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CFS WORKING PAPER

No. 2012/12

Fiscal Consolidation Strategy

John F. Cogan, John B. Taylor,
Volker Wieland, and Maik Wolters





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Fiscal Consolidation Strategy^{*}

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September 21, 2012

Abstract

In the aftermath of the global financial crisis and great recession, many countries face substantial deficits and growing debts. In the United States, federal government outlays as a ratio to GDP rose substantially from about 19.5 percent before the crisis to over 24 percent after the crisis. In this paper we consider a fiscal consolidation strategy that brings the budget to balance by gradually reducing this spending ratio over time to the level that prevailed prior to the crisis. A crucial issue is the impact of such a consolidation strategy on the economy. We use structural macroeconomic models to estimate this impact focussing primarily on a dynamic stochastic general equilibrium model with price and wage rigidities and adjustment costs. We separate out the impact of reductions in government purchases and transfers, and we allow for a reduction in both distortionary taxes and government debt relative to the baseline of no consolidation. According to the model simulations GDP rises in the short run upon announcement and implementation of this fiscal consolidation strategy and remains higher than the baseline in the long run. We explore the role of the mix of expenditure cuts and tax reductions as well as gradualism in achieving this policy outcome. Finally, we conduct sensitivity studies regarding the type of model used and its parameterization.

JEL Classifications: E27, E62, H62, H63, H68

Keywords: Fiscal Policy, Fiscal Consolidation, Government Debt, Government Deficit, DSGE Model

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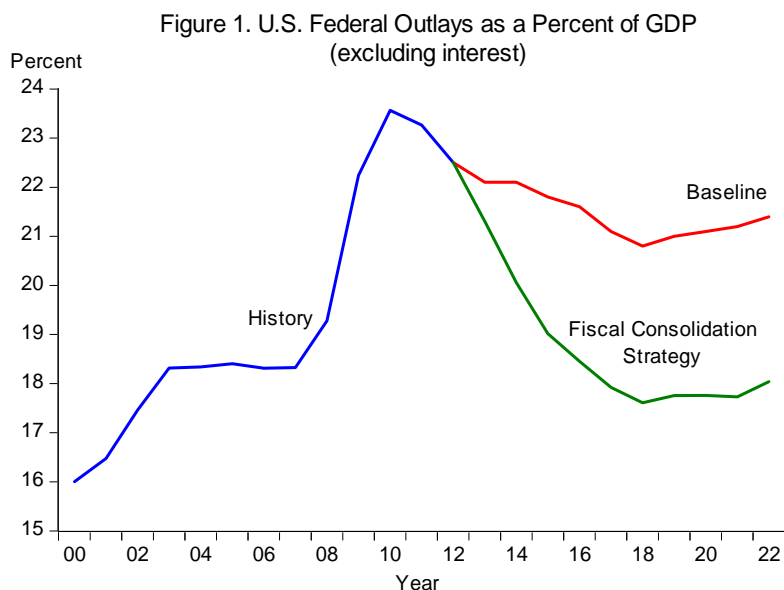
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1. Introduction

As a consequence of the financial crisis and great recession government deficits have risen substantially creating the need for a fiscal consolidation strategy to reduce the deficits and stop the growing debt. This increase in budget deficits resulted partly from greater spending and transfers and partly from lower tax receipts during the recession. Looking forward, sustained spending increases are particularly worrisome, because they ultimately require raising tax rates beyond pre-crisis levels, even after the economic recovery. Higher distortionary taxes may then dampen the economy's trend growth for a long time.

Figure 1 summarizes the federal government spending situation in the United States in 2012. It shows U.S. federal government outlays—excluding interest payments—relative to GDP. Government outlays (or government spending) include both government *transfers* and government *purchases* of goods and services. The history line shows the rapid increase in spending during the crisis. The 2012-2022 baseline is derived from the Congressional Budget Office's (CBO) Alternative Fiscal Scenario,¹ which projects the high spending levels to continue in the absence of a policy change. The interest payments on federal debt that is



expected to be issued to finance this high level of spending, (not shown in the chart) will add increasingly larger amounts to total federal spending. Under the baseline assumptions, interest

¹ Congressional Budget Office, The 2012 Long-Term Budget Outlook, June 2012. This baseline assumes that current federal expenditure policies will remain in place for the next decade. During this period, according to CBO, discretionary programs grow at a rate approximated by the rate of inflation. Mandatory programs, which are driven by three large entitlements; Social Security, Medicare and Medicaid, grow faster than GDP over the period 2013-2022, mainly as a result of an increase in the number of workers reaching retirement age and a continuation of rapidly rising health care costs. Under this baseline, non-interest federal spending gradually declines by one percent of GDP between 2013 and 2022.

payments rise from 1.4 percent of GDP in 2012 to 3.7 percent in 2022. Implicit in this baseline is a long-run increase in tax rates needed to reduce the deficit and thereby prevent the national debt from growing to economically dangerous levels. However, higher tax rates themselves will distort private incentives for saving, investment and capital accumulation to the detriment of economic growth and welfare.

Figure 1 also shows the path of federal government spending under a fiscal consolidation strategy that gradually returns spending to the pre-financial crisis level as a share of GDP. It is modelled on the 2013 Budget Resolution passed in March 2012 by the U.S. House of Representatives.² This plan, which contains reductions in both government purchases and transfer payments from their current trajectory, or baseline, might realistically be employed to reduce federal spending, and thereby, bring the U.S. federal budget deficit down from its current level of 9 percent of GDP. Because the U.S. federal budget was close to balance before the crisis, (the federal deficit was only 1.3 percent of GDP in 2007) this strategy would mitigate the size of any tax rate increase. Hence, relative to the 2012 policy baseline, long-run tax rates would be lower under this alternative strategy.

The purpose of this paper is to evaluate the impact of this fiscal consolidation plan on the U.S. economy, including quantifying its impact on GDP, consumption and investment. Of course, the size and sign of this impact is a crucial and widely debated policy question, which is at the heart of the current austerity debate. We use modern structural macroeconomic models to assess the impact.

Our primary tool for evaluating the short-, medium- and long-run impact of fiscal policy is a modified version of Coenen, McAdam and Straub's (2008) (CMS) model of the United States and euro area economies. Its authors have used it to investigate the impact of a reduction in distortionary taxes in the euro area. It is sometimes called the New-Area-Wide Model (NAWM) since a version of the model has been estimated and has replaced the so-called Area-Wide-Model (AWM) in European Central Bank policy analysis.³

The CMS model is a New Keynesian dynamic stochastic general equilibrium (DSGE) model. Thus, it accounts for the optimizing behaviour of forward-looking households and firms in an environment with short-term nominal rigidities, imperfect competition and a number of additional real economic frictions and adjustment costs. It includes a detailed fiscal sector and accounts for the evolution of government debt. On the expenditure side it

² House Concurrent Resolution, 112th Congress, 2nd Session, House Report No. 112, March 2012.

³ We have made our implementations of the AWM, NAWM and other models available online in a new macroeconomic model archive (see <http://macromodelbase.com>). The model comparison approach is presented in Taylor and Wieland (2012) and Wieland et al (2012).

distinguishes between government purchases and transfers. With regard to taxation it considers a variety of distortionary taxes.

For the purpose of our study of U.S. fiscal consolidation, we calibrate the parameters of the U.S. part of the CMS model with references to empirically estimated models, including the model of Cogan, Cwik, Taylor and Wieland (2010) (CCTW). The CCTW model is very similar to the well-known models of Christiano, Eichenbaum and Evans (2005) and Smets and Wouters (2007). It is estimated on U.S. data with Bayesian methods and useful as an empirically relevant benchmark, though it does not include distortionary taxes.

To further help establish the robustness of our results we also consider a simple neoclassical growth model with flexible prices and forward-looking households, which abstracts from all the rigidities and adjustment costs included in CMS model. Such a model is helpful for clarifying some of the longer-run implications of changes in government spending and taxes. For example, in this model, a reduction in future government spending allows for lower tax rates relative to baseline that will increase employment and GDP; if lower taxes are anticipated, then consumption will increase in the short run.

The paper is organized as follows. First, we discuss the fiscal consolidation strategy in more detail and compare it with the baseline assumption of what would happen if there were no consolidation. Then, we describe the properties of the macroeconomic model that we mainly use to evaluate the economic impact of the fiscal consolidation: the New Keynesian model of the United States and euro area economies by Coenen, McAdam and Straub (2008). The fourth section analyses the effect of the consolidation strategy on the U.S. economy using this model. The consolidation is found to induce a higher level of aggregate output throughout the simulation. In sections 5 and 6 we proceed to investigate the key ingredients of the strategy that ensure that a fiscal consolidation raises GDP even in the short- and medium-run. Section 7 provides additional sensitivity analysis regarding other types of models and parameterizations. Section 8 concludes.

2. Fiscal Consolidation Strategy

We have chosen the House Budget Resolution to give our analysis a degree of policy relevance. This budget plan is the only fiscal plan to have passed at least one house of the U.S Congress in recent years. The plan calls for sizeable reductions in expenditures in both discretionary and mandatory program expenditures relative to the budget baseline between

2013 and 2022. Under the plan, non-interest federal spending is projected to decline to 17.3 of GDP in 2022; a full 2.6 percentage points of GDP below the CBO baseline in that year.

Additionally, the Resolution's fiscal plan has two features that make it particularly well-suited for our purposes. First, it combines a long-term permanent reduction in government spending with near-term spending reductions that are gradually phased-in. This allows us to assess the impact of short and long run spending cuts in a single plan. Second, the fiscal plan's long-term spending reductions are heavily weighted toward transfers rather than purchases. Since the fiscal problem facing the U.S. and most of the European countries is primarily the result of large and growing transfer payment programs, the fiscal plan attacks the fiscal problem faced by each of the countries at its source. Thus, the results from our chosen fiscal consolidation plan have implications beyond the United States.

