilian expenditure (NMt) with military spending (Mt) in the VAR model. In this case, the vector of variables Y_t in equation (1) may be expressed as:

$$Y_t = [C_t, W_t, DINC_t, BD_t, M_t]\,. \tag{3}$$

Similarly to the civilian spending case, military spending enters the VAR as a ratio of lagged GDP. Military spending (M) is always obtained from the Bureau of Economic Analysis. Again, we adopt a Cholesky factorization in which private consumption, real wages, disposable income and budget deficits are allowed to depend on the fiscal variable (in this case, military expenditure) and are ordered, respectively.

It is worth also noting that following the literature on the effects of fiscal components on the economy, a characteristic of the government expenditure in VAR models is its persistence driven by the presence of trends. Figure 1 plots the US federal military and civilian expenditures as relative shares of GDP. Military spending has a clear downward trend, while civilian spending is more stationary. In general, the presence of trends in fiscal series (as shares of GDP) is not limited to non-defense spending, but is pervasive. For instance, in the dataset used by Leeper et al. (2010) to estimate a DSGE model using Bayesian techniques, tax revenues, transfers, and government spending (all as shares of GDP) have trends, and those trends differ from each other. Therefore, we deal with those trends including the linear trend in the model specification, which is also consistent with our DSGE model of Section 4.

[Figure 1 about here.]

3.2 Results

We estimate two VAR models according to specification equations (2) and (3) in order to obtain the empirical $IRFs$. According to the Schwarz information criterion, the number of lags is set to two. Diagnostic tests indicate the absence of serial correlation in the residuals by a Lagrange Multiplier test. We also fail to reject the hypothesis of normality of residuals with Jarque-Bera statistics and check the stability condition of the VAR, finding that all eigenvalues lie comfortably inside the unit circle. We also test for the presence of cointegrating relationships among the variables, finding mixed evidence according to rank and maximum eigenvalue tests. As a result, we decide not to impose any cointegrating restriction, and thus estimate both the VARs with the variables in levels (Sims et al., 1990; Giordano et al., 2007).

Figure 2 shows the effects of civilian spending on endogenous variables of equation (2). In accordance with this line of inquiry, in order to derive the 16th and 84th percentiles of the impulse response distribution in the graphs, we perform Monte Carlo simulations and assume normality in the parameter distribution. Accordingly, we construct t-tests based on 10,000 different responses generated by simulations, and check whether the point estimates of the mean impulse responses are statistically different from zero. The responses of the five variables are expressed by multiplying the estimated parameters of the VAR by the sample average share of civilian spending in GDP.

We note that civilian spending (graph a)) increases significantly and does not display a large persistence. To give an idea in order to compare below with shocks in military spending, the pattern of persistence decreases with a half-life of about two years. The response of the budget deficit variable (graph b)) indicates a contrasting pattern: although it starts positively, it decreases and remains significantly negative, meaning that unexpected civilian expenditure appears to be financed by an increase in the taxation rate.

We observe a positive response for disposable income (graph c) for the time-length considered. This result is in line with the prediction of the new Keynesian models, where the low persistence of civilian spending shock along with constraints in asset market participation reduces the wealth effect on asset holders.

As predicted by the new Keynesian models, real wage (graphs d)) shows a positive and persistent response to a unitary shock of civilian spending. Most interestingly, the effect of a civilian expenditure shock on consumption is shown to be significant for a large time-span, persistently above zero (graph e)). As we can observe, the response of consumption follows that of disposable income.

[Figure 2 about here.]

Figure 3 displays the IRFs of VAR in equation (3) to a positive shock in military spending. Defense expenditure response (graph a)) rises significantly showing a higher persistence with respect to civilian shocks. From the patterns of IFRs, we estimate that to achieve half-life takes more than eight years. Graph b) pertains to the estimated response of the budget deficit variable, reproducing the evidence in the US, shown in the Section 2, that the defense sector is largely financed by budget deficits. The response of disposable income is negative (graph c); this effect is driven by the high persistence of military spending shock that strengthens the wealth effect on Ricardian households.

The point estimates shown in the IRFs indicate that real wages decrease in response to the military spending shock (graph d)). Interestingly, as found in the defense spending literature which follows the neoclassical point of view, the pattern of consumption also decreases its impact (graph e)), and the point estimates reveal that the shock may produce a significant effect. Also in this case, the consumption follows the pattern of disposable income response.

[Figure 3 about here.]

The robustness of our results is tested by the estimated impact multipliers on consumption. In particular, the impact multiplier on consumption measures the change in the level of consumption k periods ahead in response to a change in the fiscal variable of interest given by ΔF_t at time t [13]:

$$\text{Impact multiplier } k \text{ periods ahead} = \left(\frac{\Delta C_{t+k}}{\Delta F_t}\right) \tag{4}$$

thus, the civilian spending impact multiplier is given by, $\frac{\Delta C_{t+k}}{\Delta NM_t}$, and for the military spending the impact multiplier is given by $\frac{\Delta C_{t+k}}{\Delta M_t}$.

Table 2 shows the results[14]. Particularly interesting for our study is the fact that positive multipliers on consumption of civilian expenditure, for the $1st$, the $4th$, the $8th$ and the $12th$ quarter, are +0.06, +0.36, +0.82 and +1.01, respectively. On the contrary (as expected from the point estimates) consumption multipliers are negative for military expenditure for the same quarters, between −0.09, −0.11, −0.10 and −0.08, respectively.

Confidence intervals of these government expenditures at 95% also indicate a statistical significance of separate consumption multipliers, emphasizing the important differences in the transmission IRFs responses of military and civilian expenditures shocks on private consumption.

[Table 2 about here.]

4 A Theoretical Model

The previous section showed the dynamic consequences of fiscal policy shocks for civilian and military components on the US consumption. Our aim here is to assess whether our model can account for these estimated patterns.

As we will observe below, our theoretical framework is fully consistent with the empirical strategy of the previous section. Indeed, we adopt a solution of our DSGE model which implies that the several variables are expressed as their respective log deviations from the model steady state. Therefore, an unanticipated shock to civilian (or military) spending causes the temporary change of any given variable of our model before returning to its steady state. Accordingly, this interpretation of civilian and military shocks fits consistently with the results of the impulse response analysis of our estimated structural VAR in Section 3.

In what follows, firstly we present the log-linearized equations under a simple dynamic general equilibrium model with new Keynesian predictions. Then, we focus on the key fiscal transmission channels related to: (i) the financing mechanism of the specific expenditure, and (ii) the persistence of military and civilian shocks. Finally, we discuss the parameters used in the calibration of the model.

[13] For example, the civilian spending multiplier is computed as follows, $\frac{\Delta C_{t+k}}{\Delta NM_t} = \frac{\%\Delta C_{t+k}}{\%\Delta NM_t}\frac{C}{NM}$, where C and NM are the steady state values of consumption and civilian expenditure, respectively.

[14] We also computed the civilian and military impact multipliers on output. As we have a different goal in this paper, we do not report these results that are available upon request.

4.1 The Basic new Keynesian Framework

This subsection describes the model, which follows the framework of Galì et al. (2007). The model consists of an economy populated by a continuum of infinitely lived households in which these are divided into Ricardian and non-Ricardian behaviors. In particular, consider λ the share of non-Ricardian households present in the economy, that is, households which do not have access to capital markets and consume their current labor income. Conversely, complementary share $1-\lambda$ defines Ricardian households.

As regards labor market structure, it is assumed that there is an economy-wide union setting wages in a centralized manner. Hence, hours worked are not chosen optimally by households, but are determined by firms, given the wage set and the union.

The economy produces a single final good and a continuum of intermediate goods. The aggregate production function includes both capital and labor inputs. The total factor productivity is assumed to follow a first order autoregressive process. The final goods sector is perfectly competitive and is consumed by households. There is monopolistic competition in the markets for intermediate goods, each of which is produced by a single firm. The model assumes that intermediate goods producer faces restrictions in the price setting process, as in Calvo (1983). In particular, θ defines the probability of a firm keeping its prices unchanged, and $1-\theta$ that of an intermediate firm can re-optimize its prices. The model encompasses a monetary authority which sets its policy instrument, the nominal interest rate, according to a generalized Taylor rule (1993).

The detailed linearized model is set out in Table 3, except the equations related to the government sector.

[Table 3 about here.]

We are going to analyze them in detail in the next subsection since our main contribution relates to consumption responses to shocks of fiscal policy components.

4.2 The Government Sector: Military and Civilian Expenditures

The government budget constraints assume that to finance public spending, the government should issue bonds and raise lump-sum taxes. As one of the main aims of this paper, we separate government purchases into the components of expenditure of civilian (NM_t) and military (M_t) and, consequently, display a composite budget constraint as:

$$P_t T_t + R_t^{-1} B_{t+1} = B_t + P_t(NM_t + M_t) \tag{5}$$

$$where \quad : \quad T_t \equiv \lambda T_t^{nr} + (1-\lambda)\, T_t^{r}$$

where T_t denotes the real taxes (lump sum) paid by (Ricardian and non-Ricardian) consumers to the government, and the variable B_{t+1} the quantity of one-period bonds purchased by households at time t. P_t denotes the price level. The last expression encompasses the sum of civilian and military components according to the additive principle.

Equation (6) shows that linearization of the government budget constraint remains around the steady state, with zero debt and a balanced primary budget:

$$b_{t+1} = \frac{1}{\beta}(b_t + nm_t + m_t - t_t) \tag{6}$$

$$\begin{aligned}
with \quad &: \quad nm_t \equiv \frac{NM_t - NM}{Y} \\
and \quad &: \quad m_t \equiv \frac{M_t - M}{Y} \\
and \quad &: \quad t_t \equiv \frac{T_t - T}{Y} \\
and \quad &: \quad b_t \equiv \frac{(B_t/P_{t-1}) - (B/P)}{Y}
\end{aligned}$$

where nm_t, m_t and t_t are expressed as deviations from their respective steady states and normalized by steady state output, whereas budget deficit is given by the real deficit at time t, divided by the last period's prices minus the steady state nominal deficit and normalized by steady state of output.

