How Did the German Government Parties Succeed in Stabilizing Cyclical Fluctuations?

by

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1. Introduction

In this article, we assess the performance of German government parties with regard to their fiscal policies. Two different governments will be considered: the Social Democrats, 1972–1983, and the Christian Democrats, 1983–1989, where the period after German unification is excluded in the latter case. In our analysis, we will stress supply side responses of labor and capital to changes in fiscal policy. For this reason, we will use a neoclassical business cycle model which is subject to exogenous technological shocks such as those in the RBC literature. In order to obtain quantitative results, the following assumptions are imposed:

1. The government parties adjust fiscal policies in order to smooth business cycle fluctuations. However, it is only politically feasible to change tax rates and government consumption gradually. Therefore, we will consider fiscal policies which fluctuate around a steady state (allowing the steady state to be different for the two government parties considered).
2. Households and firms know the stationary, long-run fiscal policies of the government parties, but can only form expectations about the short-term changes.

The actual fiscal policies of the two government periods will be compared to a hypothetical one of a constant fiscal policy, characterized by the absence of any effort to stabilize economic fluctuations. As a result, the Social Democrats

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(SPD) did better than under a rule of constant fiscal policy. The welfare change is quantitatively important and amounts to approximately 0.8% as measured by the equivalent annual consumption increase. The welfare effect of the Christian Democrats' (CDU) cyclical fiscal policy, however, is negligible.

The study of fiscal policy in general equilibrium has received increasing attention recently. The effects of government spending and taxation over the business cycle have been studied in real business cycle models where intertemporally optimizing agents adjust their behavior in response to exogenous technological shocks. The effect of government consumption on output and employment has been studied by Aiyagari, Christiano and Eichenbaum (1992), Baxter and King (1993) and Ambler and Paquet (1996). These three articles differ mainly in their assumptions on government consumption and its effect on individual utility. Aiyagari, Christiano and Eichenbaum (1992) assume that government consumption does not affect utility. An increase of government consumption is found to increase output and employment, the quantitative effect depending on the permanent or transitory nature of the increase. Baxter and King (1993) allow government consumption to affect households' utility. In their model, permanent changes are found to have larger effects than temporary changes in government consumption. The output multiplier of government consumption might well exceed one. Finally, Ambler and Paquet (1996) endogenize government spending. The government is assumed to respond optimally to technology shocks. The welfare-maximizing policy implies that public and private expenditures should behave similarly.

The effects of taxation over the business cycle have been studied by Greenwood and Huffman (1991), Zhu (1992), Braun (1994), McGrattan (1994) and Chari, Christiano and Kehoe (1995). Greenwood and Huffman (1991) study a dynamic general equilibrium model calibrated for the US economy, where the government is able to stabilize cyclical fluctuations by means of taxation. The stabilization of cyclical fluctuations results in smaller welfare gains than the reduction of long-run tax distortions. In particular, Greenwood and Huffman compute a welfare gain from stabilization policies amounting to an equivalent of 0.67% of aggregate output. Braun (1994) includes tax variables in a standard real business cycle model. Since technology shocks shift the labor demand curve, standard real business cycle models produce a strong positive correlation of employment and wages, which is at odds with empirical observations. A change in the tax rate, however, shifts the labor supply curve. For the US economy, Braun shows that including tax rates in real business cycle models reduces the correlation of employment and wages significantly. McGrattan (1994) analyzes the contribution of technology shocks on the one hand and variations in taxation and government spending policies on the other hand in explaining the amplitude of business cycle fluc-

tuations. She finds that a significant portion is explained by the latter. In particular, shocks to technology only account for 41% and 20% in the fluctuations of output and employment, respectively.

Zhu (1992) and Chari, Christiano and Kehoe (1995) study the design of optimal fiscal policies in a stochastic economy. Fiscal policies are defined as a rule which specifies state-contingent flat rate taxes and the amount of public debt issue at each date. The government is constrained from using lump-sum taxes. The implementable competitive allocation which achieves the maximum consumer utility is also known as the *Ramsey allocation*. The optimal fiscal policy is shown to be sensitive with regard to the specification of the utility function. Furthermore, Zhu (1992) shows that the Chamley-Judd result of zero limiting capital taxation is only generally valid in the deterministic growth model, but not for the stationary equilibrium of the stochastic growth model[2]. Uniform tax rates on labor income are also shown to be not always optimal, e.g. for the class of utility functions which will be applied in the present analysis. In summary, these studies suggest that there are welfare gains from a properly implemented cyclical tax policy, but that the choice of the optimal tax rule is complicated[3].

The model in this paper allows for the study of both government consumption and tax policies. Contrary to the assumptions of Zhu (1992) and Chari, Christiano and Kehoe (1995), government consumption affects consumers' utility and the government is unable to issue state-contingent debt. Instead, the present model follows Braun (1994) and McGrattan (1994). However, the approach pursued in this paper is fundamentally different from the one taken in the standard literature on real business cycles. The usual exercise of studies on real business cycles consists of evaluating the model's ability to capture features of the empirically observed business cycles. In particular, the moments of macroeconomic time series simulated with the RBC model are compared to the stylized facts. For this purpose, multiple time series of the exogenous shocks are generated randomly for the simulation procedure. In this paper, optimal responses of the private agents to the actual time series of government consumption and income taxation in the years 1972–1989 are computed. As a result, welfare implications of the fiscal policy in both 1972–1983 and 1983–1989 can be calculated.

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[2] Chamley (1986) and Judd (1985) find that, in deterministic growth models with infinite-lived households, optimal second-best tax policies do not foresee capital taxation in the long run. Zhu (1992) proves that the optimal capital tax rate is zero with probability one only for a special class of preferences. In a model without government debt, Smith (1996) demonstrates that the optimal tax rate on capital exceeds zero if uncertainty is fairly high.

[3] Missing from this analysis is, of course, the question as to whether business cycle stabilization is feasible in reality.

The organization of the paper is as follows. In section 2, the model is presented and, in section 3, it is calibrated with the help of time series observations from the German economy. The welfare effects of German fiscal policy are analyzed in section 4 and will be compared to the welfare effects resulting from a permanent change in fiscal policy. Section 5 concludes by pointing out some directions for further research.