The Fiscal Consolidation Strategy is measured against the CBO budget baseline through the year 2022. Thereafter, we assume that the Strategy's annual expenditure reduction relative to the baseline remains fixed at its 2022 level. To estimate its impact with structural macroeconomic models, the baseline and House Budget Resolution estimates, both of which are presented on a unified federal budget basis, must be first converted to a National Income and Products Account (NIPA) basis. Unfortunately, the publicly available data on the CBO baseline and the Resolution does not contain sufficient detail to permit a precise conversion to be made. Nevertheless, a reasonably accurate conversion may be obtained by making a few simple assumptions.

Our NIPA-based expenditure projections are obtained by converting three large categories of non-interest federal spending into federal purchases and transfer payments. The first category consists of four main federal entitlements: Social Security, Medicare, Medicaid, and health insurance subsidies under the Affordable Care Act. These expenditures, which account for nearly one-half of all federal spending are treated as transfers.⁴ The second category consists of defense expenditures.⁵ All of the spending in this category, which accounts for 20 percent of federal spending, is classified as purchases. The third category consists of all other non-interest expenditures. These expenditures are allocated to purchases and transfers according to their share in 2011, the latest year for which we have a detailed conversion of federal budget expenditures into NIPA expenditures.

A final step is to convert the annual budget data series to quarterly data. This step was accomplished by linearly interpolating the deviations of purchases and transfers from the

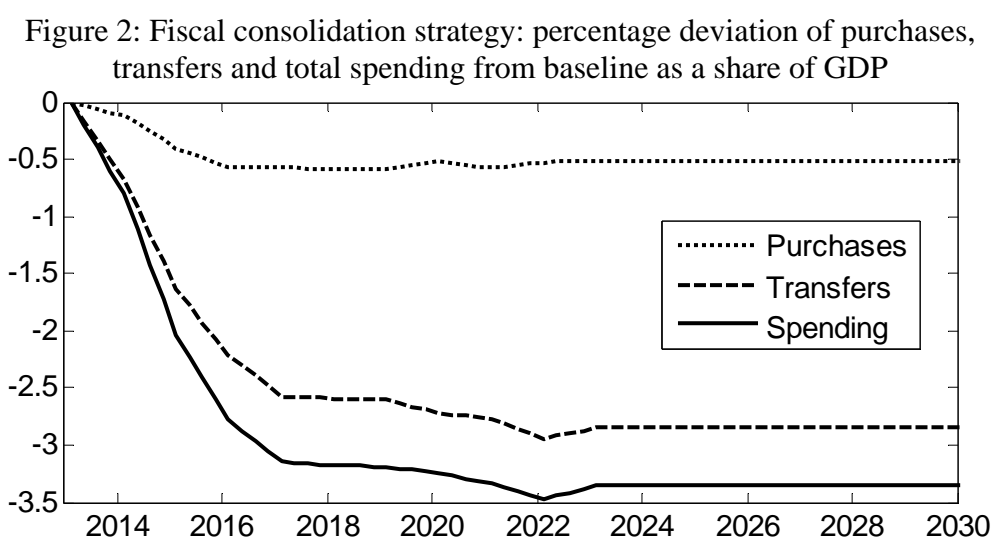
⁴ Medicare expenditures are gross of Medicare receipts, mainly premium payments by enrollees. Under NIPA accounting, these receipts are recorded as revenues.

⁵ Defense spending is measured by discretionary spending.

budget baseline, measured as a share of GDP, that is, each value in the annual series was assigned to the last quarterly observation of the associated annual series. Then intermediate points were placed on straight lines connecting these points.

Purchases and transfer payments under the Fiscal Consolidation Strategy

The budgetary impact of the Fiscal Consolidation Strategy, shown earlier in Figure 1, is substantial. By 2022, federal expenditures relative to GDP are reduced relative to the baseline by 3.4 percentage points. **Figure 2** shows how this reduction is distributed between federal government purchases and federal government transfer payments.



As the chart shows, the plan's major budgetary impact is achieved through a reduction in transfer payments. The plan reduces transfers relative to the budget baseline by 2.5 percentage points. Most of this reduction occurs relatively early in the ten year period; by 2015. The plan's impact on federal purchases is, in contrast, relatively modest. Government purchases decline relative to GDP by only .6 percentage points. As was the case with transfers, most of the decline in purchases occurs early; by 2015.

Debt and tax rates under the Fiscal Consolidation Strategy

Because the reform spending path is lower than the baseline spending path, it allows for lower tax rates and/or lower levels of government debt. We assume a mixture. Under the Fiscal Consolidation Strategy, the funds released from reduced federal spending are used to reduce the labor tax rate by about 5 percentage points relative to baseline with the remaining

funds used to reduce the debt to GDP ratio as implied by the budget constraint and the model of the economy.

To be clear, the tax cuts are relative to a baseline, which, if it corresponds to the actual current outlook for the United States economy, implicitly includes tax rate increases. Thus, in terms of practical implementation in the United States, our consolidation strategy would tend to deviate from the baseline outlook by avoiding tax increases rather than requiring actual tax cuts.

3. A model for evaluating the short-, medium- and long-run impact of fiscal consolidation

As emphasized by the well-known Lucas critique policy evaluation requires structural models that account explicitly for the decision-making of rational, forward-looking households and firms. Furthermore, an evaluation of short- to medium run changes in government expenditures should take into consideration the existence of nominal rigidities that prevent immediate adjustment towards market solutions under fully flexible prices. Such rigidities induce important interactions between monetary and fiscal policy, at least in the short-run. Finally, any model used to analyze the implications of changes in the government's budget including their effect on fiscal sustainability needs to incorporate government debt as well as the distortions in household and firm decisions resulting from taxes that are not collected lump-sum.

The model of Coenen, McAdam and Straub (CMS) (2008) satisfies these conditions. It is a modern, state-of-the-art dynamic stochastic general equilibrium (DSGE) model with optimizing and forward-looking households and firms. It is a New-Keynesian model with nominal rigidities in price and wage setting as well as additional real frictions, adjustment costs and monopolistic competition. Furthermore, it takes into account distortionary taxes on income, capital and consumption as well as the accumulation of government debt.

The CMS model covers two large open economies, the United States and the euro area. Coenen et al (2008) calibrate both economies symmetrically using parameter estimates for the euro area from Smets and Wouters (2003). Instead, we calibrate the US part of the model using parameter values from Cogan et al (2010) who used US data to estimate a version of the model by Smets and Wouters (2007) extended to include rule-of-thumb consumers. Under our calibration, the model may be used to analyze fiscal consolidation in the United States and its spillovers to the euro area.

Each economy contains households, firms, a fiscal and a monetary authority. We start with a description of the fiscal authority and then introduce the optimization problems of the households and firms to show how the different fiscal variables enter these decision problems.

Fiscal authority

To better understand the structure of the fiscal sector in the CMS model, it is useful to review the government budget constraint:

$$\begin{aligned}
P_{G,t}G_t + TR_t + B_t + M_{t-1} = \\
\tau_t^C P_{C,t}C_t + \tau_t^N (W_{I,t}N_t^I + W_{J,t}N_t^J) + \tau_t^{W_h} (W_{I,t}N_t^I + W_{J,t}N_t^J) + \tau_t^{W_f} W_t N_t + \\
\tau_t^K (R_{K,t}u_t - (\Gamma_u(u_t) + \delta)P_{I,t})K_t + T_t + R_t^{-1}B_{t+1} + M_t
\end{aligned} \tag{1}$$

The left hand side denotes expenditures while the right hand side denotes revenues. G_t , TR_t , τ_t^C , τ_t^N , $\tau_t^{W_h}$, $\tau_t^{W_f}$ and τ_t^K refer to government consumption, transfers, the consumption tax rate, the labor tax rate, employee and employers' social security contributions and the capital tax rate, respectively. These are all set exogenously. B_t and M_t are government bonds and money supply. Demands for these assets are determined by the household's utility maximization as characterized by first order conditions. Lump sum taxes T_t are determined by the following equation in which transfers as a fraction of steady state nominal output are adjusted accordingly to the gap between target and actual debt as a share of nominal output:

$$\frac{T_t}{P_{Y,t}Y_t} = \phi_{B_y} \left(\frac{B_t}{P_{Y,t}Y_t} - B^* \right), \tag{2}$$

where $P_{Y,t}Y_t$ denotes nominal GDP and B^* denotes the debt-to-GDP target. This equation is used to determine what share of the budget deficit is paid for by changes in lump-sum taxes and what share is covered by accumulating new debt. The long run stock of debt relative to GDP is determined together by the target B^* and the endogenous demand for government bond holdings of domestic and foreign households.

Households

There are two types of households that are indexed by I and J . The members of household J can smooth consumption only via holding money, while members of household I can additionally buy domestic and foreign bonds and accumulate physical capital. The

members of household I are indexed by $i \in [0, 1 - \omega]$ and the members of household J are indexed by $j \in [1 - \omega, 1]$. Each member i of household I maximizes the following utility function:

$$E_t \left[\sum_{k=0}^{\infty} \beta^k \left(\frac{1}{1-\sigma} (C_{i,t+k} - \kappa C_{I,t+k-1})^{1-\sigma} - \frac{1}{1+\theta} (N_{i,t+k})^{1+\theta} \right) \right], \quad (3)$$

where $C_{i,t}$ denotes consumption of member i of household I , $C_{I,t}$ denotes average consumption of all members of household I and $N_{i,t}$ denotes hours worked. β is the discount factor, σ denotes the inverse of the intertemporal elasticity of substitution, θ is the inverse of the Frisch labor supply elasticity and κ determines the degree of habit formation. The household maximizes utility by choosing consumption, $C_{i,t}$, investment, $I_{i,t}$, next period's capital stock, $K_{i,t+1}$, the intensity with which existing capital is utilised, $u_{i,t}$, next period's holdings of domestic and internationally traded bonds, $B_{i,t+1}$ and $B_{i,t+1}^F$, and current period's money holdings $M_{i,t}$. Household members take into account their budget constraint:

$$\begin{aligned} & (1 + \tau_t^C + \Gamma_v(\nu_{i,t}))P_{C,t}C_{i,t} + P_{I,t}I_{i,t} + R_t^{-1}B_{i,t+1} + \left((1 - \Gamma_{B^F}(B_t^F))R_{F,t} \right)^{-1}S_tB_{i,t+1}^F + M_{i,t} + \phi_{i,t} \\ & = (1 - \tau_t^N - \tau_t^{W_h})W_{i,t}N_{i,t} + (1 - \tau_t^K)(R_{K,t}u_{i,t} - \Gamma_u(u_{i,t})P_{I,t})K_{i,t} \\ & + \tau_t^K \delta P_{I,t}K_{i,t} + (1 - \tau_t^D)D_{i,t} + TR_{i,t} - T_{i,t} + B_{i,t} + S_tB_{i,t}^F + M_{i,t-1}. \end{aligned} \quad (4)$$

$P_{C,t}$ and $P_{I,t}$ denote the prices of one unit of the consumption and the investment good, respectively. R_t and $R_{F,t}$ are the risk-less returns on domestic and internationally traded bonds, respectively. Internationally traded bonds are denominated in foreign currency. To obtain the domestic value they are multiplied with the nominal exchange rate S_t . $W_{i,t}$ denotes the wage, $R_{K,t}$ denotes the rental rate for capital services rent to firms, $u_{i,t}K_{i,t}$, and $D_{i,t}$ denotes dividend payments.