Fiscal policy rules have been studied extensively, for instance, by Bohn (1998) and Galí and Perotti (2003). Here, we assume an extension that allows us to consider the two different fiscal policy components:

$$t_t = \phi_b b_t + \phi_{nm} nm_t + \phi_m m_t \tag{7}$$

where ϕ_{nm} and ϕ_m are parameters indicating the response of taxes to civilian and military expenditures, respectively. ϕ_b is the parameter capturing the response of taxes to budget deficit in the case of increases in civilian and military expenditures.

If we insert the fiscal policy rule (7) into the linearized budget constraint (6), we obtain:

$$b_{t+1} = \frac{1}{\beta}(1 - \phi_b)\, b_t + \frac{1}{\beta}(1 - \phi_{nm})\, nm_t + \frac{1}{\beta}(1 - \phi_m)\, m_t \tag{8}$$

A necessary and sufficient condition for non-explosive deficit dynamics is given by:

$$\frac{1}{\beta}(1 - \phi_b)\, b_t < 1 \quad \Rightarrow \quad \phi_b > 1 - \beta \tag{9}$$

This assumption is crucial in order to choose the value of ϕ_b in the model calibration.

Civilian and military expenditures (in deviations from their respective steady states, and normalized by output steady state) evolve exogenously, according to two distinct first order autoregressive processes. Indeed, we assume that the resources destined for civilian and military sectors are AR(1) processes in line with the dynamic responses of our VAR based estimates. Following Smets and Wouters (2007), we also allow for both civilian and military spending processes to respond to total factor productivity shock. Accordingly, we have that:

$$nm_t = \rho_{nm} nm_{t-1} + \epsilon_t^{nm} + \gamma_{nm}\epsilon_t^a \tag{10}$$
$$with \quad : \quad 0 < \rho_{nm} < 1,\, \epsilon_t^{nm} \sim N\left(0, \sigma_\epsilon^2\right)$$

and:

$$m_t = \rho_m m_{t-1} + \epsilon_t^m + \gamma_m \epsilon_t^a \tag{11}$$
$$with \quad : \quad 0 < \rho_m < 1,\, \epsilon_t^m \sim N\left(0, \sigma_\epsilon^2\right)$$

where ρ_{nm} and ρ_m are persistence parameters, whereas ϵ_t^{nm} and ϵ_t^m are the i.i.d. shocks of civilian and military expenditures. As we can observe from equations (10) and (11), the total factor productivity shock is weighted by the steady-state shares of civilian (γ_{nm}) and military (γ_m) spending on output, respectively.

4.3 Market Clearing

The final goods market is in equilibrium if production equals demand by total household consumption, aggregate private investment and total government spending. The log-linearized market equilibrium condition may be expressed as follows:

$$y_t = \gamma_c c_t + \gamma_i i_t + nm_t + m_t \tag{12}$$
$$where \quad : \quad \gamma_c = \frac{C}{Y}$$
$$\gamma_i = \frac{I}{Y}$$

where γ_c and γ_i denote the steady state ratios of consumption-output and investment-output, respectively. Note that, even disentangling government spending in its components of expenditure, the steady state of consumption does not depend on the fraction of non-Ricardian consumers (as reported in Appendix).

4.4 Calibration of the Parameters

We propose a model calibration with quarterly data starting from "standard" parameters extracted from new Keynesian literature. While here we discuss briefly the model parameters, Table 4 summarizes their values and sources. Thus, the discount factor, β, is set at 0.99, which implies an annual steady state real interest rate of 0.04. while depreciation rate, δ, is set at 0.025 per quarter, which implies an annual depreciation on capital of 0.10. In addition, α, at 0.30, which roughly implies a steady state share of US labor income in total output of 0.70. In addition, we fix the parameter capturing the mark-up, μ^p, at 0.2. The fraction of non-Ricardian households, λ, is set at 0.5, a value which is in line with the one assumed by Galí et al. (2007), within the range of estimated values in the literature (see Mankiw, 2000).

The probability of firms keeping their prices unchanged, θ, is fixed at 0.65, i.e. slightly lower than the one used by Bilbiie et al. (2008). The value for the elasticity of wages with respect to hours worked, φ, is set at 0.2, in line with the calibrations of Rotemberg and Woodford (1997, 1999). Following King and Watson (1996), the elasticity of investment with respect to q, η, is fixed at 1. We follow Clarida et al. (2000) in setting the parameter, capturing the response of the monetary authority to inflation, ϕ_π, at 1.5. This value clearly satisfies the Taylor principle. Finally, in line with previous literature, we set the persistence parameter for the total factor productivity shock, ρ_a, equal to 0.90.

Now, we focus on the parameters describing the fiscal sector which are estimated from our sample. In equation (7), we set the parameters capturing the responses of taxes to civilian (ϕ_{nm}) and military (ϕ_m) expenditures, respectively. These values are obtained as the difference of the estimated effects of the VAR in civilian/military expenditures and the budget deficit. In line with the findings in the literature, the estimates for our sample are of ϕ_{nm}=0.16 and ϕ_m=0.18.

We also estimate the persistence parameters of civilian and military expenditures, ρ_{nm} and ρ_m, according to the procedure proposed by Marques (2004), in which the absence of mean reversion of a given series is measured by using the following statistic:

$$\rho = 1 - \frac{n}{t} \tag{13}$$

where n stands for the number of times the series crosses the mean during a time interval with t observations. Montecarlo simulations have shown the correctness and consistence of this estimator to obtain measure of persistence.

Our VAR-based estimates indicate the lower persistence of civilian spending shock, whereas the higher persistence appears in the estimated patterns of military expenditure. By using the persistent estimator in equation (13), after detrending the time-series of the fiscal components, we estimate $n = 60$ for civilian and $n = 8$ for military spending, such as we have $\rho_{nm} = 0.7$ and $\rho_m = 0.97$, respectively[15].

Finally, we calibrate the parameter ϕ_b such that it is consistent with the necessary and sufficient condition for non-explosive deficit dynamics (9). Thus, we fix ϕ_b equal to 0.1.

[Table 4 about here.]

5 Impulse Response Analysis of the Simulated Model

In this section we are going to present the impulse response analysis for the theoretical model described above. Our objective is to compare between the simulated IRFs with those obtained from the SVAR. Our interest is for the transmission mechanisms implied by the two different shocks to civilian and military expenditures. We start by describing the impulse response functions of the baseline model. Afterward, we propose some robustness exercises that are helpful to validate the behavior of the main macroeconomic variables of interest.

[15]The persistence can also be obtained by the AR(1) coefficients that match the half-life of the estimated government expenditure responses. We estimated them for civilian and military expenditures and the results were similar to the ones based on the hypothesis of the absence of mean reversion.

5.1 Implications for the Model with Heterogeneous Fiscal Policy Shocks

Figures 4 and 5 show the IRFs of the variables to positive civilian or military spending shocks. The sizes of these shocks are normalized to 1% of the steady states of the respective government expenditures.

We first discuss the implications of the model in the case of a positive civilian spending shock (Figure 4). Graph a) shows that the persistence of this shock is very low. Interestingly, this result confirms our empirical finding of Section 3. In particular, the low persistence of civilian spending shock reduces the negative wealth effect on Ricardian agents. These perceive that the increase in the tax burden (in present value terms) is only temporary and they do not change significantly their consumption level. In addition, one year after the shock the budget deficit becomes negative and remains persistently below zero for all the horizons considered (graph b). Thus, the reduction of budget deficit moves further resources to consumption of Ricardian agents.

As we can observe from graph d), real wage increases after the shock occurring to civilian spending. This result can be explained by the substantial rise of labor demand, since the civilian spending shock causes an increase of aggregate demand. Due to sticky price, not all the firms can change their prices after the shock, and firms that cannot change their prices are forced to modify their production quantity. Thus, in order to increase their output, firms rise their demand for labor and the new equilibrium in the labor market implies an higher real wage.

The aggregate disposable income of non-Ricardian and Ricardian households increases (graph c). As a consequence, we observe the so called "crowding-in" effect on total consumption spending. This result is evident from graph e). The higher disposable income of non-asset holders induces a substantial increase their consumption level, which leads to the rise of private consumption expenditure.

[Figure 4 about here.]

Turning to the effects of a rise in military spending, Figure 5 shows the IRFs related to this shock. We note a high level of persistence of military expenditure in line with our estimated results of Section 3 (graph a). As a consequence, the negative wealth effect is substantial on Ricardian households. Indeed, these agents decide to postpone their consumption because they perceive that the increase of tax burden will last for a long period.

As we can see from graph b), budget deficit expands after the shock. This result is in accordance with the idea that policy-makers in periods of uncertainty, like wars or threat episodes, perceive the conflict challenges and their unpredictability by developing preferences to postpone the taxation to the future generations. However, the increase of budget deficit further reduces the incentive of consumption in the Ricardian households that end up holding all the bonds issued by government.

The increase of military spending shows a reduction of real wage (graph d). This effect is mainly due to a positive shift of labor supply. Non-asset holders choose to increase their hours worked because of the increase in the tax burden. Similarly, Ricardian households increase their labor supply for a given wage. The new equilibrium in the labor market implies a lower real wage.

Overall, from graph c), the military spending shock reduces aggregate disposable income of non-Ricardian and Ricardian households with a significant "crowding-out" effect (graph e).

[Figure 5 about here.]

5.2 Robustness

5.2.1 Persistence shocks and financing mechanisms

The impulse response analysis just described shows that private consumption responds differently according to the high/low persistences of the specific government spending component. In what follows, we develop an exercise in order to carefully understand this result (see Figure 6).

We start by describing the behavior of private consumption in response to different persistence values of civilian spending shocks. As we can see from graph a), the "crowding-in" effect clearly emerges in the benchmark case ($\rho_{nm} = 0.7$), while if we increase the value of ρ_{nm} to 0.8, we note a negligible increase of private consumption expenditure. Accordingly, when we fix ρ_{nm} equal to 0.97 we obtain the "crowding-out" effect on consumption.

Focusing on military spending, we run the opposite exercise. Accordingly, we start by fixing ρ_m equal to 0.97 and, successively, we decrease it to 0.85 and 0.7. As expected, private consumption responds negatively in the presence of the high shock persistence whereas it increases when ρ_m is low.