2. The Model

The model is based on the stochastic neoclassical growth model, augmented by a government sector. Three different sectors are depicted: households, firms, and the government. Households maximize their intertemporal utility subject to their budget constraints. They receive income from labor and capital. Firms maximize their profits and produce with constant returns to scale using labor and capital as inputs. The government receives revenues from the taxation of income, which it spends on government consumption and transfers.

2.1. Households

Households are supposed to be of measure one and infinitely-lived. Households are further assumed to be identical so that their behavior can be studied with the help of a representative household which maximizes the expected value of its intertemporal utility:

$$(1) \qquad \max E_0\left[\sum_{t=0}^{\infty} \beta^t U(c_t, l_t)\right], \quad 0<\beta<1,$$

where β is a discount factor and expectations are conditioned on the information set of the household at time 0. Instantaneous utility $U(c_t, l_t)$ in period t is a function of both consumption c_t and leisure l_t:

$$(2) \qquad u_t = \frac{(c_t l_t^{\gamma})^{1-\sigma}}{1-\sigma}.$$

$1/\sigma$ denotes the intertemporal elasticity of substitution. Consumption can be decomposed into private and public consumption. However, government consumption G_t is only an imperfect substitute for private consumption c_t^P (capital letters denote aggregate quantities expressed in per-capita terms):

$$(3) \qquad c_t = c_t^P + \psi G_t, \quad 0 \le \psi \le 1.$$

The greater the parameter ψ is, the better private and public goods can be substituted for each other. Following Barro (1989), ψ is assumed to lie

between zero and one[4]. The household also faces a budget constraint. It receives income from labor and capital, as well as government transfers which are spent on consumption and investment:

$$(4) \qquad c_t^p + i_t = (1-\theta_t)\, w_t n_t + (1-\tau_t)\, r_t k_t + \tau_t \delta k_t + B_t\,,$$

where i_t, k_t, n_t, w_t, r_t, B_t, δ denote investment, the capital stock, labor, the wage rate, the interest rate, government transfers, and the depreciation rate, respectively. The time budget of the household is normalized to one, implying $1 = l_t + n_t$. θ_t and τ_t denote the tax rate on income from labor and capital in period t, respectively. Capital depreciation can be deducted from the tax bill, which is reflected by the term $\tau_t \delta k_t$ in equation (4). As capital k_t is the only asset in the economy, the household's wealth accumulates according to:

$$(5) \qquad k_{t+1} = (1-\delta)\, k_t + i_t\,.$$

2.2. Production

Firms are owned by the households and maximize profits with respect to their labor and capital demand. Production y_t is characterized by constant returns to scale in labor n_t and capital k_t. Furthermore, as the time series of German total factor productivity is not stationary, labor-augmenting technological progress is introduced:

$$(6) \qquad y_t = z_t k_t^{\alpha} (\gamma_N^t\, n_t)^{1-\alpha}\,,$$

where z_t and γ_N denote a stochastic technology level and the rate of labor-augmenting technological progress, respectively.

In a market equilibrium, factors are compensated according to their marginal products:

$$(7) \qquad w_t = (1-\alpha)\,\frac{y_t}{n_t}\,,$$

$$(8) \qquad r_t = \alpha\,\frac{y_t}{k_t}\,.$$

2.3. The Government

Government expenditures consist of government consumption G_t and government transfers to households B_t. Government expenditures are financed

[4] For many municipal services like garbage collection, public goods are close substitutes for private goods and $\psi = 1$ will approximately hold.

by a tax on income and the government budget is assumed to balance in every period t[5]:

$$\theta_t N_t w_t + \tau_t (r_t - \delta) K_t = G_t + B_t \,. \tag{9}$$

The household considers the government's behavior to be exogenous and observes the stochastic structure of the government variables G_t, τ_t, and θ_t. Tax rates and government consumption are observed to be persistent and fluctuate around a steady state. In steady state (steady state variables are marked by a bar), the government size γ_g is constant, $\bar{G} = \gamma_g \bar{y}$, and government consumption G_t grows at the same rate γ_N as output y_t. Let $\tilde{G}_t$ denote detrended government consumption, $G_t = \tilde{G}_t \gamma_N^t$. The exogenous variables of the model – the technology level z_t, government consumption G_t, and the two tax rates (θ_t, τ_t) – are assumed to be governed by the following stationary vector $VAR(1)$ process[6]:

$$\begin{pmatrix} \ln(z_t) \\ \ln(\tilde{G}_t) \\ \ln(\theta_t) \\ \ln(\tau_t) \end{pmatrix} = \begin{pmatrix} c_1 \\ c_2 \\ c_3 \\ c_4 \end{pmatrix} + A \begin{pmatrix} \ln(z_{t-1}) \\ \ln(\tilde{G}_{t-1}) \\ \ln(\theta_{t-1}) \\ \ln(\tau_{t-1}) \end{pmatrix} + \varepsilon_t \,, \tag{10}$$

where $A = [a_{ij}]$, $i, j = 1, \ldots, 4$ is the matrix of autoregressive parameters; $\varepsilon_t = (\varepsilon_{zt}, \varepsilon_{gt}, \varepsilon_{\theta t}, \varepsilon_{\tau t})'$ is a four-dimensional error term with $E(\varepsilon_t) = 0$ and $E(\varepsilon_t \varepsilon_s') = 0$ for $t \neq s$. For stationarity of the process, the eigenvalues of A have to lie inside the unit circle. Note that (10) implies that the percentage changes of the variables are an autoregressive process themselves (with an $MA(1)$ error term). No constraints are put on the structure of the covariance matrix of ε_t except that it be positive definite.

2.4. The Competitive Rational Expectations Equilibrium

A *competitive rational expectations equilibrium* consists of a collection of individual and aggregate decision rules $\{i_t, I_t, n_t, N_t, c_t^p, C_t^p\}$ as well as

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[5] As is evident from (9), an increase in government consumption G_t reduces transfers to households B_t ceteris paribus. If the return on government debt is not state-contingent, but rather equal to the return on capital, Ricardian equivalence holds for constant tax rates as demonstrated by Barro (1974). Hence, contrary to a change in government consumption or the tax rates, a change in government debt does not affect steady state allocation. Following Baxter and King (1993) and in order to simplify our analysis, we will not consider government debt in our model.