The budget constraint indicates some frictions that the household has to take into account. The purchase of the consumption good is subject to a transaction cost Γ_v that depends on the consumption-based velocity, $\nu_{i,t}$. Γ_{B^F} is a financial intermediation premium that the households must pay when buying internationally traded bonds. Varying the intensity

of capital utilisation relative to its steady-state level is subject to a cost $\Gamma_u(u_{i,t})$. The budget constraint includes a number of different tax rates so that changes in fiscal policy have a direct effect on the consumption-savings choice, the labor supply, investment decisions and the other variables the household members use to maximize their expected life-time utility. Households pay taxes on consumption purchases, on wage income and on capital income. Furthermore, they pay social security contributions, a lump-sum tax and receive transfers. The household members take their decisions in a forward looking manner so that not only changes in fiscal policy today, but also anticipated future changes can have an immediate effect on households' decisions today.

The capital stock owned by household member i evolves according to the usual capital accumulation equation:

$$K_{i,t+1} = (1 - \delta)K_{i,t} + (1 - \Gamma_I(I_{i,t}/I_{i,t-1}))I_{i,t}, \quad (5)$$

where $\Gamma_I(I_{i,t}/I_{i,t-1})$ denotes investment adjustment costs. The members of household I have monopolistic power in the labor market and therefore some wage-setting power. To achieve sticky wages the staggered nominal wage setting scheme by Calvo (1983) is used. In each period household members can optimally reset their wage with probability $1 - \xi_I$. All members that reset their wage optimally set the same wage rate $W_{i,t} = \tilde{W}_{i,t}$. Those members that cannot reset their wage in a specific period adjust their wage by indexing it to a geometric average of last period's change in the price of the private consumption good and the steady-state consumer-price inflation rate:

$$W_{i,t} = \left(\frac{P_{C,t-1}}{P_{C,t-2}} \right)^{\chi_I} \pi_C^{1-\chi_I} W_{i,t-1}, \quad (6)$$

where χ_I denotes the indexation parameter. Households that are allowed to optimally reset their wage are assumed to maximize lifetime utility taking into account the indexation scheme and the demand for their labor services.

Members of household J also maximize the utility function in equation (3), but do not have access to the bond market and cannot accumulate physical capital. Therefore, they

choose consumption $C_{j,t}$ and money holdings $M_{j,t}$ to maximize their lifetime utility function subject to the following budget constraint:

$$(1 + \tau_t^C + \Gamma_v(v_{j,t}))P_{C,t}C_{j,t} + M_{j,t} = (1 - \tau_t^N - \tau_t^{W_h})W_{j,t}N_{j,t} + TR_{j,t} - T_{j,t} + M_{j,t-1} + \phi_{j,t} \quad (7)$$

The members of household J also act as wage-setters in a manner analogous to the members of household I . We deviate from Coenen et al (2008) by assuming that transfer and lump-sum tax payments are equally distributed between households of type I and J . Coenen et al (2008) instead consider an unequal distribution, which implies that changes in transfer payments induce redistribution of transfers and lump-sum taxes, a feature not intended to be part of the fiscal consolidation strategy that we evaluate.

Firms

There are two types of firms. Intermediate goods firms indexed by $f \in [0,1]$ produce a tradable differentiated intermediate good, $Y_{f,t}$. Perfectly competitive final goods firms combine domestically produced goods and imported intermediate goods into a consumption good, Q_t^C , an investment good, Q_t^I , and a public consumption good, Q_t^G .

Intermediate goods firms produce a single, tradable differentiated good using an increasing-returns-to-scale Cobb-Douglas technology with capital services and labor as inputs:

$$Y_{f,t} = \max[z_t K_{f,t}^\alpha N_{f,t}^{1-\alpha} - \psi, 0], \quad (8)$$

where $K_{f,t}$ denotes capital services rented from household I and $N_{f,t}$ an index of differentiated labour services provided by members of households I and J . z_t denotes total-factor productivity and ψ represents fixed cost of production that ensure zero profits in steady state. The firm takes the rental cost of capital, $R_{K,t}$, and the aggregate wage index, W_t , as given and minimises total input costs $R_{K,t}K_{f,t} + (1 + \tau_t^{W_f})W_tN_{f,t}$ which yields an equation for marginal cost. Marginal costs are identical across all firms as they face the same input prices:

$$MC_t = \frac{(R_{K,t})^\alpha \left((1 + \tau_t^{W_f}) W_t \right)^{1-\alpha}}{z_t \alpha^\alpha (1-\alpha)^{(1-\alpha)}}. \quad (9)$$

Intermediate goods firms have monopolistic pricing power. In addition, price changes are subject to staggered price contracts of the Calvo (1983) variety. The firms sell their goods in both the domestic and foreign market and charge different prices at home and abroad, i.e. they engage in local currency pricing.⁶ Each firm can reset domestic prices in period t with probability $1 - \xi_H$ and prices charged abroad with probability $1 - \xi_X$.

Firms that can optimally reset their domestic and/or foreign price in period t maximize the sum of discounted expected future profits taking as given domestic and foreign demand $H_{f,t}$ and $X_{f,t}$:

$$E_t \left[\sum_{k=0}^{\infty} \Lambda_{t,t+k} \left(\xi_H^k (P_{H,f,t} H_{f,t} - MC_t H_{f,t}) + \xi_X^k (S_t P_{X,f,t} X_{f,t} - MC_t X_{f,t}) \right) \right]. \quad (10)$$

Firms that cannot reset their price optimally in period t index it to a geometric average of last period's change in the price indexes $P_{H,t}$ and $P_{X,t}$ and the steady state inflation rates π_H and π_X :

$$P_{H,f,t} = \left(\frac{P_{H,t-1}}{P_{H,t-2}} \right)^{\chi_H} \pi_H^{1-\chi_H} P_{H,f,t-1}, \quad P_{X,f,t} = \left(\frac{P_{X,t-1}}{P_{X,t-2}} \right)^{\chi_X} \pi_X^{1-\chi_X} P_{X,f,t-1}. \quad (11)$$

The final goods firms produce the non-tradable final private consumption and investment goods by combining purchases of domestically produced intermediate goods with purchases of imported foreign intermediate goods using a constant-returns-to-scale CES technology:

$$Q_t^X = \left(\nu_X^{1/\mu_X} (H_t^X)^{1-1/\mu_X} + (1 - \nu_X)^{1/\mu_X} \left((1 - \Gamma_{IM,X} (IM_t^X / Q_t^X)) IM_t^X \right)^{1-1/\mu_X} \right)^{\mu_X / (\mu_X - 1)}, \quad X \in \{C, I\}, \quad (12)$$

where $\mu_X > 1$ denotes the intratemporal elasticity of substitution between domestic and foreign intermediate goods and ν_X denotes the home bias. There is also a cost $\Gamma_{IM,X}$ that the

⁶ See Cwik, Müller and Wolters (2011) for a detailed analysis of differences in producer currency pricing and local currency pricing and estimated shares for each pricing scheme.

firm has to pay when varying the use of the bundle of imported intermediate goods to make the import share relatively unresponsive in the short run to changes in the relative price of import goods.

The public consumption good is produced by combining domestic intermediate goods without any use of imported intermediate goods: $Q_t^G = H_t^G$.

Central bank

The monetary authority sets the interest rate according to the following Taylor-type rule with interest rate smoothing, where the nominal interest rate responds to deviations of CPI-inflation from the inflation target and output growth from steady state output growth:

$$R_t^4 = \phi_R R_{t-1}^4 + (1 - \phi_R) \left[R^4 + \phi_\Pi \left(\frac{P_{C,t}}{P_{C,t-4}} - \Pi \right) + \phi_{g_Y} \left(\frac{Y_t}{Y_{t-1}} - g_Y \right) \right]. \quad (13)$$

Parameterization

The countries differ with respect to their population size. Otherwise, Coenen et al (2008) have parameterized the two economies symmetrically using values estimated by Smets and Wouters (2003) with euro area data. By contrast we set most of the parameter values of the U.S. part of the model along the lines of Cogan et al's (2010) medium-scale DSGE model estimated with U.S. data.

Table 1 reports chosen parameter values. The labor supply elasticity equals $1/\theta = 0.5$ in both countries and is consistent with microeconomic estimates (see Chetty et al, 2011). Since it is a key parameter determining the effects of fiscal policy, we will examine the sensitivity of the simulation results to variations in this parameter in section 7.

We deviate from Coenen et al (2008) with respect to the calibration of the intertemporal elasticity of substitution. Instead of a value of $1/\sigma = 2$ we use $1/\sigma = 1$ for both economies. This value implies log utility and is consistent with a balanced-growth path. Though the model is simulated without trend growth, it is advisable to use growth-consistent preferences in order to render findings from model simulations meaningful to baseline scenarios with balanced growth.