In general, the persistences of civilian and military components determine the strength of the negative wealth effect on Ricardian households induced by the increase of tax burden. The low persistence of civilian spending shock implies a relatively small wealth effect, and consumption of asset holders does not change substantially. Accordingly, in the presence of a considerable rise in the consumption of non-asset holders, we observe the "crowding-in" effect. At the contrary, the high persistence of military spending shock causes a strong wealth effect. Thus, Ricardian households reduce substantially their consumption causing the "crowding-out" effect.

[Figure 6 about here.]

A crucial aspect of our impulse response analysis is also related to the different financing mechanisms of civilian and military spending. As we explained before, in our benchmark calibration we consider the responses of taxes to civilian (ϕ_{nm}) and military (ϕ_m) expenditures equal to 0.16 and 0.18, respectively. As concerns the response of taxes to budget deficit (ϕ_b), we assume it equal to 0.1. In the following exercise, we change the values of the parameters ϕ_{nm} and ϕ_m, keeping satisfied the parameterization for ϕ_b. Our objective is assessing the different reactions of total private consumption to these changes (Figure 7).

We start by analyzing the case of a positive shock to civilian expenditure. We assume three different values for ϕ_{nm}, that are 0.01, 0.16 (benchmark case) and 0.99. As we can note from graph a), the "crowding-in" effect on private consumption remains unchanged in all the three cases. However, the magnitude of the rise in total consumption expenditure changes substantially. Interestingly, when the response of taxes to civilian spending is particularly high, the increase of private consumption is modest compared to the case of a low ϕ_{nm}.

In order to explain the last result, we need to think at the negative wealth effect on Ricardian households caused by the increase of the tax burden. The high response of taxes to a rise in civilian spending generates a substantial wealth effect on Ricardian agents, postponing their current consumption. At the contrary, when ϕ_{nm} is low, the increase in tax burden is small and Ricardian households do not change significantly their level of consumption. As a consequence, the crowding effect is larger.

Turning to the military spending shock, graph b) shows the reaction of private consumption to different values of ϕ_m (i.e., ϕ_m is equal to 0.01, 0.18 - benchmark case - and 0.99, respectively). It is evident that the "crowding-out" effect operates in all the three cases. A low value of ϕ_m implies a sharp increase of the budget deficit in response to the military spending shock. This siphons further resources away from potential consumption of Ricardian households because they end up holding all the government bonds. At the contrary, with an high value of ϕ_m the increase of budget deficit is less accentuated. The latter, in turn, reduces the "crowding-out" effect on private consumption.

[Figure 7 about here.]

5.2.2 Non-Ricardian Households and Price Rigidities

Until now, we have shown the amplifying effects of the introduction of non-Ricardian consumers and sticky prices: the consumption response is expected systematically higher than that generated by the neoclassical model (i.e., when prices are fully flexible, and/or when all consumers are Ricardian), irrespective of the sector of expenditure. As an exercise, Figure 8 compares the dynamic responses of private consumption to positive civilian (graph a)) and military (graph b)) spending shocks under our baseline calibration and with different parameterizations of λ and θ. In both the civilian and military cases, the solid black lines represent the benchmark case with λ and θ equal to 0.50 and 0.65, respectively. Instead, the dash dotted green lines correspond to the case of λ fixed to 0 and θ equal to 0.65. Finally, the dashed red lines represent the neoclassic model calibration, which excludes non-Ricardian consumers and considers fully flexible prices (e.g., $\lambda = 0$; $\theta = 0$)[16].

[16]Note that we have run several experiments under different calibrated values of λ and θ and the results are consistent with the ones reported in the figure.

Graph a) of Figure 8 indicates that our model predicts the "crowding-in" effect only in the presence of a substantial share of non-Ricardian consumers. At the contrary, under the standard assumption of RBC models (accounting only for Ricardian households), our model generates a negative response of private consumption to the increase in civilian spending. As a consequence, the latter result is in sharp contrast with the empirical evidence we have shown in Section 3.

In the case of flexible economy, graph a) also shows that the increase of civilian spending generates the "crowding-out" effect on private consumption. Evidently, aggregate demand expands after a positive civilian spending shock. Without price rigidities, all the firms can change their prices and they do not need to increase their production. In turn, their demand for labor input remains unchanged and the real wage does not increase. The simultaneous rise of tax burden reduces the household's disposable income, with a contraction of private consumption.

At the contrary, in the presence of price rigidities, not all the firms can change their prices. In order to face the expansion of aggregate demand, those firms are forced to increase their output demanding higher quantity of input factors. Thus, we observe a positive shift of labor demand and a rise of real wage. If this increase is strong enough to expand substantially of non-asset holder's consumption, the "crowding-in" effect arises.

Graph b) of Figure 8 reproduces the same experiment for the military spending shock. As we can see, moving from our new Keynesian benchmark toward models with neo-classical characteristics, we find that the negative response of consumption to a positive military spending shock is strengthened. Interestingly, the magnitude of the negative impact is in accordance with the findings in the defense economics literature using partial equilibrium specification[17].

Evidently, this result is channeled by the exclusion of non-Ricardian consumers and the flexible economy set up. Firstly, with an economy populated only by Ricardian households, the "crowding-out" effect is large enough because of the strong negative wealth effect on these agents. Secondly, without price rigidities, real wage does not change significantly after the military spending shock. Accordingly, the rise of the tax burden further reduces significantly private consumption expenditure.

[Figure 8 about here.]

6 Conclusions

This paper analyzed the effects of fiscal policy shocks on private consumption. The particular feature of our analysis is that we explicitly allowed for the impact of both civilian and military spending. We used time-series US quarterly data in order to reproduce IRFs of these government spending components, emphasizing the differences with the current literature addressed to evaluate the effects of aggregate government spending shocks.

[17]See, for example, Pieroni (2009).

Most interestingly, when we examined IRF estimates of components of fiscal policy, we found that civilian spending mimics patterns in the variables close to aggregate ones, while a negative impact was found between military spending shock and consumption response. Our estimates also suggest that the persistence of military spending is larger than civilian spending one.

As second step of our analysis, we adopted a new Keynesian DSGE model which accounts for these findings. Our main results are as follows. Focusing on increases in military spending, we were able to calibrate the negative consumption response of the VAR-estimates, identifying two specific channels. Firstly, the high persistence of this expenditure increases the negative income effect on Ricardian household. Thus, these agents reduce drastically their consumption implying the "crowding-out" effect. Secondly, a positive response of the budget deficit, through which military spending is generally financed, implies a further reduction in the consumption of Ricardian agents that prefer to hold government bonds.

The new Keynesian model also predicts that the lower persistence of civilian expenditure from its own shocks reduces the negative wealth effect associated to Ricardian agents. When this effect is associated with a strong rise in the real wage, we observe a positive response of aggregate consumption. Indeed, a high real wage stimulates the consumption of non-asset holders that dominates the fall in consumption of Ricardian households.

Although we believe that this analysis is a useful contribution to more effective management of fiscal policy tools on the expenditure side, it does leave several interesting questions open for future research. Firstly, the general validity of our findings is certainly limited by the closed-economy one-country investigation. We believe that comparative analysis would give a more complete answer to our original question. Secondly, issues in estimating the parameter of non-Ricardian households has received increasing interest in the macro-econometric literature. Obviously, a framework which includes Bayesian estimation provides opportunities for future research.

Appendix: Steady State Analysis of the Components of Fiscal Policy

Here we show that the steady state ratio of consumption to total output does not depend on the fraction of non-Ricardian consumers. Note that the market clearing condition for final goods implies:

$$Y_t = C_t + I_t + NM_t + M_t \quad \Rightarrow \quad C_t = Y_t - I_t - NM_t - M_t \tag{A1}$$

and in steady state:

$$C = Y - I - NM - M \tag{A2}$$

Dividing by Y and knowing that $\frac{I}{K} = \delta$, we can write:

$$\gamma_c = 1 - \frac{\delta\alpha}{\alpha\frac{Y}{K}} - \gamma_{nm} - \gamma_m \tag{A3}$$

where $\gamma_c = \frac{C}{Y}$, $\gamma_{nm} = \frac{NM}{Y}$ and $\gamma_m = \frac{M}{Y}$.
When we consider the marginal product of capital:

$$\alpha\frac{Y}{K}\lambda_t\left(j\right) = R^k \tag{A4}$$

the first order condition of the intermediate firm's problem in steady state:

$$MC = \frac{1}{\mu_p} = \lambda_t\left(j\right) \tag{A5}$$

we obtain:

$$R^k = \frac{\alpha Y}{\mu_p K} \tag{A6}$$

Let:

$$R^k = \frac{1}{\beta} - 1 + \delta \tag{A7}$$

we can equate:

$$R^k = \frac{1}{\beta} - 1 + \delta = \frac{\alpha Y}{\mu_p K} = R_t^k \tag{A8}$$

solving for:

$$\frac{1}{\beta} - 1 + \delta = \frac{\alpha Y}{\mu_p K} \quad \Rightarrow \quad \alpha\frac{Y}{K} = \mu_p\left(\frac{1}{\beta} - 1 + \delta\right) \tag{A9}$$

Lastly, we obtain:

$$
\begin{aligned}
\gamma_c &= 1 - \frac{\delta\alpha}{\alpha\frac{Y}{K}} - \gamma_{nm} - \gamma_m \\
&= (1 - \gamma_{nm} - \gamma_m) - \frac{\delta\alpha}{\alpha\frac{Y}{K}} \\
&= (1 - \gamma_{nm} - \gamma_m) - \frac{\delta\alpha}{\mu_p\left(\frac{1}{\beta} - 1 + \delta\right)}
\end{aligned}
$$

This result confirms that the steady state ratio between consumption and output is independent from share of non-Ricardian consumers.

References

[1] Auerbach, A. (2000). "Formation of Fiscal Policy: the Experience of the Past Twenty-Five years", *Federal Reserve Bank of New York Economic Policy Review*, April 2000, 9-32.

[2] Barro, R. (1974). "Are Government Bonds Net Wealth?", *Journal of Political Economy*, 82,1095-1117.