[6] As proposed and analyzed by Sargent (1984) and more recently applied by Braun (1994) in a dynamic general equilibrium model of cyclical fiscal policy, we do not specify the government's objective function. We rather use historical data to develop a statistical model of the feedback rule used by the government.

prices $\{w_t, r_t\}$ such that:

1. $\{i_t, n_t, c_t^p\}$ solves the household optimization problem.
2. Aggregate variables equal individual variables:

$$I_t = i_t(K_t, k_t, z_t, G_t, \theta_t, \tau_t)\,, \tag{11}$$

$$N_t = n_t(K_t, k_t, z_t, G_t, \theta_t, \tau_t)\,, \tag{12}$$

$$C_t^p = c_t^p(K_t, k_t, z_t, G_t, \theta_t, \tau_t)\,. \tag{13}$$

3. Wages and interest rates are given by (7) and (8), respectively.
4. Firms maximize their profits.
5. The government budget balances at all times.

A solution to this problem provides decision rules for investment, consumption, and labor supply of the individual household, depending on the information set in period t, $\Omega_t = \{K_t, k_t, z_t, G_t, \theta_t, \tau_t\}$.

2.5. The Steady State under Certainty

In the nonstochastic steady state, consumption, output, and investment will all grow at the constant rate γ_N. In order to calculate the steady state, it turns out to be convenient to introduce the following transformations of the variables:

$$\tilde{c}_t \equiv \frac{c_t}{\gamma_N^t}\,,\quad \tilde{i}_t \equiv \frac{i_t}{\gamma_N^t}\,,\quad \tilde{y}_t \equiv \frac{y_t}{\gamma_N^t}\,,\quad \tilde{k}_t \equiv \frac{k_t}{\gamma_N^t}\,,\quad \tilde{w}_t \equiv \frac{w_t}{\gamma_N^t}\,,\quad \tilde{B}_t \equiv \frac{B_t}{\gamma_N^t}\,. \tag{14}$$

The steady state is described by the following system of nonlinear equations in the three endogenous stationary variables $\bar{c}^p$, $\bar{k}$, and $\bar{n}$:

$$\bar{w}(1-\bar{\theta}) = \frac{\gamma}{1-\bar{n}} \cdot (\bar{c}^p + \psi \bar{G})\,, \tag{15}$$

$$1 + (1-\bar{\tau})(\bar{r} - \delta) = \frac{\gamma_N^\sigma}{\beta}\,, \tag{16}$$

$$\bar{y} = \bar{i} + \bar{c}^p + \bar{G}\,, \tag{17}$$

where

$$\bar{y}(\bar{k}, \bar{n}, \bar{c}^p) = \bar{k}^\alpha\, \bar{n}^{1-\alpha}\,, \tag{18}$$

$$\bar{i}(\bar{k}, \bar{n}, \bar{c}^p) = (\gamma_N - 1 + \delta)\bar{k}\,, \tag{19}$$

$$\bar{w}(\bar{k}, \bar{n}, \bar{c}^p) = (1-\alpha)\frac{\bar{y}(\bar{k}, \bar{n}, \bar{c}^p)}{\bar{n}}\,, \tag{20}$$

$$(21) \qquad \bar{r}(\bar{k}, \bar{n}, \bar{c}^p) = \alpha \frac{\bar{y}(\bar{k}, \bar{n}, \bar{c}^p)}{\bar{k}},$$

$$(22) \qquad \bar{G}(\bar{k}, \bar{n}, \bar{c}^p) = \gamma_g \bar{y}(\bar{k}, \bar{n}, \bar{c}^p).$$

Equations (15) and (16) are the first-order conditions of the household with respect to its labor supply and savings decision, respectively. Equation (17) represents the resource constraint of the economy.

3. Calibration

In order to compute the quantitative effects of the different fiscal policy regimes on output, employment, and welfare, the model has to be calibrated. The model parameters are chosen with respect to the characteristics of the German economy and the steady state conditions (15)–(17). A description of the data is contained in Heer and Linnemann (1998).

3.1. Utility

The functional form of utility is specified in (2). Empirical estimates of households' intertemporal elasticity of substitution $1/\sigma$ vary considerably. In models of applied general equilibrium, σ is often chosen to be in the range of [1, 4]. For example, real business cycle models of Kydland and Prescott (1982) or Hansen (1985) apply a value of $\sigma=1.5$ and $\sigma=1$, respectively, while Lucas (1990) and Jones, Manuelli and Rossi (1993) apply values of $\sigma=2$ and $\sigma \in \{1, 2.5\}$, respectively. We will choose $\sigma=2$ as a benchmark case, but we will also test for $\sigma=1$ and $\sigma=4$. Furthermore, the usual discount rate $\beta=0.99$ is chosen.

Following Barro (1989), ψ is taken from the unit interval with a benchmark value of $\psi=0.5$[7]. We will also test for the case where public consumption does not affect utility, $\psi=0$, as in Aiyagari, Christiano and Eichenbaum (1992), and the case of $\psi=1$. Finally, the preference parameter γ is calibrated with the help of the steady state conditions in order to imply an average working time of 30%.

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[7] Ambler and Paquet (1996) apply a value of $\psi=0.3$, which is close to the empirical estimate of Aschauer (1985), $\psi=0.23$. McGrattan (1994) applies maximum likelihood parameter estimates to postwar US data and calculates a value of $\psi=-0.026$, which, however, is not significantly different from zero.

3.2. Production

The quarterly deterministic growth rate of output, $\gamma_N = 1.007$, is calculated as the slope of an exponential trend through gross national product. The production elasticity of capital, $\alpha = 0.36$, and the quarterly rate of capital depreciation, $\delta = 0.0104$, are taken from Heer and Linnemann (1998).

3.3. Steady State Parameters of the Government

Government spending G_t affects household utility, but not production. For this reason, we only consider government consumption, and neglect public investment[8]. Furthermore, we subtract military spending from government consumption[9]. The government consumption share in output γ_g was estimated for the period of the Schmidt (SPD) and Kohl (CDU) governments, respectively. Non-military government spending account for 16.8% and 17.0% of GNP in the period 1972.iv–1983.i and 1983.ii–1989.iv, respectively.