Table 1: Parameter choices

Parameter	Symbol	U.S.	Euro zone
Labor supply elasticity	$1/\theta$	0.5	0.5
Intertemporal elasticity of substitution	$1/\sigma$	1	1
Share of constrained households J	$1 - \omega$	0.27	0.25
Calvo price stickiness, domestic market	ξ_H	0.65	0.90
Calvo price stickiness, exports	ξ_X	0.30	0.30
Price indexation parameter	χ_H	0.22	0.50
Calvo wage stickiness	ξ_I	0.73	0.75
Wage indexation parameter	χ_I	0.62	0.75
Home/foreign good substitution elasticities	μ_X	1.50	1.50
Adjustment cost conc.imports in investment	$\Gamma_{IM,X}$	2.50	2.50
Consumption habits parameter	κ	0.67	0.71
Tax Rates (in%):			
Consumption tax rate	τ^C	7.70	18.3
Labor tax rate	τ^N	15.4	12.2
Social security contributions (employee)	τ^{W_h}	7.10	11.8
Social security contributions (employer)	τ^{W_f}	7.10	21.9
Capital tax rate	τ^K	18.41	18.41

The other parameters may be found in the earlier equations and are taken from Cogan et al (2010) or Coenen et al (2008). The tax rates are key policy parameters and all taken from the comparative study of U.S. and euro area taxes by Coenen et al. Their values for consumption, income and social security taxes are based on data for the U.S. and the euro area. The capital tax rate is calibrated to match the observed investment-to-output expenditure ratio. The government consumption-to-GDP ratio is calibrated to $G_t/Y_t = 16\%$ for the US and $G_t^*/Y_t^* = 18\%$ for the euro area.

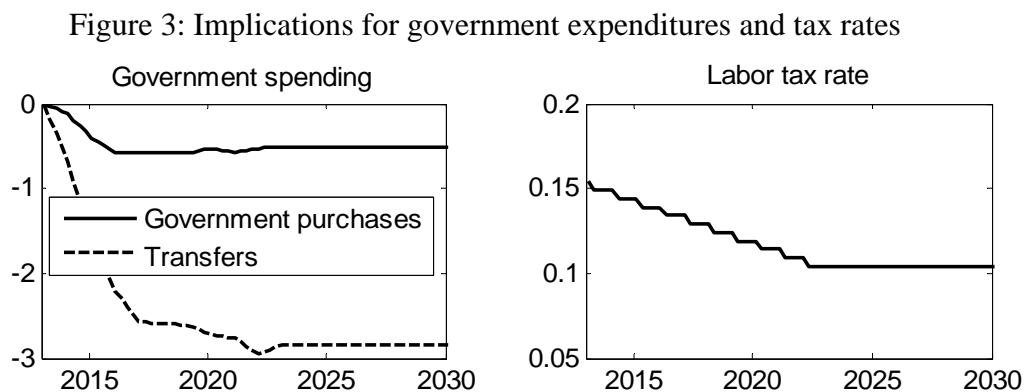
The target for the debt-to-GDP ratio is set to $B^* = 60\%$ of annual GDP in both countries. In Coenen et al (2008) transfers in per capita terms are unevenly distributed between households J and households I in the proportion 3 to 1. Lump-sum taxes in per capita terms

are collected in the proportion of 1 to 3 from household J and household I . We deviate from this setting and distribute transfers and lump-sum taxes equally between household J and I .

4. The impact of the Fiscal Consolidation Strategy

We consider the impact of the budget reform on the economy by simulating it in the CMS model.⁷ We assume that the strategy is announced and implemented starting in the first quarter of 2013 as indicated earlier in **Figure 1**. Thus, households and firms immediately anticipate that the plan is carried out from 2013 onwards. Making decisions in a forward-looking manner they take into account future reductions in government spending and taxes and expect after-tax income to rise. Given the planned reduction in the labor tax rate, they also face more favorable conditions for private sector production and work effort.

Figures 3 through **7** report on the impact of the budget reform on key macroeconomic variables. **Figure 3** displays the proposed changes in government expenditures, that is purchases and transfers, and the tax rate on labor income. They are exogenous inputs to the model simulations. As explained previously, expenditures are reduced gradually over the course of 10 years up to 3.4 percent of GDP below baseline. The labor tax is lowered gradually over the same period from 15 to 10 percent. The simulation is implemented as a transition from an initial baseline, actually a steady state, to a new state with lower government purchases and transfers and a lower labor tax. This scenario is considered with reference to the current situation in the United States, which requires returning government spending to pre-crisis levels in order to avoid impending tax hikes.

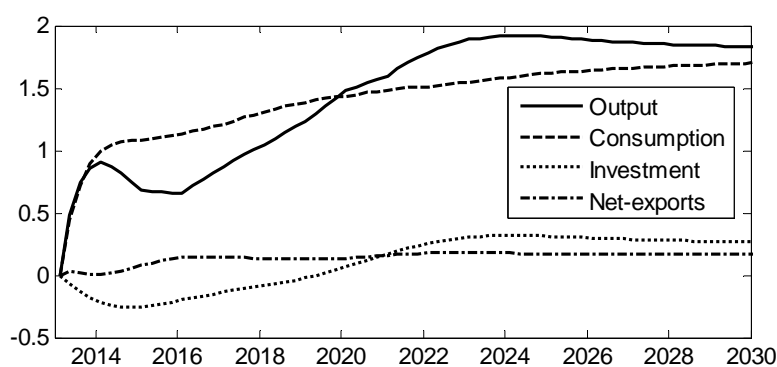


Notes: Expenditures are shown in terms of percentage deviations from baseline. The labor tax rate is given in levels.

⁷ The model is nonlinear and solved numerically employing the stacked Fair-Taylor solution algorithm as implemented in Dynare. For further information on this implementation see Juillard (1996).

The impact of the budget reform on GDP, consumption, investment and net exports is shown in **Figure 4**. Interestingly, aggregate output increases throughout the simulation. Even in the short-run, the consolidation of government finances is found to boost economic activity in the private sector sufficiently to overcome the reduction in government spending. Consumption and output increase on impact with another increase after 5 to 10 years. Consumption even exceeds output for several years. Investment decreases temporarily, but also rises in the longer run. The reduction in government spending raises permanent income of households, who then wish to consume more goods and to enjoy more leisure. The labor tax cuts lower distortions to the incentives to work and produce and trigger an increase in labor demand and supply.

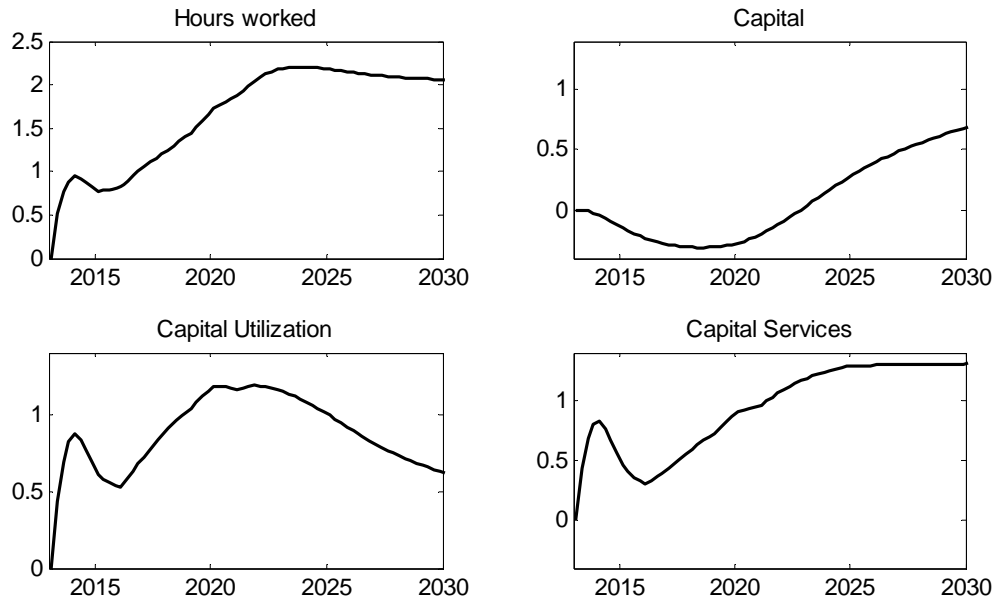
Figure 4: Impact on GDP and its components



Notes: Values shown are percentage deviations from baseline.

As shown in **Figure 5** hours worked increase substantially parallel with produced output. More work effort also induces higher demand for capital services input in production. The CMS model allows for variable capital utilization subject to an adjustment cost. Initially, increased input of capital services in production is achieved by greater capital utilization. In fact, the intensity of use rises sufficiently to tolerate a small temporary decline in the stock of capital. Thus, it allows investment to decline temporarily, so that consumption growth can exceed output growth for a few years. Over time, investment turns positive and capital is accumulated to reach a higher level in the long-run steady-state.

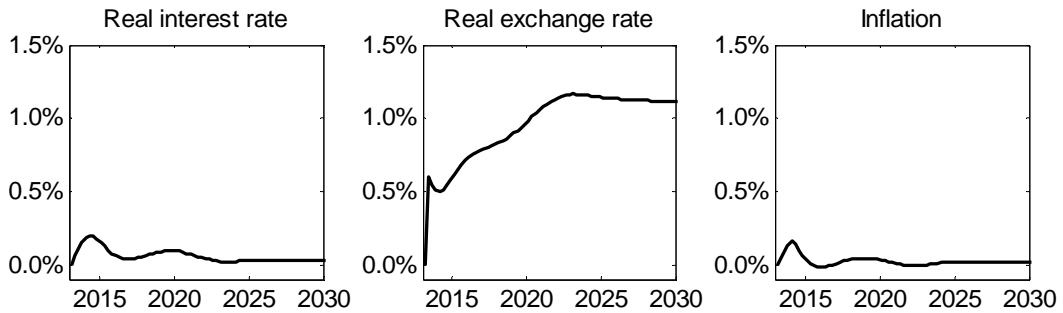
Figure 5: Labor and capital services in production



Notes: Values shown are percentage deviations from baseline.