[3] Barro, R. (1979). "On the Determination of the Public Debt", *Journal of Political Economy*, 87, 940-971.

[4] Barro, R. (1981). "Output effects of government purchases", *Journal of Political Economy*, 89(6), 1115.

[5] Barro, R. (2011). "Macroeconomic Effects From Government Purchases and Taxes", *The Quarterly Journal of Economics*, 126(1), 51-102.

[6] Beetsma, R., Giuliodori M., & Klaassen, F. (2006). "Trade Spill-Overs of Fiscal Policy in the European Union: A Panel Analysis", *Economic Policy*, 21(48): 639-687.

[7] Beetsma, R., Cukierman, A., & Giuliodori, M. (2007). "On the relationship between defence and non-defence spending in the U.S. during the world wars", *Economics Letters,* 95, 415-421.

[8] Beetsma, R. (2008). "A Survey of the Effects of Discretionary Policy", *Working paper, University of Amsterdam, Amsterdam School of Economics.*

[9] Beetsma, R., & Giuliodori, M. (2011). "The Effects of Government Purchases Shocks: Review and Estimates for the EU", *Economic Journal*, 121(550), F4-F32.

[10] Benetrix, A., & Lane, P., (2009). "Fiscal Shokcs and the Real Exchange Rate", *IIIS Discussion Paper N. 286.*

[11] Bilbiie, F., Meier, A., & Müller, G. (2008). "What Accounts for the Changes in U.S. Fiscal Policy Transmission?", *Journal of Money, Credit and Banking*, 40(7), 1439-1470.

[12] Blanchard, O., & Perotti, R. (2002). "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output", *Quarterly Journal of Economics*, 117, 1329-1368.

[13] Bohn, H. (1998). "The Behavior of U.S. Public Debt and Deficits", *Quarterly Journal of Economics*, 113, 949–63.

[14] Boulding, K. (1973). "The Impact of the defence industry on the structure of the American Economy" In: Udis, B. (Ed.), The Economic Consequences of Reduced Military Spending. *Lexington Books*, Lexington, 225–252.

[15] Burnside, C., Eichenbaum, M., & Fisher, j. (2004). "Fiscal shocks and their consequences", *Journal of Economic Theory,* 115, 89-117.

[16] Caldara, D., & Kamps, C. (2012). "The analytics of SVARs: a unified framework to measure fiscal multipliers,", *Finance and Economics Discussion Series 2012-20*, Board of Governors of the Federal Reserve System (U.S.).

[17] Calvo, G., A. (1983). "Staggered Prices in a Utility-Maximizing Framework", *Journal of Monetary Economics*, 13, 383-98.

[18] Campbell, J., & Mankiw, N. (1989). "Consumption, Income, and Interest Rates: Reinterpreting the Time Series Evidence", *NBER Macroeconomics Annual 1989*, edited by O. J. Blanchard and S. Fischer. MIT Press,185-216.

[19] Canova, F., & Pappa, E. (2007). "Price Differentials in Monetary Unions: The Role of Fiscal Shocks", *Economic Journal*, 117, 713-737.

[20] Canzoneri, M., Collard, F., Dellas, H., & Diba, B., (2012). "Withering Government Spending Multipliers", *Journal of Money, Credit and Banking*, 44, 185-210.

[21] Clarida, R., Galí, J., & Gertler, M. (2000). "Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory", *Quarterly Journal of Economics*, 115, 147-180.

[22] Cogan, F., Cwik, T., & Taylor, J. (2010). "New Keynesian versus old Keynesian government spending multipliers", *Journal of Economic Dynamics and Control*, 34(3), 281-295.

[23] Corsetti, G., Meier A., & Muller, G.J. (2012). "Fiscal Stimul with Spending Reversal", *Review of Economics and Statistics*, XCVI(4), 878-895.

[24] Edelberg, W., Eichenbaum, M., & Fisher, J. (1999). "Understanding the Effects of Shocks to Government Purchases", *Review of Economic Dynamics*, 2, 166-206.

[25] Edelstein, M. (1990). "What price cold war? Military spending and private investment in the US, 1946–1979", *Cambridge Journal of Economics,* 14, 421-437.

[26] Enders, Z., Muller, G., & Scholl, A. (2008). "How Do Fiscal and Technology Shocks Affect Real Exchange Rates? New Evidence for the United States", *Center of Financial Studies*, N. 2008/22.

[27] Favero, C., & Giavazzi, F. (2007). "Debt and the Effects of Fiscal Policy", *NBER Working Papers 12822, National Bureau of Economic Research, Inc..*

[28] Feldstein, M. (2008). "Defense Spending Would Be Great Stimulus", *Wall Street Journal.*

[29] Forni, M., & Gambetti, L. (2010). "The dynamic effects of monetary policy: A structural factor model approach", *Journal of Monetary Economics*, 57(2), 203-216.

[30] Galí, J., & and Perotti, R. (2003). "Fiscal Policy and Monetary Integration in Europe". *Economic Policy*, 37, 534-72.

[31] Galí, J., López-Salido, D., & Vallés, J. (2007). "Understanding the Effects of Government Spending on Consumption", *Journal of the European Economic Association*, 5, 227-70.

[32] Giordano, R., Momigliano S., Neri, S., & Perotti, R. (2007). "The Effects of Fiscal Policy in Italy: Evidence from a VAR Model", *European Journal of Political Economy*, 23(3), 707-733.

[33] Hall, R. (1986). "The Role of Consumption in Economic Fluctuations", *NBER Chapters, in: The American Business Cycle: Continuity and Change*, 237-266.

[34] Jacob, P. (2015). "Deep Habits, Price Rigidities and the Consumption Response to Government Spending", *Journal of Money, Credit and Banking*, 47(2-3), 481-510.

[35] King, R., & Watson, M. (1996). "Money, Prices, Interest Rates and the Business Cycle", *Review of Economics and Statistics*, 78, 35-53.

[36] King, R., & Rebelo, S. (1999). "Resuscitating real business cycles," *Handbook of Macroeconomics*, 1, 927-1007.

[37] Leeper, M., Plante, M., & Traum, N. (2010). "Dynamics of fiscal financing in the United States", *Journal of Econometrics,* 156(2), 304-321.

[38] Leeper, M., Richter, W., & Walker, B. (2012). "Quantitative Effects of Fiscal Foresight", *American Economic Journal: Economic Policy,* 4(2), 115-144.

[39] Leeper, M., Walker, B., & Yang, S. (2013). "Fiscal Foresight and Information Flows", *Econometrica*, 81(3), 1115-1145.

[40] Mankiw, N., G. (2000). "The Savers-Spenders Theory of Fiscal Policy", *American Economic Review*, 90, 120-125.

[41] Marcellino, M. (2006). "Some Styilized Facts on Non-Systematic Fiscal Policy in the Euro Area", *Journal of Macroeconomics*, 28, 461-479.

[42] Marques, C. (2004). "Inflation persistence - facts or artefacts?", *Working Paper Series 371*, European Central Bank.

[43] Monacelli, T., & Perotti, R. (2008). "Openness and the Sectoral Effects of Fiscal Policy", *Journal of the European Economic Association*, 6 (2.3), 395-403.

[44] Mountford, A., & Uhlig, H. (2005). "What Are the Effets of Fiscal Policy Shocks?", *SFB 649 Discussion Papers SFV649DP2005-039*, Sonderforschungsbereich 649, Humboldt University, Berlin, Germany.

[45] Muller, G. (2008). "Understanding the Dynamic Effects of Government Spending on Foreign Trade", *Journal of International Money and Finance*, 27 (3), 345-371.

[46] Pieroni, L. (2009). "Does defence expenditure affect private consumption? Evidence from the United States", *Economic Modelling*, 26(6), 1300-1309.

[47] Perotti, R. (2005). "Estimating the effects of fiscal policy in OECD countries", Proceedings, *Federal Reserve Bank of San Francisco.*

[48] Ramey, V., A., & Shapiro, M., D. (1998). "Costly capital reallocation and the effects of government spending", *Carnegie-Rochester Conference Series on Public Policy*, 48, 145-194.

[49] Ramey, V., A. (2011). "Identifying Government Spending Shocks: It's all in the Timing", *The Quarterly Journal of Economics*, 126(1), 1-50.

[50] Rotemberg, J., Woodford,M., (1997). "An Optimization Econometric Framework for the Evaluation of Monetary Policy", *NBER Macroeconomics Annual 1997*, edited by O. J. Blanchard and S. Fischer. MIT Press, pp. 297-346.

[51] Rotemberg, J., & Woodford, M. (1999). "Interest Rate Rules in an Estimated Sticky Price Model", *Monetary Policy Rules*, edited by J.B. Taylor, University of Chicago Press and NBER.