The tax rates θ and τ on labor and capital income, respectively, are estimated from annual data provided by Mendoza, Rasin and Tesar (1994)[10]. Mendoza et al. provide estimates of effective tax rates on labor income, capital income, and corporate capital income. The corporate capital income tax is added to the capital income tax in order to obtain an estimate of τ[11]. The average tax rates for the two subperiods are presented in table 1.

3.4. Technology and Policy Innovations

The logarithms of the technology level z_t, government consumption G_t, and the two tax rates on labor and capital income, θ_t and τ_t, are assumed to follow the stationary $VAR(1)$ process given in equation (10).

In contrast to the restrictive approach of Aiyagari, Christiano and Eichenbaum (1992) or Burnside, Eichenbaum and Rebelo (1993), we do not put any

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[8] Recent work on endogenous growth has emphasized the effects of public investment on growth, e.g. Lucas (1988) and Barro (1990).

[9] Unfortunately, the data which is available does not exactly correspond to the economic variables used in the model. For example, government expenditures on education can be interpreted as investments in human capital and might well increase productivity. A similar reasoning applies to expenditures on the health system.

[10] All annual data are log-linearly interpolated to obtain quarterly data. In order to obtain the data for 1989, we extrapolated log-linearly.

[11] In the model of section 2, corporate income taxes are not explicitly modeled. However, introducing a corporate capital income tax is straightforward. Since, in the model, tax incidence does not have a real effect, we restrained from doing so in order to keep the description of the model as simple as possible.

Table 1

Calibration of Parameter Values for the Benchmark Case

Description	Function	Parameter
Utility Function	$u_t = \frac{(c_t l_t^{\gamma})^{1-\sigma}}{1-\sigma}$	$\sigma = 2,\ \gamma = 1.18$
Consumption	$c_t = c_t^p + \psi G_t$	$\psi = 0.5$
Discount Factor	β	$\beta = 0.99$
Production Function	$y_t = z_t k_t^{\alpha}(\gamma_N^t n_t)^{1-\alpha}$	$\alpha = 0.36,\ \gamma_N = 1.007$
Depreciation	δ	$\delta = 0.0104$
1972.iv–1983.i:		
Government Consumption	$\bar{G} = \gamma_g \bar{y}$	$\gamma_g = 0.168$
Income Tax Rates	θ, τ	$\theta = 0.380,\ \tau = 0.356$
1983.ii–1989.iv:		
Government Consumption	$\bar{G} = \gamma_g \bar{y}$	$\gamma_g = 0.170$
Income Tax Rates	θ, τ	$\theta = 0.405,\ \tau = 0.341$

a-priori constraints on the coefficients of the autocorrelation matrix A or the vector of constants. Restricting A to be diagonal would imply (a) that the government does not react to technological shocks and hence output, and (b) that there is no relationship between the policy instruments government consumption, labor income tax and capital income tax; they would form three uncorrelated $AR(1)$ processes. We do not believe these restrictions to be appropriate for the model presented in this paper.

In order to calibrate the *VAR* parameters, we estimated (10) for each government period separately with Ordinary Least Squares using the Solow residuals for z_t and historical fiscal data of G_t, θ_t, and τ_t.

The estimates are, under the SPD government,

$$(23)\quad \begin{pmatrix} \ln(z_t) \\ \ln(\tilde{G}_t) \\ \ln(\theta_t) \\ \ln(\tau_t) \end{pmatrix} = \begin{pmatrix} 0.069 \\ -0.170 \\ -0.025 \\ -0.033 \end{pmatrix} + \begin{pmatrix} 0.987 & -0.008 & 0.159 & -0.081 \\ 0.316 & 0.789 & -0.154 & -0.021 \\ -0.047 & -0.001 & 1.051 & -0.074 \\ 0.416 & -0.115 & -0.171 & 0.805 \end{pmatrix} \begin{pmatrix} \ln(z_{t-1}) \\ \ln(\tilde{G}_{t-1}) \\ \ln(\theta_{t-1}) \\ \ln(\tau_{t-1}) \end{pmatrix} + \varepsilon_t$$

with

$$\widehat{\mathrm{Cov}}(\varepsilon_t) = \begin{pmatrix} 3.8\times10^{-5} & 1.7\times10^{-5} & 0.8\times10^{-5} & 0.3\times10^{-5} \\ 1.7\times10^{-5} & 6.5\times10^{-5} & -1.0\times10^{-5} & -1.4\times10^{-5} \\ 0.8\times10^{-5} & -1.0\times10^{-5} & 2.4\times10^{-5} & 3.1\times10^{-5} \\ 0.3\times10^{-5} & -1.4\times10^{-5} & 3.1\times10^{-5} & 11.7\times10^{-5} \end{pmatrix}.$$

A Wald test strongly rejects the hypothesis that A is diagonal (at any conventional level of significance). We further tested for Granger non-causality of the policy instruments, the null hypothesis being $a_{12}=a_{13}=a_{14}=0$. Again, the hypothesis is clearly rejected. Although each of these coefficients is individually insignificant, they are jointly significant and, hence, must not be abandoned.

We estimated the same model for the CDU government period. The null hypothesis of diagonality is rejected again, but the test for Granger non-causality of the policy instruments yields a p-value of 0.22. It is admissible to introduce the coefficient constraints $a_{12}=a_{13}=a_{14}=0$. Of course, under these constraints, OLS is no longer efficient. Instead, one should estimate the parameters using Generalized Least Squares or rather feasible GLS, since the covariance matrix of the innovation vector ε_t is not known. We estimated the covariance matrix consistently from the LS residuals. The constrained estimation results in

$$(24) \qquad \begin{pmatrix} \ln(z_t) \\ \ln(\tilde{G}_t) \\ \ln(\theta_t) \\ \ln(\tau_t) \end{pmatrix} = \begin{pmatrix} 0.000 \\ 0.123 \\ -0.010 \\ -0.485 \end{pmatrix} + \begin{pmatrix} 0.724 & 0.000 & 0.000 & 0.000 \\ -0.433 & 0.698 & 0.056 & 0.068 \\ 0.058 & 0.011 & 0.972 & 0.012 \\ 0.585 & 0.141 & -0.429 & 0.916 \end{pmatrix} \begin{pmatrix} \ln(z_{t-1}) \\ \ln(\tilde{G}_{t-1}) \\ \ln(\theta_{t-1}) \\ \ln(\tau_{t-1}) \end{pmatrix} + \varepsilon_t$$