The real interest rate is nearly flat throughout the simulation (see **Figure 6**) increasing slightly due to the expected increase in consumption and output growth. The sustained decline in the real wage mirrors the finding that the positive labor supply effect of reduced distortions outweighs the negative effect from increased life-time income.

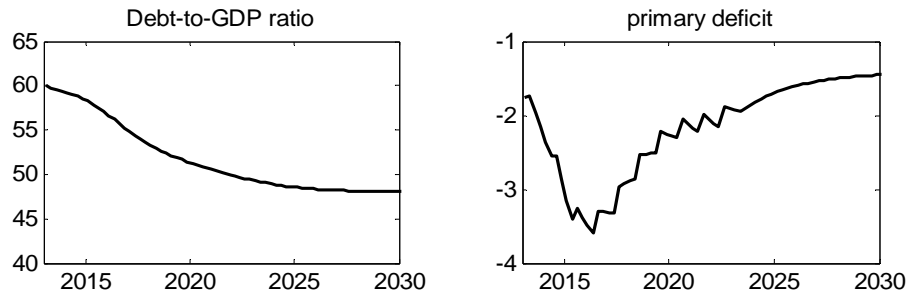
Figure 6: Interest rate, exchange rate and inflation



Notes: The scale on the vertical axis denotes percentage point changes.
An increase in the real exchange rate is a real depreciation.

Furthermore, the CMS model shows that net exports also contribute to the increase in GDP (dashed-dotted line in Figure 4). They are stimulated by a real depreciation of the dollar as indicated in **Figure 6**.

Figure 7: Debt and primary deficit

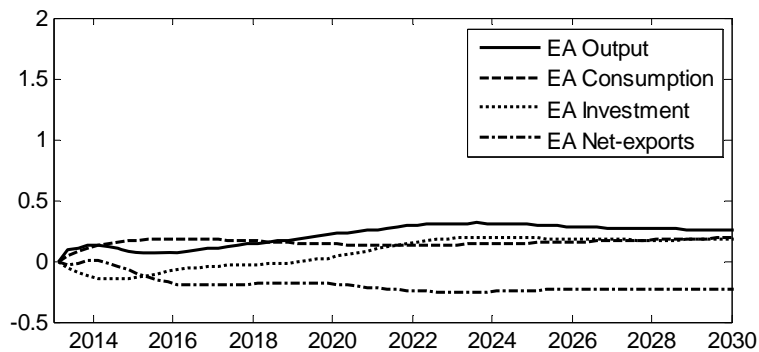


Notes: The debt-to-GDP ratio as well as the primary deficit are shown in levels in terms of percent of output. Primary deficit prior to interest paid on existing debt. A negative primary deficit implies a surplus.

While some of the government savings achieved by expenditure reform are used to lower the labor tax rate, the remainder is applied to debt reduction.⁸ Lower government debt together with the increase in GDP implies a decline in the debt to GDP ratio from the initial level of 60 percent to about 48 percent by 2030 as shown in **Figure 7**. The primary deficit, which initially just covers interest paid on existing debt, improves with the start of the consolidation. Ultimately, it implies that the stock of debt is reduced by almost 19 percent.

Since the CMS model covers the U.S. and the euro zone economies, it allows us to evaluate the foreign impact of U.S. budget consolidation. **Figure 8** shows that spillover effects to the euro area are relatively moderate. The effect on aggregate euro zone GDP is small but positive throughout the simulation. While net exports decrease due to the real appreciation of the euro, consumption and wages increase on impact. Investment falls for some time before it returns to positive territory.

Figure 8: Spillovers to the euro area



Notes: Values shown are percentage deviations from baseline.

⁸The model also contains lump-sum taxes. Small fluctuations in these taxes occur due to the difficulty of finding a path which gives both a smooth reduction in the debt to GDP ratio and in the tax rate.

5. Why tax cuts rather than only debt reduction? Lower distortions raise growth.

Our evaluation indicates that lower taxes *relative to the baseline* are central to ensuring a positive impact of the consolidation on aggregate GDP and employment, which suggests that expenditure cuts rather than tax hikes should be used to generate government savings. While part of these savings would be applied to reducing outstanding debt, the remainder would be used to keep tax rates below what they would otherwise have been.

With regard to the current outlook for the United States economy, our consolidation strategy implies returning government expenditures to pre-crisis levels in terms of share of GDP in order to avoid an increase in distortionary taxes. Thus, at this juncture in the United States, the strategy would not necessarily require legislating actual tax reductions, but rather deciding not to let them rise, so as to negate the disincentives to work and production arising from currently expected tax hikes.

In our model simulations, we explore the role of taxes further by considering two additional scenarios relative to the benchmark consolidation of section 4. One additional scenario considers the planned reduction in government purchases and transfers but leaves the labor tax rate unchanged. The other scenario considers a mixture of labor and capital tax rate reductions of 3 and 2 percent, respectively.

Table 2: Lowering tax distortions raises GDP: long-run effects

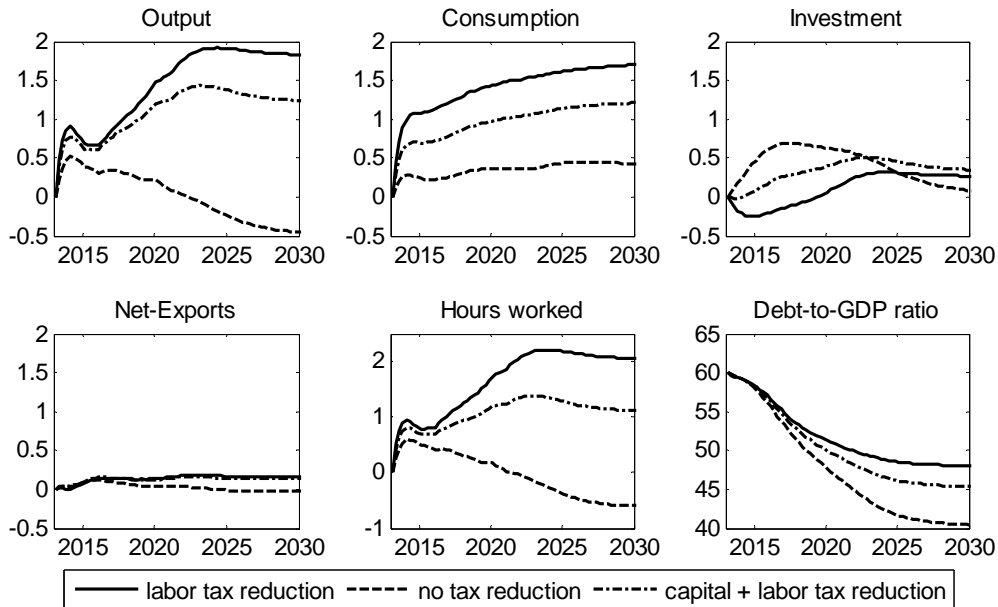
Variable	Benchmark consolidation G, TR, τ^N	Labor tax constant G, TR	Labor&capital tax reduced G, TR, τ^N, τ^K
Government purchases	-0.51%	-0.51%	-0.51%
Transfers	-2.85%	-2.85%	-2.85%
Labor tax rate	-5%	0%	-3%
Capital tax rate	0%	0%	-2%
Output	1.82%	-0.51%	1.22%
Consumption	1.83%	0.12%	1.24%
Investment	0.31%	-0.10%	0.34%
Net Exports	0.16%	-0.01%	0.13%
Hours worked	1.99%	-0.52%	1.08%
Capital	1.42%	-0.48%	1.54%
Debt-to-GDP (initially 60%)	47.87%	40.34%	45.20%

Notes: Values shown are percentage deviations from baseline, except for changes in tax rates that are indicated in percentage points and the debt-to-GDP ratio that is given in levels in terms of percent of output.

Table 2 reports the long-run effects under the three scenarios. GDP increases by 1.82 percent in the benchmark case. If the labor tax rate is kept at the baseline then the longer run effect of government spending cuts on GDP is negative, at -0.51 percent, while it remains positive with regarding to private sector consumption. In this case, the incentive to enjoy more leisure in response to an increase in lifetime income dominates households' labor supply decision and results in a reduction in hours worked. With the labor and capital tax cuts together, GDP still increases but less than in the benchmark case, at 1.22 percent. In this scenario, the capital stock is greater and hours worked smaller than for the benchmark.

Figure 9 displays the transition paths for output, consumption, investment, net exports, hours and the debt-to-GDP ratio under the three scenarios. Even in the simulation with constant labor tax, output rises initially. The reason is that government spending is reduced only very gradually, but permanent-income households increase consumption on impact anticipating higher lifetime income. Also, investment is up for some time before it declines towards a lower value in the long run. The debt-to-GDP ratio, however, declines fastest and furthest in the simulation with constant tax rates.