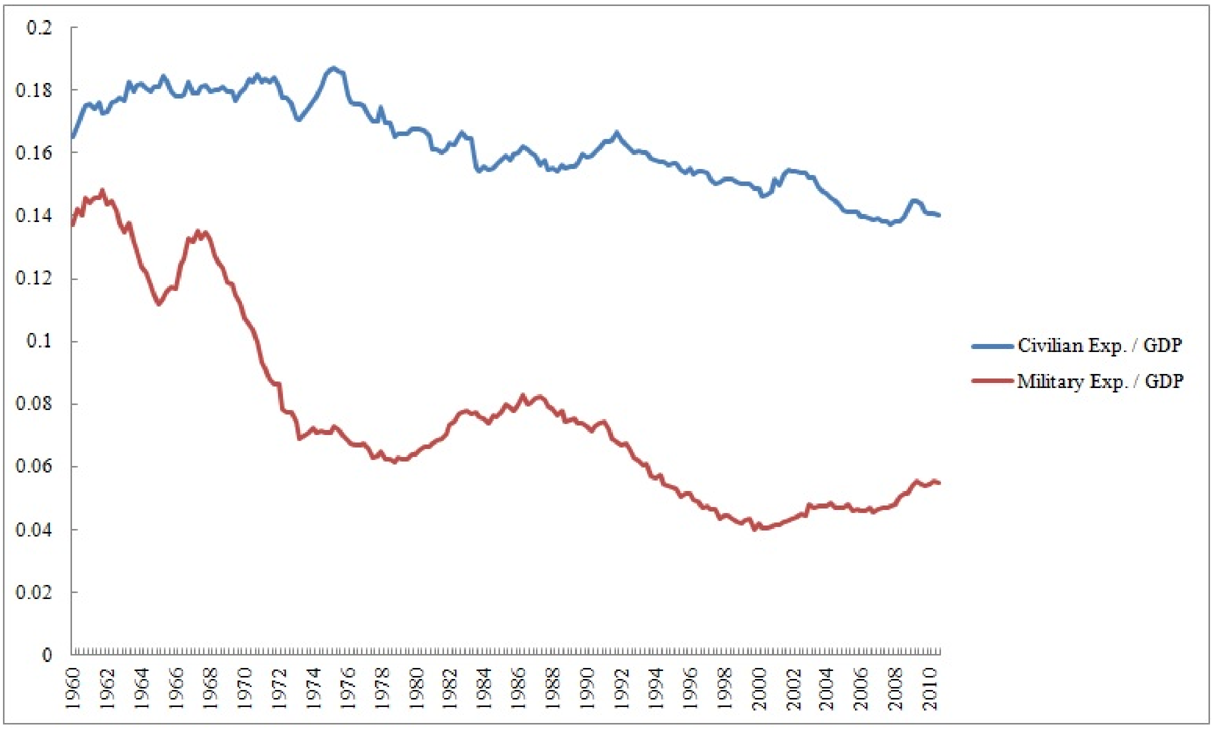
[52] Sims, C., Stock, J., & Watson, M. (1990). "Inference in Linear Time Series Models with Some Unit Roots", *Econometrica*, 58, 113-44.

[53] Smith, R. (1980). "Military expenditure and investment in OECD countries, 1954-1973", *Journal of Comparative Economics,* 4, 19-32.

[54] Taylor, J., (1993). "Discretion versus Policy Rules in Practice", *Carnegie Rochester Conference Series on Public Policy*, 39, 195-214.

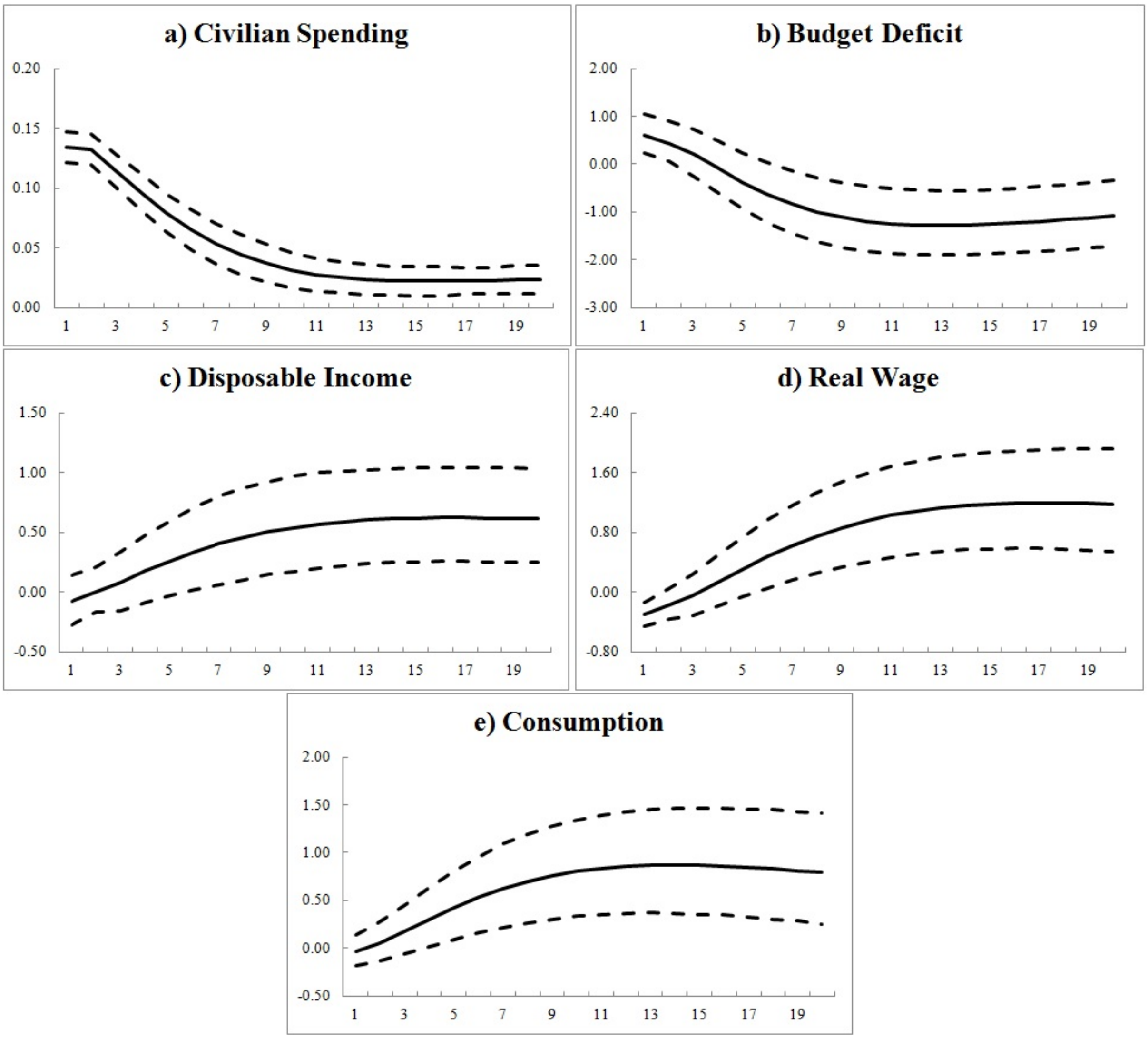
[55] Uhlig, H., (2005). "What Are the Effects of Monetary Policy on Output? Results from An Agnostic Identification Procedure", *Journal of Monetary Economics*, 52 (2), 381-419.

[56] Zubairy, S., (2014). "On Fiscal Multipliers: Estimates From A Medium Scale Dsge Model", *International Economic Review*, 55, 169-195.



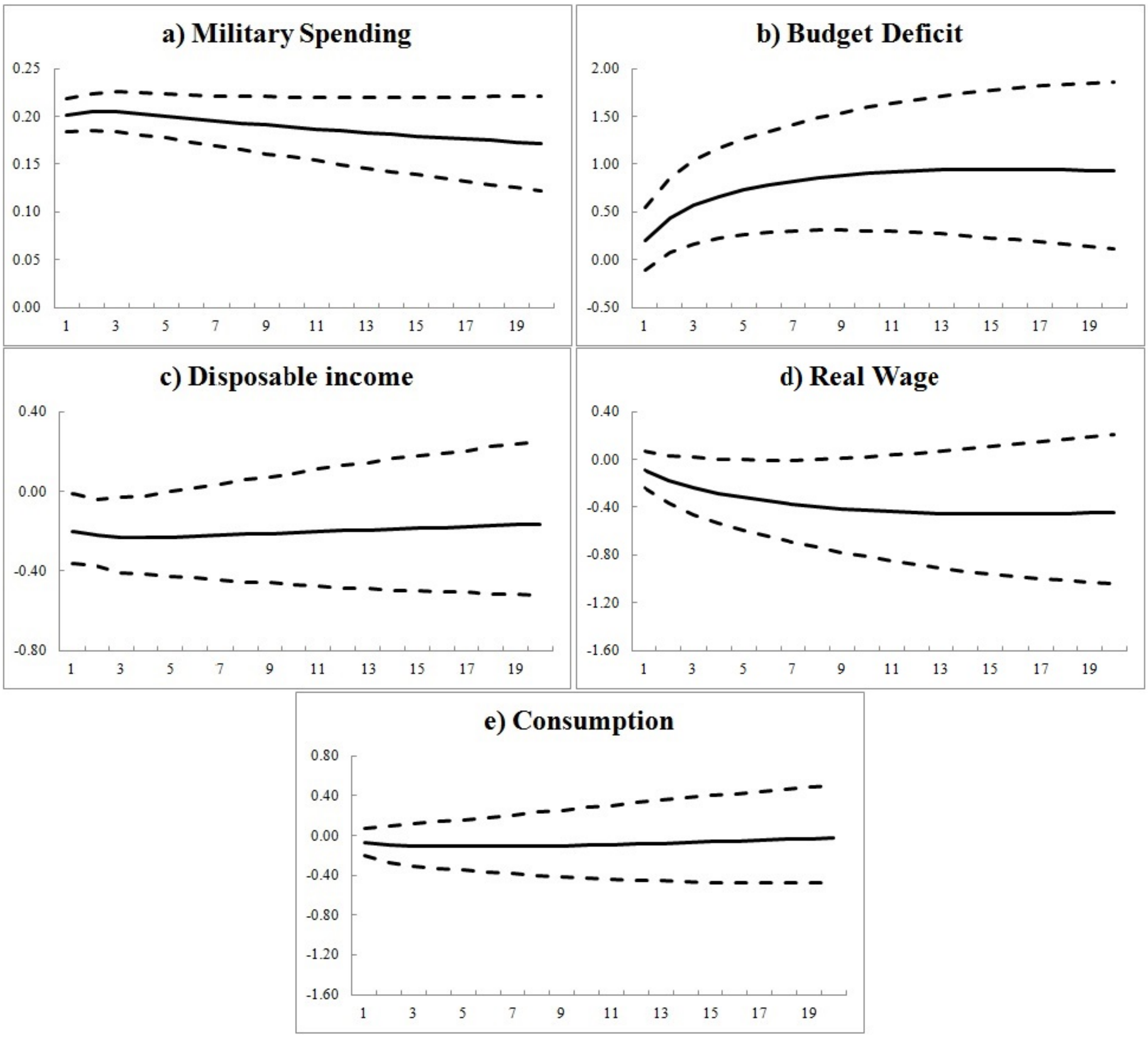
Notes: The relative shares of civilian and military expenditures on GDP are obtained from the Bureau of Economic Analysis (National Economic Accounts).