with

$$\widehat{\mathrm{Cov}}(\varepsilon_t) = \begin{pmatrix} 2.8\times10^{-5} & -2.2\times10^{-5} & 0.2\times10^{-5} & 1.2\times10^{-5} \\ -2.2\times10^{-5} & 5.9\times10^{-5} & -0.2\times10^{-5} & -0.2\times10^{-5} \\ 0.2\times10^{-5} & -0.2\times10^{-5} & 0.1\times10^{-5} & 0.9\times10^{-5} \\ 1.2\times10^{-5} & -0.2\times10^{-5} & 0.9\times10^{-5} & 9.1\times10^{-5} \end{pmatrix}.$$

The eigenvalues of both A_{SPD} and A_{CDU} are all less than unity in absolute value; the estimated *VAR* processes are stationary.

For the calibrated model, decision functions of the households can be calculated. Investment, labor supply, and consumption demand of the household are functions of the technology level z_t, government consumption G_t, the two tax rates θ_t and τ_t, their stochastic properties, and both the individual and aggregate capital stock k_t and K_t, respectively. The decision functions are computed with the algorithm of King, Plosser and Rebelo (1987) [12]. A description of the qualitative properties of the model is provided in the appendix.

4. Welfare Effects of German Fiscal Policy 1972–1989

In this section, the welfare effects of fiscal policies will be calculated for the German economy. Welfare will be measured by the utility of the representative individual. The government parties' success in stabilizing the economy with the help of fiscal policy will be compared to a policy of constant government consumption and constant tax rates. The welfare effect from stabilizing economic fluctuations will further be compared to that of a change in steady-state fiscal policy parameters.

In order to study the welfare effects of the fiscal policy for i) the Social Democratic (SPD) government and ii) the Christian Democratic (CDU) government, we make the following assumptions:

1. At the start of each government period, the state variable $\{K_t, k_t, z_t, G_t, \theta_t, \tau_t\}$ is equal to the empirical value in this period, i.e. for $t = 1972.\text{iv}$ and $t = 1983.\text{ii}$.
2. The government party can adjust fiscal policy gradually.
3. Households do not have perfect foresight of the technology level and the fiscal policy, but form expectations about it according to (23) and (24) for each government period.

The numerical procedure for calculating quantitative effects of the two government policies is described in the appendix.

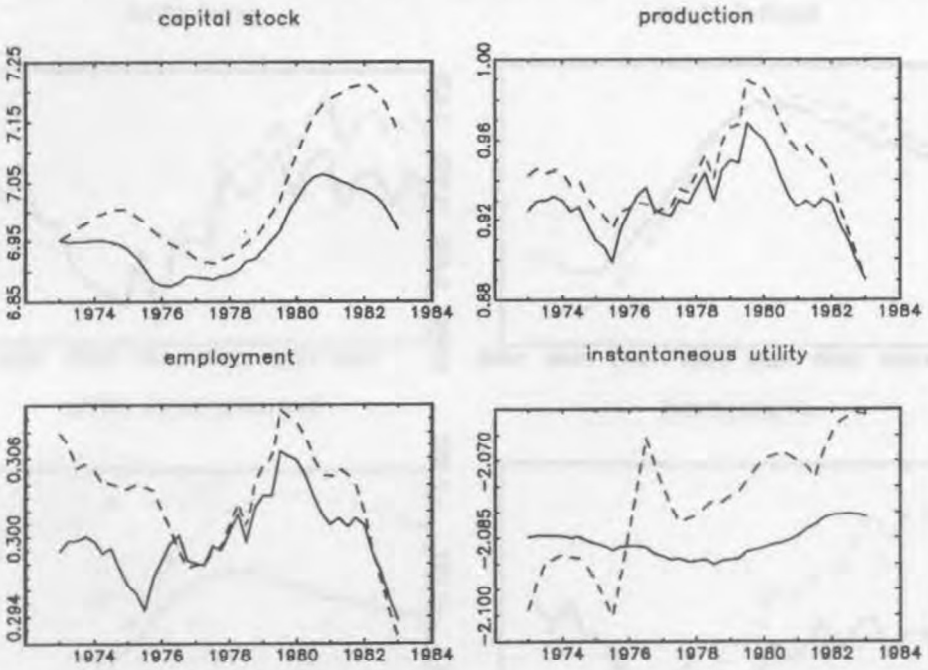
4.1. Welfare Effects of Cyclical Fiscal Policy

The government is able to use three different instruments of fiscal policy in the model: government consumption, labor income tax rates, and capital income tax rates. The effects of German fiscal policy on the capital stock, output, employment, and utility of the representative household [13] are illus-

[12] The GAUSS computer programs are available from the authors upon request.

[13] Instantaneous utility from (2) is discounted by the factor $\gamma_N^{1-\sigma}$ in order to obtain stationary values.

Figure 1
Fiscal Policy in the Years 1972–1983: Actual Fiscal Policy of the SPD Government (broken line) and Constant Fiscal Policy (solid line)



trated in figures 1 and 2 for the Social Democrats and the Christian Democrats, respectively. The macroeconomic variables as implied by the actual fiscal policy (broken line) are compared to the ones in the case of constant fiscal policy (solid line). Evidently, fiscal policy had a substantial impact on the cyclical behavior of the economy during 1972–1989.

In 1973, the German economy entered into a recession. The oil price shock had a profound negative effect on production and employment. During this period, the effective labor income tax rate was 36.6% according to Mendoza, Rasin and Tesar (1994), approximately 1.4% less than the average labor income tax during the SPD government period. The procyclical behavior of the labor income tax rate is also reflected in the empirical correlation of output and the labor income tax rate as presented in table 2. On average, a 1% deviation of output from trend is accompanied by a 0.45% deviation of the labor income tax rate [14]. The procyclical labor income tax rate helped to offset the reduction of private agents' income. In addition, the capital stock recovered much faster than compared to a situation without stabilization policy.