Figure 9: Benchmark consolidation vs scenario without labor tax reduction and mixture of labor and capital tax reduction



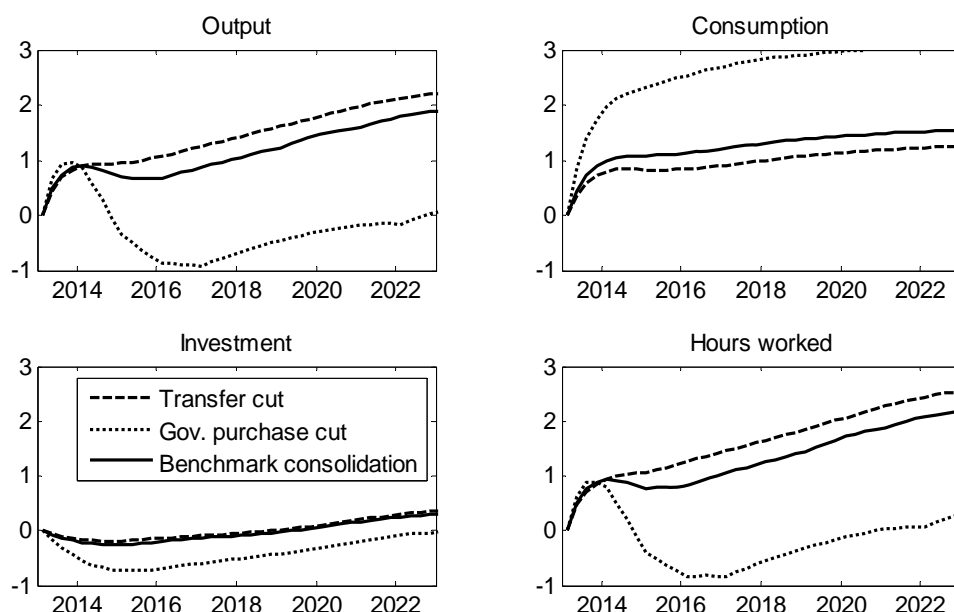
Notes: Values shown are percent deviations from baseline, except for the debt-to-GDP ratio which is given in levels in terms of percent of output. Reduction in government purchases and transfers with tax adjustment (solid), without tax adjustment (dashed), with labor and capital tax reduction (dashed-dotted; labor tax reduced by 3%, capital tax reduced by 2%)

6. How does the Fiscal Consolidation Strategy stimulate GDP in the near term?

An important finding of our analysis with the CMS model is that the Fiscal Consolidation Strategy already increases GDP in the short- and medium-run. It is natural to ask to what extent this finding depends on specific features of the strategy such as the mix of cuts in government purchases versus transfers and the degree of gradualism, or on features of the economic environment such as particular nominal rigidities.

Figure 10 reports the outcomes under the two extreme alternatives regarding the mix of purchases versus transfer cuts while maintaining the benchmark path for the labor tax rate. In one case the full reduction of 3.4 percent of GDP is achieved by cutting government purchases and in the other case by cutting transfers. Variables shown include aggregate output, consumption, investment and hours worked.

Figure 10: Reduction in government purchases and transfers separately



Notes: Values shown are percentage deviations from baseline. All scenarios include a reduction of the labor tax rate of 5%.

If it is all transfer cuts (dashed line), output increases even a bit more than in the benchmark case. If consolidation is achieved by reducing government purchases only, output declines in the medium to longer-term (dotted line). Although household consumption rises by more than 3 percent due to the increase in lifetime income with lower taxes and constant transfers, this increase is not sufficient to offset the reduction in direct government demand. Hours worked decline in the medium term because the positive incentive effects from lower

labor taxes are not sufficient to overwhelm the negative labor supply effect of increased lifetime income and the negative demand effect from government purchases cuts.

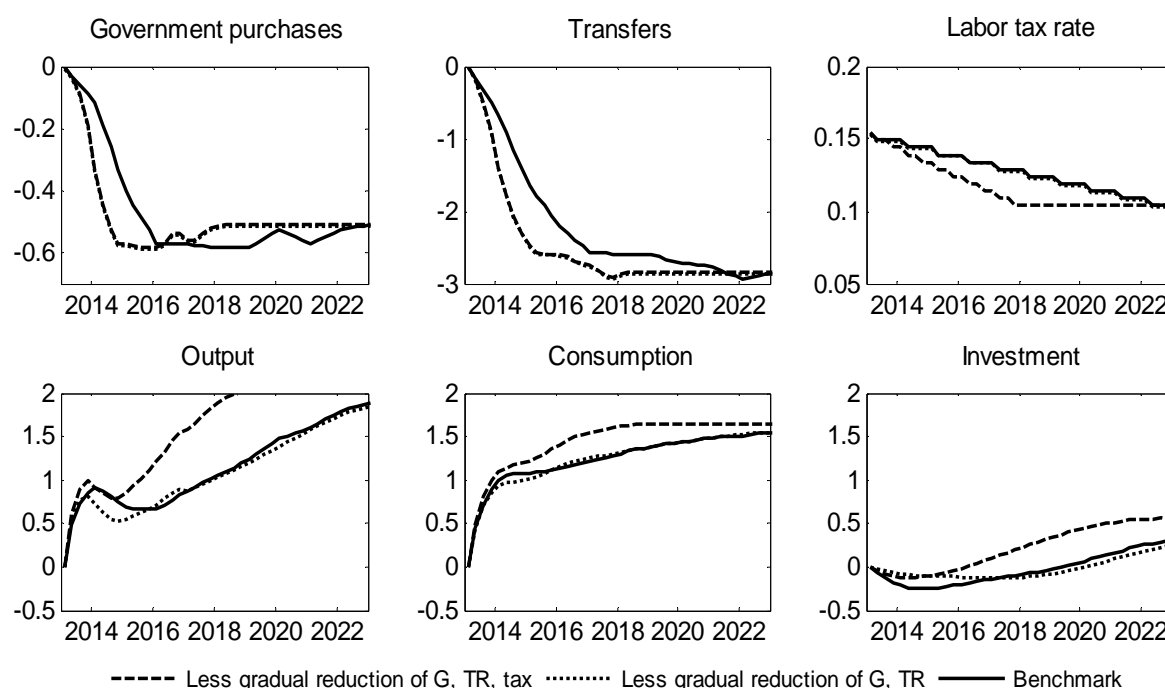
According to this model a mixture of spending cuts that is more tilted towards a reduction in transfers has a greater chance to increase GDP and employment in the short-, medium- and longer-run. Transfers affect demand indirectly through household consumption, while government purchases have a direct demand effect. In a model with only forward-looking permanent-income consumers and lump-sum taxes, transfer cuts would leave output unchanged while reductions in government purchases would reduce it, because such consumers would only use part of the possible increase in income to consume goods but forego the rest to enjoy more leisure. This negative labor supply effect of the reduction in government purchases would reduce output. With distortionary taxation, transfer cuts would reduce distortions and therefore increase output. The GDP impact of purchases cuts in such a model could be negative or positive depending on whether the effect of lowering distortions is sufficiently large to overcome the direct demand effect. Gradualism in reducing purchases increases the chance that the short-run impact on GDP is positive. The reason is that permanent-income consumers respond immediately to higher anticipated lifetime income. The presence of financially constrained households as in the model used here further boosts the short-run effect, because their consumption is more responsive to current income.⁹ For these reasons, the GDP impact of our benchmark strategy benefits from the greater weight on transfer cuts. Importantly, such a mixture is also more appropriate to reign in government debt under current circumstances, because post-crisis increases in government expenditures are primarily attributable to greater transfers.

Next, we consider three different experiments regarding the degree of gradualism. In doing so, we maintain the original mix of transfers and purchases from the benchmark consolidation. First, we accelerate government spending reductions keeping the speed of labor tax reduction unchanged. Second, we also accelerate the tax reduction. Third, we consider a delay of the tax reduction leaving the timing of spending cuts unchanged.

The impact of the first two experiments on the economy is displayed in **Figure 11**. Purchases and transfers are reduced twice as fast (dotted and dashed lines) as in the benchmark case (solid line). If the speed of labor tax reduction remains the same (dotted line), then the near-term increase of GDP is smaller than under the benchmark consolidation.

⁹ This finding was also obtained in Cwik and Wieland (2011) in the case of anticipated future spending cuts that were of a temporary nature.

Figure 11: Less gradual versus benchmark consolidation



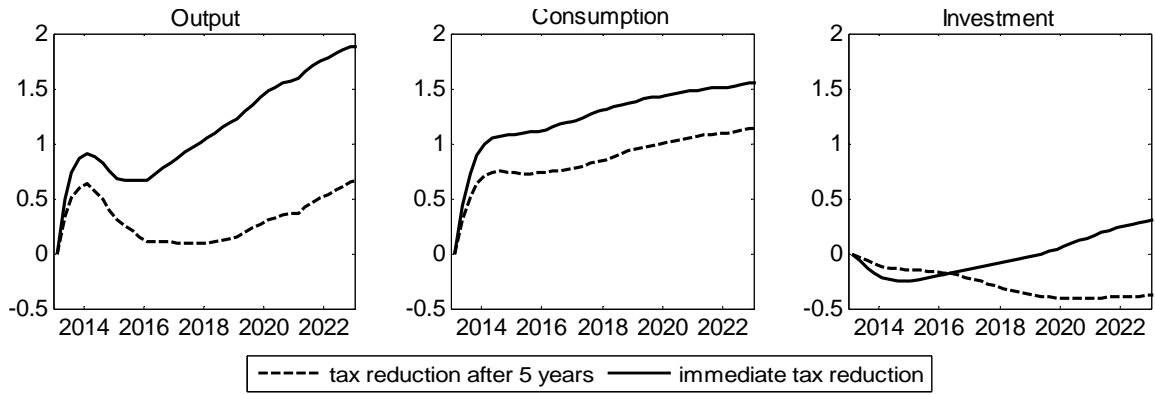
Notes: Values shown are percentage deviations from baseline, except for the labor tax rate which is shown in levels.

Thus, more gradual phasing-in of expenditure cuts improves the near-term stimulative effect on production and employment. However, if the labor tax is also reduced twice as fast (dashed line) as in the benchmark consolidation, then GDP increases much more in the medium term. Gradual phasing-in of tax cuts, therefore, weakens the medium-term stimulus to production and employment that comes from lowering distortions to incentives.

The outcome under the third experiment is shown in **Figure 12**. In this scenario, the labor tax cut is postponed by five years. Spending reductions, however, continue to be implemented with the original timing. Relative to the benchmark consolidation (solid line) the delay in lowering the labor tax substantially weakens the positive medium-term impact on overall GDP, consumption and employment. Investment even declines in the medium term.

From a political perspective, the strategy with delayed tax cuts might be considered more easily implementable, if such cuts are perceived as unpopular during the initial period of expenditure-based austerity. However, to the extent that the current baseline outlook for the United States incorporates tax increases, the strategy would primarily require abstaining from tax hikes. In this case, such concerns regarding political feasibility would appear less relevant.