Figure 1: Civilian and Military Expenditures as shares of GDP



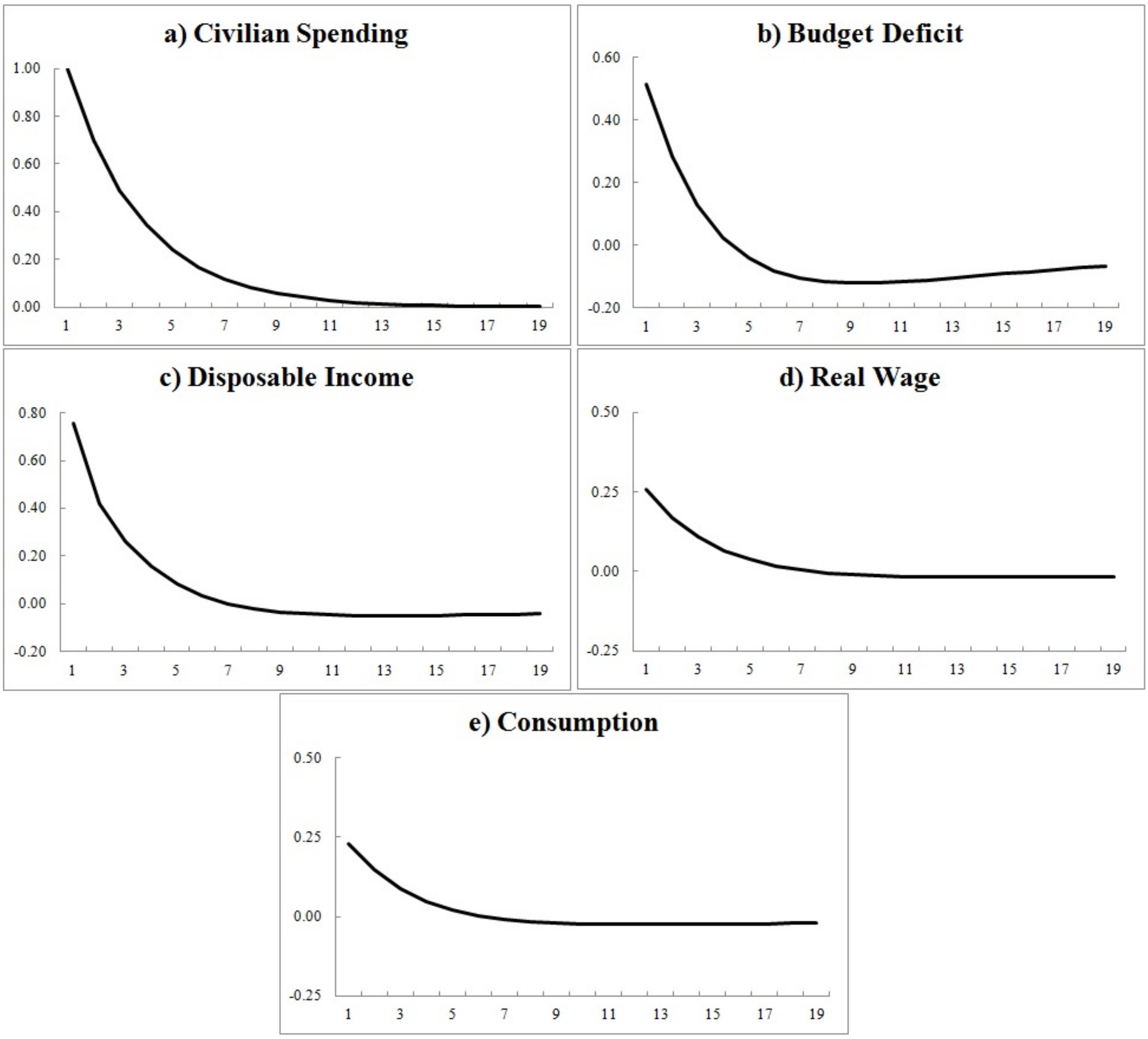
Notes: Estimated impulse responses to a civilian spending shock in SVAR. Sample Period 1960:1-2010:4. Horizontal axis: quarters after shock. Confidence intervals: (+/-)1 standard deviations of empirical distributions, based on 10,000 Monte Carlo replications.

Figure 2: Response of VAR Model to a Civilian Spending Shock



Notes: Estimated impulse responses to a military spending shock in SVAR. Sample Period 1960:1-2010:4. Horizontal axis: quarters after shock. Confidence intervals: (+/-)1 standard deviations of empirical distributions, based on 10,000 Monte Carlo replications.

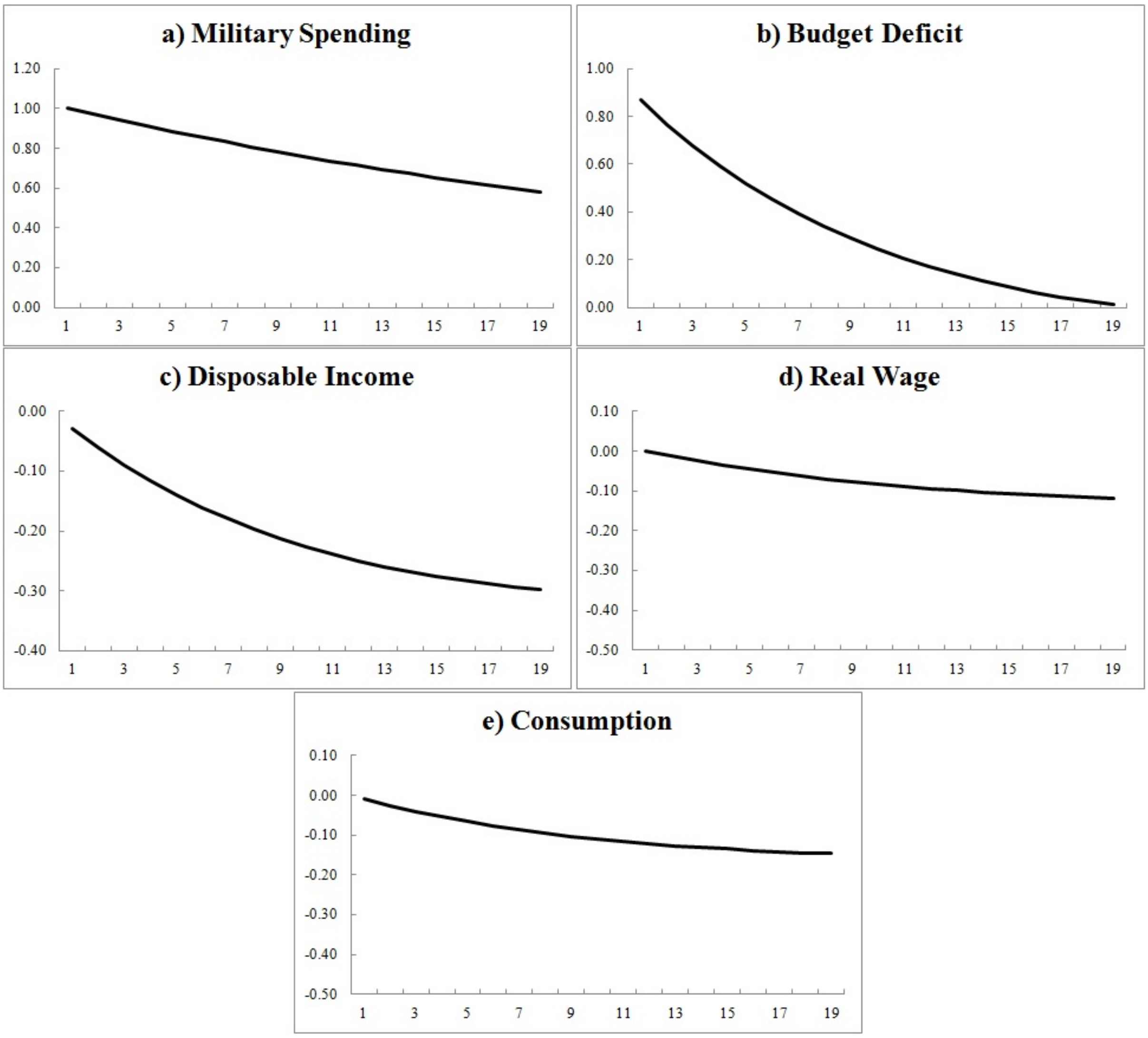
Figure 3: Response of VAR Model to a Military Spending Shock



Notes: The shock is normalized to 1% of civilian expenditure in steady state.