[14] In this paper, we refrain from discussing whether the government party intended to implement the actual fiscal policy or whether it was a mere outcome of, for example, the progressive tax structure and built-in stabilizers.

Figure 2

Fiscal Policy in the Years 1983–1989: Actual Fiscal Policy of the CDU Government (broken line) and Constant Fiscal Policy (solid line)

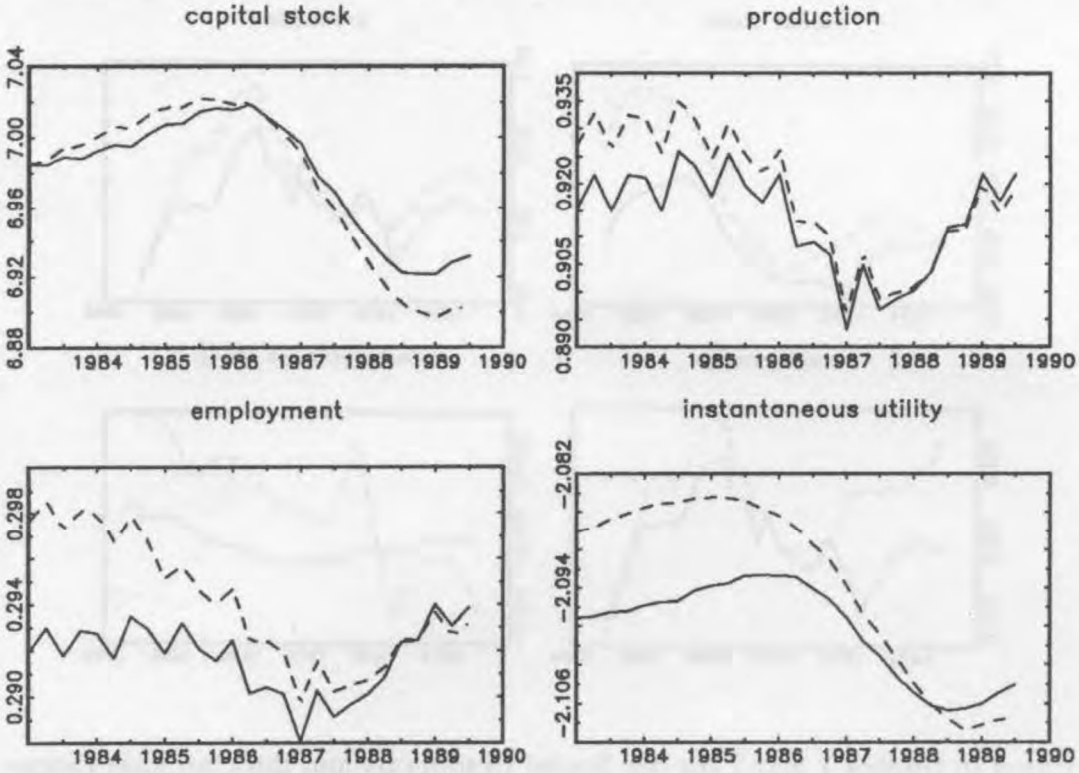


Table 2

Empirical Correlation of Fiscal Policy Variables with Output

Government Party	Government Consumption G	Labor Income Tax Rate θ	Capital Income Tax Rate τ
SPD	0.17	0.45	0.60
CDU	−0.13	−0.10	0.42

All correlations are calculated in terms of variables expressed as logarithmic deviations of seasonally adjusted quarterly data from Hodrick-Prescott trends with smoothing parameter 1600.

During the CDU government period, the effective tax rate on labor income was higher on average, while the effective tax rate on capital income was lower on average compared to the corresponding tax rates during the SPD government period. The cyclical fiscal policy of the CDU resulted in an increase of employment and production during 1983–1987 (see figure 2). Dur-

ing this period, the income tax rates were below their average values in the period 1983–1989. Over the whole period, labor income taxes are only weakly negatively correlated with output, while capital income taxes are procyclical. Furthermore, government consumption is slightly anticyclical during the CDU government period[15].

In order to quantify the change in welfare, we apply the welfare measure as suggested by McGrattan (1994). The welfare gain of moving from allocation (c, l) to (c', l') will be measured by the consumption equivalent increase δ_c[16]:

$$u[(1+\delta_c)c, l] = u(c', l') \,. \tag{25}$$

On average, the government of the Social Democrats performed better than under a 'constant fiscal policy' rule. Quantitative results are significant and amount to $\delta_c = 0.819\%$. The cyclical fiscal policy of the Christian Democrats, however, did not have a significant impact on welfare, amounting to $\delta_c = 0.037\%$[17].

Results are quantitatively but not qualitatively sensitive with regard to the choice of the intertemporal elasticity of substitution, $1/\sigma$, and the substitutability of public and private consumption as measured by ψ[18]. Not surprisingly, as individuals are less willing to accommodate income shocks by intertemporal substitution, the welfare costs of cyclical fluctuations increase modestly. However, for all parameter combinations under consideration, the government policies of the SPD resulted in an increase of welfare amounting to approximately 0.7–0.9% of annual consumption, while the government policies of the CDU resulted in only a small welfare gain which did not exceed $\delta_c = 0.125\%$[19].

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[15] The cyclical behavior of government consumption is found to have a rather small effect on output, employment, and utility. The reason is the weak wealth effect of government consumption on employment. Following a 1% increase in government consumption, employment increases by only 0.15%.

[16] As is evident from figures 1 and 2, the capital stock in the last quarter of the two government periods is different from the one in the case of no stabilization policy. In order to correct for this last-period capital stock effect on households' utility, we computed the value function and adjusted instantaneous utility in the last period accordingly. The numerical procedure is described in the appendix. We would like to thank an anonymous referee for pointing this out to us.

[17] The magnitude of these effects is in accordance with the results from other applied general equilibrium studies of cyclical fiscal policy such as, for example, Greenwood and Huffman (1991).

[18] Sensitivity of the welfare results with regard to the choice of the intertemporal elasticity of consumption $1/\sigma$ and the substitution parameter of private and public consumption ψ is reported in the appendix. Qualitative results are shown to be independent of these two parameters.