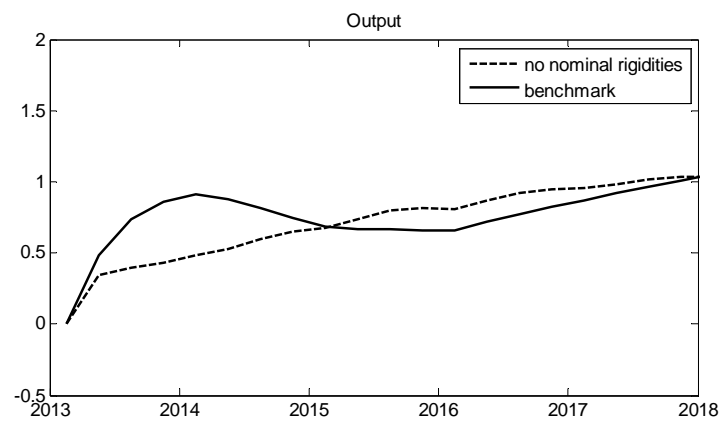
Figure 12: Lowering of labor tax postponed by 5 years.



Notes: Values shown are percentage deviations from baseline.

Finally, we consider the influence of nominal rigidities in the economy with regard to the near-term impact of fiscal consolidation on GDP. To this end, we set the so-called Calvo parameters for wage and price setting (ξ_H, ξ_X, ξ_I) and the indexation parameters (χ_H, χ_I) that govern the importance of nominal rigidities to zero. As shown in **Figure 13**, GDP rises more slowly in the near term, if nominal rigidities are suppressed in this manner (dashed line). This finding indicates that price flexibility mutes the near term stimulative impact of fiscal consolidation. With rigid prices, quantities, including overall production and employment, adjust more in the near term. Firms that are faced with higher demand but prevented from setting higher prices instead hire more labor and increase their output. Higher household income translates to greater demand, even more so, if some of the households are financially constrained and consume more in line with current income.

Figure 13: Extent of nominal rigidities and fiscal consolidation



Notes: Values shown are percentage deviations from baseline.

7. Sensitivity studies

Other modelling approaches

To help establish the robustness of our results we consider two additional types of models. First, we present a neoclassical growth model with flexible prices, forward-looking households and distortionary taxes. Such a model is useful for comparing some of the longer-run implications of changes in government spending and tax cuts. Second, we employ the CCTW model, which is estimated with U.S. data, to check whether comparable experiments imply similar impulse responses in the short to medium run.

The neoclassical model we use builds on King, Plosser and Rebelo (1988) and the discussion in Baxter and King (1993) and the Ljungvist and Sargent (2004) textbook. As in the CMS model, the government purchases goods and finances its purchases with distortionary consumption, capital and labor taxes as well as non-distortionary lump-sum per-capita taxes. Households have preferences over consumption and leisure using exactly the same functional form for the utility function as in the CMS model except that we set the degree of habit formation to zero. However, all households can buy bonds and hold physical capital for smoothing consumption. Households and the government have to fulfill the following budget constraints:

$$\sum_{t=0}^{\infty} \{p_t(1+\tau_{ct})c_t + p_t i_t\} \leq \sum_{t=0}^{\infty} \{r_t(1-\tau_{kt})k_t + w_t(1-\tau_{lt})l_t - p_t \tau_{ht}\}, \quad (14)$$

$$\sum_{t=0}^{\infty} p_t g_t \leq \sum_{t=0}^{\infty} \{\tau_{ct} p_t c_t + r_t \tau_{kt} k_t + w_t \tau_{lt} l_t + p_t \tau_{ht}\}. \quad (15)$$

Here, p_t denotes the time period 0 pre-tax price of one unit of investment, consumption or government spending. w_t refers to nominal pre-tax wages and r_t to the nominal pre-tax rental rate of capital. The consumption-, capital- and labor tax rates are set exogenously. Lump-sum taxes are a residual used to balance the government budget given the exogenously specified paths for government spending and distortionary tax rates ($g_t, \tau_{ct}, \tau_{kt}, \tau_{lt}$). Output is produced with a standard Cobb-Douglas production technology (similar to the one in equation (8), but without any fixed costs) and capital is accumulated as in equation (5), but without any investment adjustment costs. The model is a closed economy model so that market clearing requires that $y_t = c_t + i_t + g_t$.

In equilibrium a representative household chooses $\{c_t, l_t, i_t\}_{t=0}^{\infty}$ to maximize utility subject to the budget constraint. A representative firm chooses $\{k_t, l_t\}_{t=0}^{\infty}$ to maximize profits subject to the production function. A feasible government policy is an expenditure and tax plan $\{g_t, \tau_{ct}, \tau_{kt}, \tau_{lt}, \tau_{ht}\}_{t=0}^{\infty}$ that satisfies its budget constraint, equation (17). A feasible allocation is a sequence $\{c_t, i_t, y_t\}_{t=0}^{\infty}$ that satisfies market clearing.

The parameter values are chosen similarly to comparable parameters in the CMS model including the tax rates. One exception is the labor tax rate which we set to 22.5% initially, that is equal to the sum of the labor tax rate and households social security contributions in the CMS model.

A comparison of the long-run effects of the Fiscal Consolidation Strategy and an alternative scenario with all transfer cuts in the CMS and the neoclassical (NC) models is reported in **Table 3**. The long-run impact on GDP is very similar. It is up 1.82 percent in the CMS and 1.93 in the NC model. Also, investment and hours worked converge to very similar values in the two models. The effect on consumption is a bit larger in the NC model, which as

Table 3: Long-run effects: CMS versus NC model

Model	Variable	Benchmark consolidation G, TR, τ^N	All transfers TR, τ^N
	Government Purchases	-0.51%	0.00%
	Transfers	-2.9%	-3.36%
	Labor tax rate	-5%*	-5%**
CMS	Output	1.82%	2.16%
NC		1.93%	1.85%
CMS	Consumption	1.83%	1.59%
NC		2.08%	1.50%
CMS	Investment	0.31%	0.39%
NC		0.36%	0.35%
CMS	Hours worked	1.99%	2.33%
NC		1.93%	1.85%
CMS	Capital	1.42%	1.76%
NC		1.93%	1.85%

Notes: Values shown are percentage deviations from baseline.

*In the case of the NC model we need to adjust the labor tax rate so that the change in transfers is -2.9%. The required change in the labor tax rate deviates slightly from 5% and amounts to 5.5%.

**In the case of the NC we need to adjust the labor tax rate so that the change in transfers is -3.36%. The required change in the labor tax rate deviates slightly from 5% at 4.7%.

a closed economy does not incorporate the stimulative effect of the real depreciation that is at work in the CMS model. Finally, the stock of capital rises somewhat more in the NC model than the CMS model.

The simulation with only transfer cuts implies slightly larger deviations in terms of the impacts on GDP and hours but smaller ones concerning the capital stock. Overall, the simple NC model delivers the same qualitative conclusions and surprisingly similar quantitative findings regarding the long-run impact of fiscal consolidation when compared to the more complicated CMS model.

Additionally, we consider the CCTW model, which is estimated with U.S. data using Bayesian methods, as an empirical benchmark. Note also, the “rule-of-thumb” households in this model are less sophisticated than the households of type J in the CMS model who can still use money in place of bonds to smooth consumption. Because the CCTW model does not incorporate the incentive effects of changes in tax rates we confine these comparisons to simulations of reductions in government purchases where the funds saved are paid out in lump sums. The short- to medium run impact is qualitatively similar to the CMS model, though consumption increases a bit less and output declines faster in the CCTW model.

Other parameterizations: labor supply elasticity, openness and capital utilization

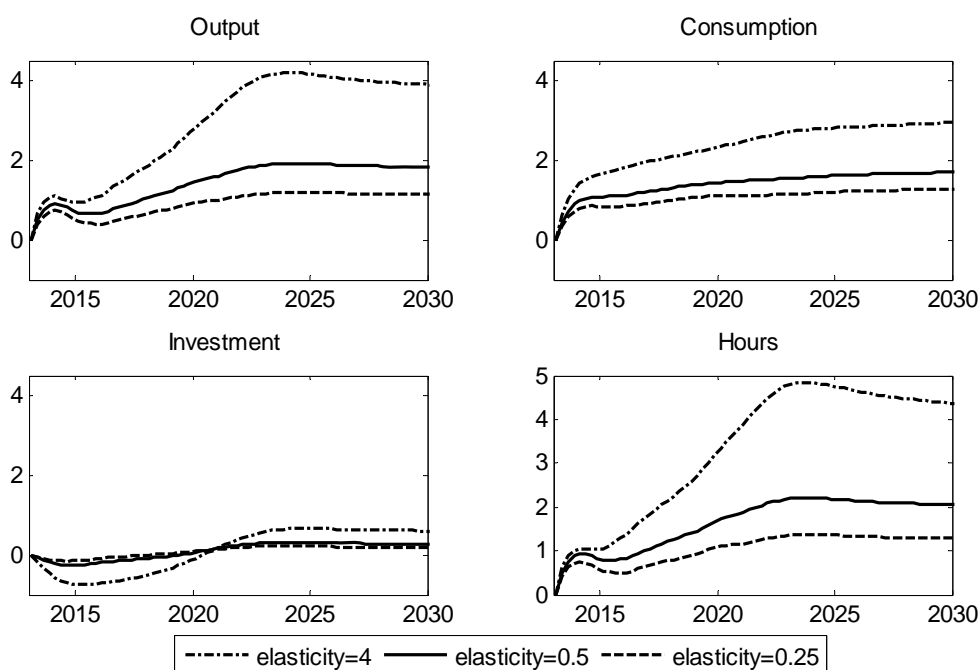
Since we have not estimated the CMS model’s parameters directly, it is important to consider the robustness of our findings across plausible parameter values. One check that we have conducted is to use the euro area parameter values that were taken by Coenen et al (2008) from Smets and Wouters (2003) for evaluating fiscal consolidations. We obtained the same qualitative findings as with our U.S. parameters from Cogan et al (2010).