Figure 4: Dynamic Effects of Civilian Spending Shock

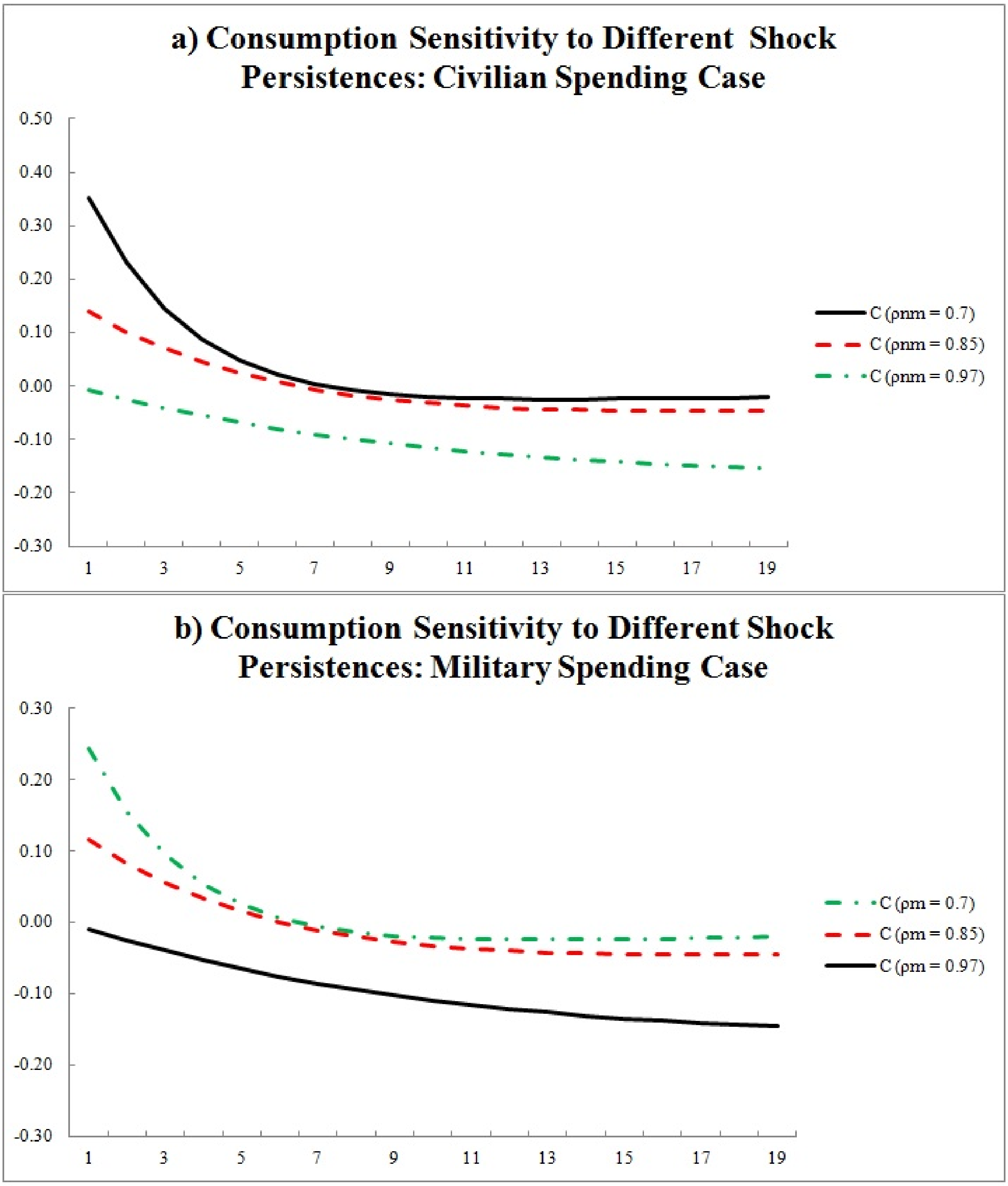
.



Notes: The shock is normalized to 1% of military expenditure in steady state.

Figure 5: Dynamic Effects of Military Spending Shock

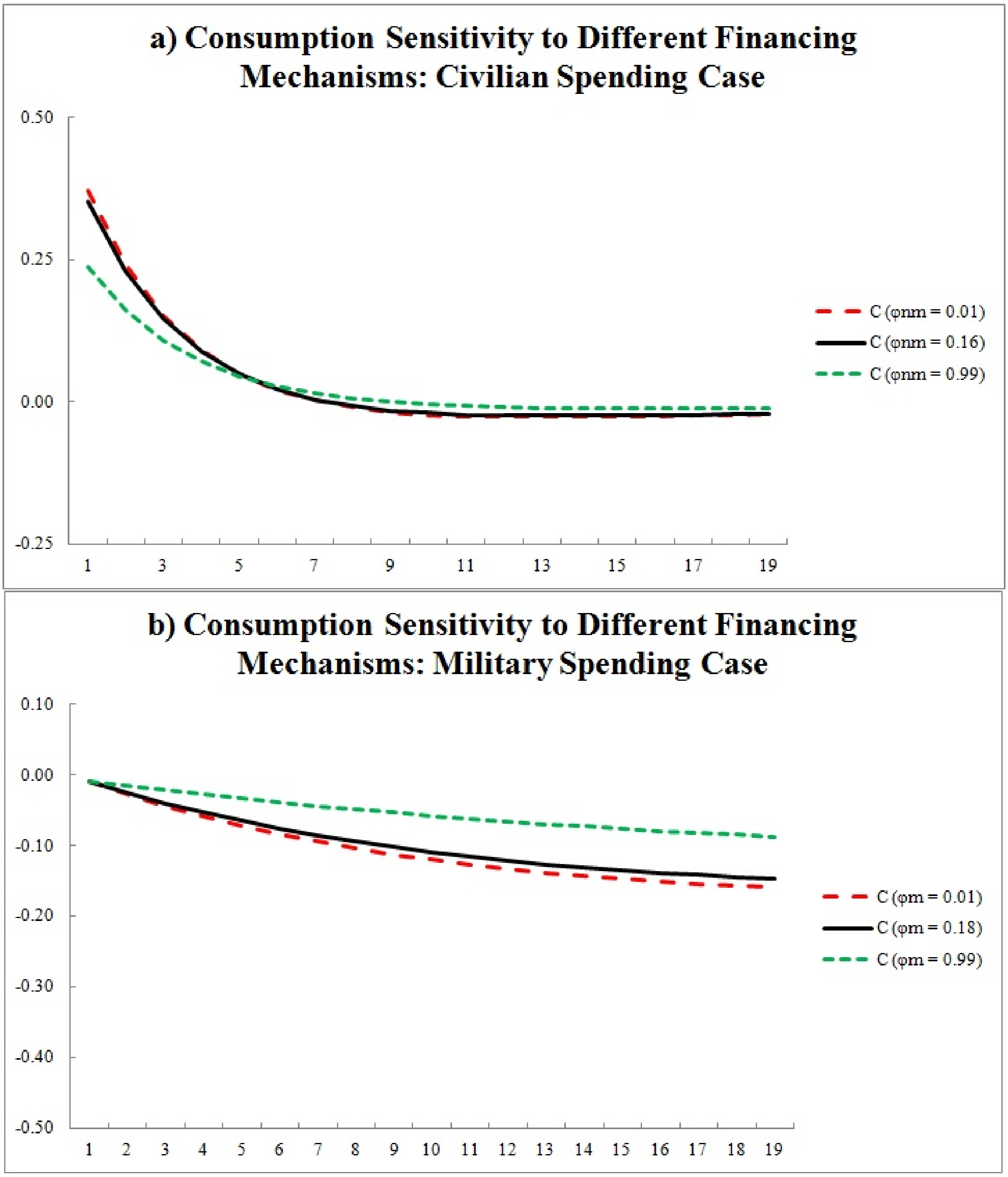
.



Notes: for civilian spending the solid black line corresponds to $\rho_{nm} = 0.70$*, the dash red line to* $\rho_{nm} = 0.85$ *and the dash dotted green line to* $\rho_{nm} = 0.97$*; for military spending the solid black line corresponds to* $\rho_m = 0.97$*, the dash red line to* $\rho_m = 0.85$ *and the dash dotted green line to* $\rho_m = 0.70$.

Figure 6: Consumption Sensitivity: Different Shock Persistences of Civilian and Military Expenditures

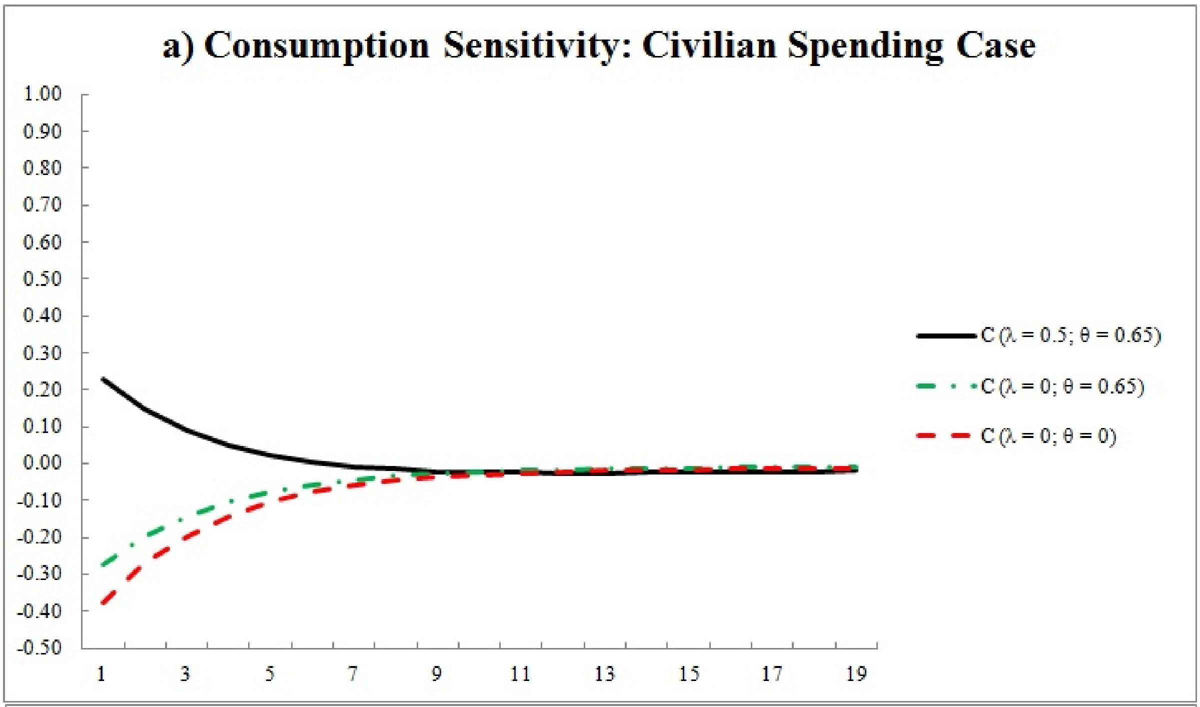
.