[19] Furthermore, the results are qualitatively the same if one assumes that the government does not have control over fiscal spending until 3 or 6 months after the election.

4.2. Steady State Effects of Fiscal Policy

How does the welfare gain from stabilization compare with the gain resulting from a long-run change of fiscal policy? The effects of a one percentage point increase of the government share γ_g, the labor income tax rate θ, and the capital income tax rate τ relative to the values prevailing during the SPD government period are presented in table 3. All fiscal policies act as a distortion in the economy and reduce welfare as measured by the equivalent annual consumption increase[20]. An increase in the government share in output, γ_g, increases both employment and output for $\psi<1$ because a larger government sector decreases household wealth. The net effect of an increase in employment and consumption on utility is negative for the calibrated economy. For $\theta=0.38$ and $\tau=0.356$, for example, an increase of government consumption relative to GNP from 16.8% to 17.8% results in a welfare loss amounting to 0.59% of annual consumption (see table 3). The increase of the two tax rates θ and τ results in similar welfare losses.

Three observations are worth pointing out from this steady state comparative analysis: 1) The quantitative effect on output and employment is most pronounced following a change in the labor income tax rate θ. Hence, the lower labor income tax rate during the SPD government period was more suitable for increasing employment than the CDU fiscal policy. 2) Welfare effects of the SPD stabilization policy have roughly the same magnitude as those of a two percentage point change in the long-run fiscal policy variables[21]. The analysis in this section suggests that fiscal policy and stabilization policy imply sizeable welfare gains. The policy recommendation from the above model is straightforward: reduce distortions, i.e. the government share in output, the tax rates and, if feasible (this is a big if), engage in procyclical income taxation and anticyclical government consumption. 3) On average, the fiscal policy during the SPD government period compared to the one during the CDU government resulted in higher output, employment,

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[20] The steady state effects of an increase in government consumption on output, employment, and welfare, of course, depend crucially on the substitutability of private and public consumption. If public consumption is a perfect substitute for private consumption, $\psi=1$, a change in government consumption has no effect on either output, employment, or utility. In fact, any change in public consumption is exactly balanced by an offsetting change in individuals' private consumption.

[21] One note of caution might be appropriate when comparing the welfare effects resulting from a stabilization policy with the ones resulting from a comparative steady state analysis. Contrary to the former, the latter neglects any welfare losses resulting from the transition from one steady state to another. These transition effects might be quite substantial. For example, Lucas (1990) estimates the welfare gain from the abolition of capital income taxes in the US to amount to a 3% consumption equivalent increase. Considering the transition from the old to the new steady state, however, reduces the welfare gain of such a policy to 1%.

Table 3
Increase of Steady State Fiscal Policy Variables by One Percentage Point

$\begin{pmatrix}\gamma_g\\ \theta\\ \tau\end{pmatrix}$	$\begin{pmatrix}0.168\\ 0.380\\ 0.356\end{pmatrix}$	$\begin{pmatrix}0.178\\ 0.380\\ 0.356\end{pmatrix}$	$\begin{pmatrix}0.168\\ 0.390\\ 0.356\end{pmatrix}$	$\begin{pmatrix}0.168\\ 0.380\\ 0.366\end{pmatrix}$	$\begin{pmatrix}0.170\\ 0.405\\ 0.341\end{pmatrix}$
Output $\bar{y}$	0.930	0.934	0.919	0.922	0.915
Employment $\bar{n}$	0.300	0.301	0.296	0.299	0.292
Welfare Increase δ_c	0	−0.59%	−0.35%	−0.56%	−0.21%

and welfare (compare the first and the last columns of table 3). However, quantitative effects are small. In particular, employment and welfare during the SPD government period exceeded the corresponding values during the CDU government period by 2.7% and 0.21%, respectively.

5. Conclusion

In this paper, we investigated the quantitative effects of cyclical fiscal policies in Germany during 1972–1989 using a computable general equilibrium model. The quantitative evaluations in this paper are helpful in order to understand the effects of the actual business cycle policies as resulting from the variation in both government consumption and income tax rates. On average, the SPD government performed better than the CDU government with regard to the promotion of employment and welfare. The cyclical fiscal policies of the Social Democrats' government in the years 1972–1983 is demonstrated to have resulted in sizeable welfare gains, while the policy of the Christian Democrats' government in the years 1983–1989 is found to have had a negligible impact on welfare. The welfare gain of the SPD cyclical fiscal policy amounts to approximately 0.8% of annual consumption. The magnitude of the welfare effect is about the same for a two percentage points reduction in the income tax rate or the government share in output.

A computational exercise like this, of course, cannot be completed without mentioning some remaining issues for further elaboration. Let us concentrate on two points. First, we assume Walrasian labor markets. A more accurate description of the German labor market might allow for phenomena such as labor hoarding, search unemployment, or labor force heterogeneity. Recent work on this issue in applied general equilibrium modeling includes work by Andolfatto (1996), Merz (1995), Burnside, Eichenbaum and

Rebelo (1993), and Danthine and Donaldson (1995), among others. While these models, with the exception of Burnside, Eichenbaum and Rebelo (1993), have not introduced a government sector, it is straightforward to do so in a manner similar to the one in this paper. Accordingly, in these kind of models, government consumption expenditures would exert an influence on the household's allocation through a wealth effect as well. Following an increase in government consumption, households receive less income and increase their labor supply. Hence, the mechanism through which government consumption affects the cyclical behavior of macroeconomic variables is the same. A similar reasoning applies to the effects of income taxes in a non-Walrasian economy. The introduction of a non-Walrasian labor market, though, might affect 1) the quantitative magnitude of the effect and 2) the dynamic pattern.

Secondly, agents are assumed to be homogeneous. The behavior of the economy is studied by means of a representative household. The introduction of heterogeneity might further reveal interesting conclusions with regard to the quantitative effects of fiscal policy. For example, Aiyagari and McGrattan (1994) study the optimal quantity of debt in a model consisting of liquidity-constrained heterogeneous households facing idiosyncratic income shocks. They find that if the US moved from its current level of debt to its optimal level, welfare gains would accrue at the level of approximately 4% of consumption. However, it is not straightforward to argue that the result of the steady state analysis of Aiyagari and McGrattan carries over to the study of cyclical stabilization policies. In Aiyagari and McGrattan (1994), the welfare gains result from the reduction of *individual* income risk. Stabilization policies might only reduce one source of individual income risk, namely the *aggregate* income variability. As argued by Lucas (1987), stabilization policy "... cannot be expected to eliminate more than a small part of the uninsurable risk borne at the individual level".