Clearly, the household labor supply reaction plays an important role in the analysis. In the absence of a reduction in distortionary taxation, for example if government expenditure cuts are used to lower lump-sum taxes, households in a standard neoclassical model would react by increasing consumption but also enjoying more leisure. The negative labor supply response would induce lower production. Our consolidation strategy overcomes this effect by applying part of the government savings to lower distortionary taxes (relative to baseline). The resulting boost to GDP, though, still depends on the preference parameter in household utility that governs the labor supply elasticity.

In the benchmark calibration we have set the parameter to the value estimated by Cogan et al (2010), which in turn is very close to the value estimated by Smets and Wouters (2007). The resulting elasticity is 0.5. While this is a widely used value that is also consistent

with microeconomic studies (see Chetty et al 2011), it might be too high to capture labor supply responses, at least with regard to reductions in labor supply. Over coming years when the economy may require substantial shifts in sectoral labor allocation following the great recession, job holders may be less willing to reduce hours or quit their job compared to earlier decades. As to increases of hours worked, the elasticity may be higher because of the pool of unemployed.

Figure 14: The role of the labor supply elasticity.



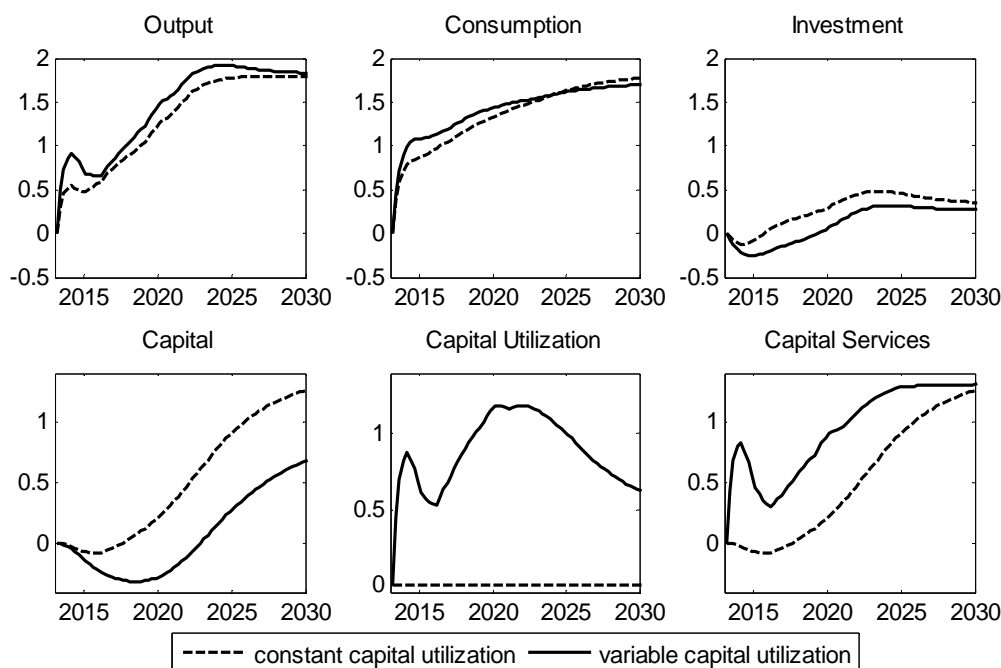
Notes: Values shown are percentage deviations from baseline. The labor supply elasticity parameter is set as follows: baseline: elasticity=0.5 (solid line); very elastic (elasticity=4; dashed-dotted line); very inelastic (elasticity =0.25; dashed line).

To illustrate the implications of different assumptions about the elasticity of labor supply we simulate the Fiscal Consolidation Strategy in the CMS model with more extreme settings. **Figure 14** displays outcomes with a low elasticity of 0.25 (dashed line) and a very high elasticity of 4 (dashed-dotted line) relative to the original parameterization (solid line). Since the consolidation incorporates lower distortionary taxes and induces an increase in labor supply in the benchmark strategy, its GDP impact is even greater with a more elastic labor supply.

As noted earlier, another special feature of the CMS model is the variability of capital utilization. The fiscal consolidation we have studied induces a faster increase in consumption than in GDP over the medium term, along with a temporary decline in investment. Even so capital services input increases thanks to greater capital utilization (recall Figure 5). **Figure**

15 provides a comparison with constant capital utilization (dashed lines). In this case, consumption and output increase more slowly while investment rises in the medium term. The capital stock increases much more quickly since utilization cannot be intensified.

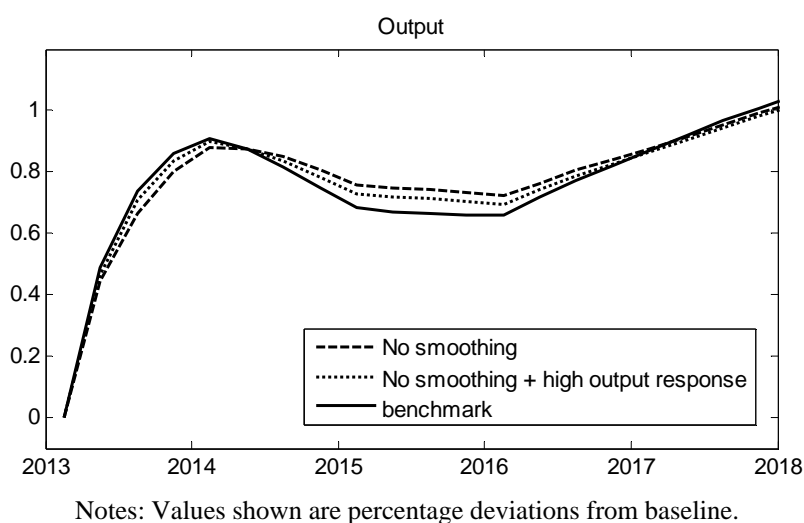
Figure 15: Constant versus variable capital utilization.



Notes: Values shown are percentage deviations from baseline.

Finally, we investigate monetary and fiscal policy interaction in the very near term. To this end, we simulate versions of the CMS model with different monetary policy rules. In one case, we just reduce the coefficient on the lagged interest rate to zero, that is we remove the interest rate smoothing feature of the rule. In the other case, we remove smoothing and increase the coefficient of output growth from 0.1 in the original model specification to a much greater value of 2. **Figure 16** indicates the near term changes in the path of GDP induced by the fiscal consolidation under these two modifications relative to the baseline specification. Quantitatively, the differences are rather small. Output rises a bit less in the first year of the simulation but exceeds the benchmark simulation in the second and third year.

Figure 16: Different monetary policy rules.



8. Conclusions

In this paper we estimated the macroeconomic impacts of a fiscal consolidation strategy in which the government gradually reduces spending over time in order to reduce the deficit and the growth of the debt. For concreteness the starting point for assessing the strategy is the current budget situation in the United States where federal spending increased sharply as a share of GDP during the recent financial crisis and great recession. Spending is expected to remain high into the future under the baseline projection of the Congressional Budget Office (CBO), with sustainability requiring that taxes will be raised in the future.

The fiscal consolidation strategy considered here brings federal spending below this CBO baseline with spending as a share of GDP returning to the percentage observed prior to the crisis. While the decrease in spending is gradual, it starts in the first quarter of the new strategy. Both transfer payments and government purchases of goods and services are reduced relative to the baseline, though transfers are reduced by a larger amount. The strategy uses the funds saved both to reduce tax rates and the debt relative to the baseline.

A big question is whether the reduction in government spending reduces GDP in the short run, a concern that has been raised by many economists and policy makers. We examine this question and others by simulating the strategy in a modern economic model calibrated to the U.S. and euro area economies. In this model, households are forward looking and they adjust their behavior in response to expectations of future tax and spending policy. Furthermore, the model incorporates price and wage rigidities that are aimed at more explicitly capturing short run effects as well.

According to the model simulations, the strategy increases GDP in both the short run and the long run relative to the baseline. There appear to be three sources of this positive effect. First, lower levels of government spending in the future, compared to the baseline, imply lower taxes and thereby higher lifetime income for households, who respond by consuming more even in the short run. Second, the lowering of future tax rates removes distortions and provides incentives that stimulate employment and production. And third, lower government spending and debt reduces the exchange rate thereby increasing net exports, which also help offset the decline in government spending.

More generally, the gradual and credible decline in government spending allows the private sector to adjust smoothly to the decline in spending without negative disruptions. Delaying tax reductions, by contrast, would also delay the beneficial impact of reduced distortions on employment and production. Clearly, the credibility of future consolidation is key to inducing the positive GDP response in the short- to medium run. A full technical analysis of the quantitative implications of imperfect credibility needs to be taken up in future work. Even so, if credibility is imperfect, policy makers would be well advised to implement binding legislations as quickly as possible so that households and firms can make plans on this new basis. Furthermore, if implementation needs to be accelerated in order to convince markets, our simulations would suggest that the lowering of taxes should be accelerated along with the expenditure cuts, in order to take advantage of improved incentives at an earlier stage.

While the fiscal consolidation strategy focusses on current circumstances in the United States, the methodology can easily be applied to consolidation plans in other countries or to joint consolidation plans in several countries.¹⁰ Thus, it would be very worthwhile to conduct similar investigations using structural macroeconomic models that are calibrated or estimated with data from other countries. Interestingly, empirical studies such as Alesina, Favero and Giavazzi (2012) that use the so-called narrative approach for analysing the impact of multi-period consolidation plans on economic growth obtain findings that complement our more structural analysis.¹¹

¹⁰ See Roeger and in 't Veld (2010) for an analysis of fiscal policy options in the euro area.

¹¹ Using data from 17 OECD countries collected by Devries et al (2011) they conclude that spending based adjustments have been associated with mild, short-lived recessions, or no recession at all, while tax-based adjustments have been associated with deep and pro-longed recessions. See also Alesina and Ardagna (2012) and Perotti (2012) for the positive effects of fiscal consolidations that have been accompanied by reductions in policy-induced economic distortions.

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