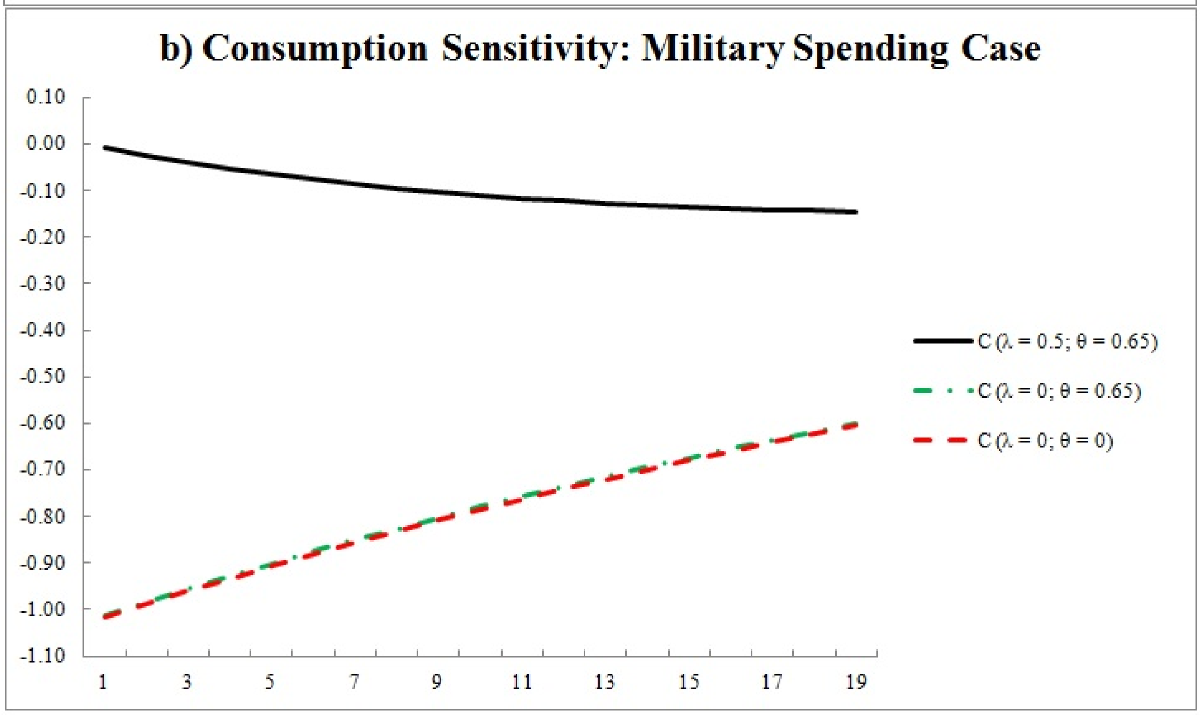


Notes: for civilian spending the solid black line corresponds to $\phi_{nm} = 0.16$*, the dash red line to* $\phi_{nm} = 0.01$ *and the dash dotted green line to* $\phi_{nm} = 0.99$*; for military spending the solid black line corresponds to* $\phi_m = 0.18$*, the dash red line to* $\phi_m = 0.01$ *and the dash dotted green line to* $\phi_m = 0.99$.

Figure 7: Consumption Sensitivity: Different Financing Mechanisms of Civilian and Military Expenditures

.





Notes: in both civilian and military shocks the solid black lines correspond to benchmark values of λ *and* θ*, the dash dotted green lines to* $\lambda = 0$ *and* $\theta = 0.65$ *and the dotted red lines to* $\lambda = 0$ *and* $\theta = 0$.

Figure 8: Consumption Sensitivity for Different Values of λ and θ

.

Table A.1: Government spending and financing mechanisms in the US for military conflicts and episodes

	Time	Military outlay (% of GDP)	Civilian outlay (% of GDP)	Budget Deficit (% of GDP)	Tax-revenue (% of GDP)
Vietnam conflict	Q1-1963	13.61	17.53	-0.85	28.83
	Q1-1965	11.21	17.67	-0.03	28.12
	Q1-1967	13.18	18.09	-2.71	28.51
	Q1-1969	12.15	17.81	0.43	31.57
	Q1-1971	9.73	17.99	-2.47	29.54
	Q1-1973	7.56	17.15	-0.19	31.28
	Q1-1975	7.21	18.76	-4.26	30.64
Carter-Reagan	Q1-1980	6.40	16.71	-2.12	31.36
Military Build-up	Q1-1982	7.16	16.38	-3.89	32.33
	Q1-1984	7.46	15.15	-4.56	31.46
	Q1-1986	7.72	15.82	-5.02	32.00
	Q1-1988	7.89	15.41	-4.04	32.76
Desert Storm	Q1-1989	7.35	15.39	-2.86	33.19
Operation	Q1-1991	7.45	16.27	-4.06	33.03
	Q1-1993	6.27	16.00	-5.83	32.46
11 September 2001	Q1-1999	4.21	14.92	0.63	34.84
and 2nd Iraq War	Q1-2000	4.01	14.81	1.79	35.73
	Q1-2001	4.09	14.83	0.93	35.49
	Q1-2002	4.27	15.34	-3.50	32.17
	Q1-2003	4.44	15.32	-4.68	31.76
	Q1-2004	4.73	14.69	-4.90	31.28

Notes: Percentages of civilian and military expenditures over GDP obtained from Bureau of Economic Analysis (various years). Budget deficit and tax revenues as percentages of GDP from OECD Economic Outlook, No. 88.

Table A.2: Estimated fiscal policy effects (civilian and military spending)

	Estimated Fiscal Policy Multipliers			
Quarters	1	4	8	12
Civilian spending	0.06	0.36	0.82	1.01
	[0.04/0.09]	[0.33/0.39]	[0.78/0.87]	[0.96/1.06]
Military spending	-0.09	-0.11	-0.10	-0.08
	[-0.08/-0.11]	[-0.08/-0.13]	[-0.07/-0.13]	[-0.05/-0.12]

Notes: Results from cumulated IRFs. 95% confidence intervals (CI) are listed in brackets.

Table A.3: Linearized model equations

Equations	Log-linearized equation
Tobin's q equation	$q_t = \beta E_t \{q_{t+1}\} + [1-\beta(1-\delta)] E_t \left\{r^k_{t+1}\right\} - (r_t - E_t\{\pi_{t+1}\})$
Investment equation	$i_t - k_t = \eta q_t$
Capital accumulation	$k_{t+1} = \delta i_t + (1-\delta) k_t$
Euler equation for Ricardians	$c^r_t = E_t\{c^r_{t+1}\} - (r_t - E_t\{\pi_{t+1}\})$
Euler equation for non-Ricardians	$c^{nr}_t = \left(\frac{WN^{nr}}{C^{nr}}\right)(w_t + n^{nr}_t) - \left(\frac{Y}{C^r}\right) t^{nr}_t$
Aggregate consumption equation	$c_t = \lambda c^{nr}_t + (1-\lambda) c^r_t$
Aggregate hours worked equation	$n_t = \lambda n^{nr}_t + (1-\lambda) n^r_t$
Wage equation	$w_t = c_t + \varphi n_t$
Intertemporal eq. condition for agg. cons.	$c_t = E_t\{c_{t+1}\} - \sigma(r_t - E_t\{\pi_{t+1}\}) -$
	$\Theta_n E_t\{\Delta n_{t+1}\} + \Theta_{tax} E_t\{\Delta t^{nr}_{t+1}\}$
New Keynesian Phillips curve	$\pi_t = \beta\{\pi_{t+1}\} - \lambda_p \hat{\mu}^p_t$
Price mark-up equation	$\mu^p_t = (y_t - n_t) - w_t = (y_t - k_t) - r^k_t$
Production function of final good firms	$y_t = a_t + (1-\alpha) n_t + \alpha k_t$
Monetary policy function	$r_t = r + \phi_\pi \pi_t$
Total Factor Productivity Shock	$a_t = \rho_a a_{t-1} + \epsilon^a_t$
Definitions	
	$t^{nr}_t = \frac{T^{nr}_t - T^{nr}}{Y}$
	$r_t \equiv R_t - 1$
Parameters	
	$\sigma = \gamma_c \Phi \mu^p (1-\lambda)$
	$\Theta_n = \lambda \Phi (1-\alpha)(1+\varphi)$
	$\Theta_{tax} = \lambda \Phi \mu^p$
	$\Phi = (\gamma_c \mu^p - \lambda(1-\alpha))^{-1}$
	$\gamma_c \equiv \frac{C}{Y}$
	$\lambda_p = (1-\beta\theta)(1-\theta)\frac{1}{\theta}$

Notes: Lower-case letters denote log-deviations with respect to the corresponding steady state values. q_t is the current value of capital stock, r^k_{t+1}, the expected rental rate, r_t, the nominal interest rate, π_{t+1}, the expected inflation, i_t, the investment, k_t, the capital service, c^r_t, the consumption of Ricardian households, c^{nr}_t, the consumption of non-Ricardian households, n^r_t, the hours worked of Ricardian households, n^{nr}_t, the hours worked of non-Ricardian households, w_t, the real wage rate, t^{nr}_t, the lump sum taxes of non-Ricardian consumers, c_t, the aggregate consumption, n_t, the aggregate hours worked, μ^p_t, the price mark-up, y_t, the final output, a_t, the total factor productivity.

Table A.4: Calibrated Parameters of the Model

Parameter	Symbol	Value	Target/Source
Discount Factor	β	0.99	Steady state real interest rate: 0.04
Elasticity of Investment wrt q	η	1	King and Watson (1996)
Depreciation Rate	δ	0.025	Annual depreciation on capital: 0.10
Fraction of non-Ricardians	λ	0.5	Galì et al. (2007)
Capital Share	α	1/3	Labor share: 70%
Elasticity of Wages wrt Hours Worked	φ	0.2	Rotemberg and Woodford (1997, 1999)
Mark-up Parameter	μ^p	0.2	Galì et al. (2007)
Probability of Price Fixed	θ	0.65	Average price duration: 4 quarters
Policy Rate Response to Inflation	ϕ_π	1.5	Clarida et al. (2000)
Response of Taxes to Civilian Spending	ϕ_{nm}	0.16	Estimates from our data sample
Response of Taxes to Military Spending	ϕ_m	0.18	Estimates from our data sample
Response of Taxes to Budget Deficit	ϕ_b	0.1	Calibrated according cond. in Eq. (8)
Persistence of Civilian Spending	ρ_{nm}	0.7	Estimates from our sample
Persistence of Military Spending	ρ_m	0.97	Estimates from our sample
Persistence of TFP	ρ_a	0.99	King and Rebelo (1999)

Notes: Calibration of the parameters according quarterly data.