Appendix

1. Administration Periods of German Government Parties

Even though Kohl was already chancelor in 1982, the CDU party is assumed not to control fiscal policy until 1983.ii in the benchmark case.

2. Qualitative Properties of the Model

In order to study the qualitative properties of the model, the impulse response functions of the macroeconomic variables to a 1% shock of both gov-

Table 4
Administration Periods of German Government Parties

Administration	Legislation Period	Election Date
Brandt (SPD/FDP)	72.IV–74.I	19. 11. 1972
Schmidt (SPD/FDP)	74.II–76.III	
Schmidt (SPD/FDP)	76.IV–80.III	3. 10. 1976
Schmidt (SPD/FDP)	80.IV–83.I	5. 10. 1980
Kohl (CDU/CSU, FDP)	83.II–86.IV	6. 3. 1983
Kohl (CDU/CSU, FDP)	87.I–90.IV	25. 1. 1987

CDU – Christian Democratic Union; CSU – Christian Social Union; SPD – Social Democratic Party; FDP – Free Democrats.

ernment consumption and the labor income tax rate are illustrated[22]. The parameters are taken from the benchmark case during 1972–1983 as given in table 1. The VAR(1) process is taken from (23).

Figure 3 illustrates the quarterly percentage impulse responses to an orthogonal shock amounting to 1% of government consumption. The responses are expressed relative to the steady state values of the respective variable[23]. Following an increase in government consumption, output and employment increase in the short run. Furthermore, government consumption is a distortion in the economy and reduces utility. Public consumption partially crowds out investment. The effect on investment, however, is sensitive with regard to the intertemporal elasticity of substitution $1/\sigma$. On the one hand, employment increases and, hence, the marginal product of capital. On the other hand, the interest rate increases as households substitute consumption intertemporally. For the benchmark calibration of $\sigma=2$, the net effect on investment is negative. Investment only increases for values of σ below one.

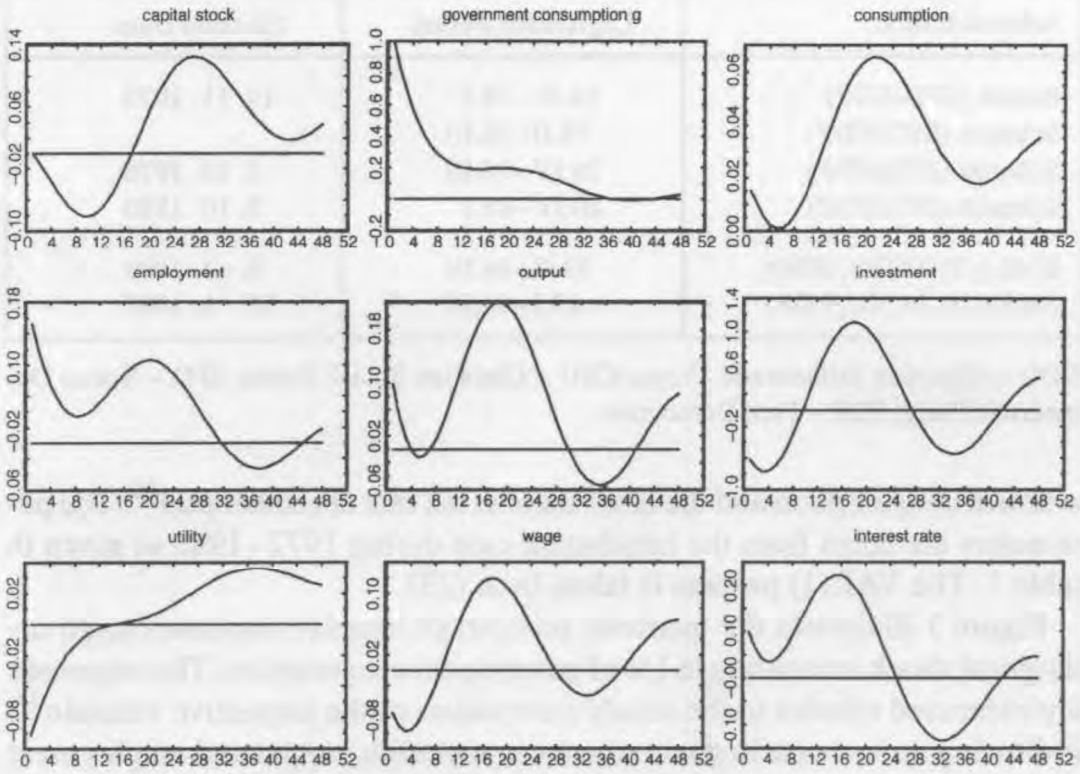
Figure 4 illustrates the effect of a 1% increase of the labor income tax rate θ. Not surprisingly, output, investment, and employment all decline immediately following a tax increase. The quantitative effect is much more pronounced (by a factor of five) in the case of a change in the labor income tax rate than in the case of a change in the capital income tax rate (not illus-

[22] In order to economize on space, we refrain from presenting the impulse response functions to a shock in the technology level and the capital income tax rate. The impulse responses to a technology shock are qualitatively the same as in Hansen (1985). The impulse responses to a temporary increase in the tax rate on capital income can be found in Braun (1994).

[23] Obviously, the impulse responses of the macroeconomic variables to a shock are not a monotonic function over time, as usually implied in models of real business cycles. The fluctuations of the impulse responses are a consequence of our estimate of the matrix of autoregressive parameters A. If A were restricted to be diagonal, impulse responses would regain their usual non-oscillatory shape.

Figure 3

Impulse Response Functions to a Government Demand Shock



trated). In Braun (1994), the same observation is found in a model calibrated with regard to the characteristics of the postwar US economy.

3. Numerical Procedure

3.1. Computation of the Dynamics

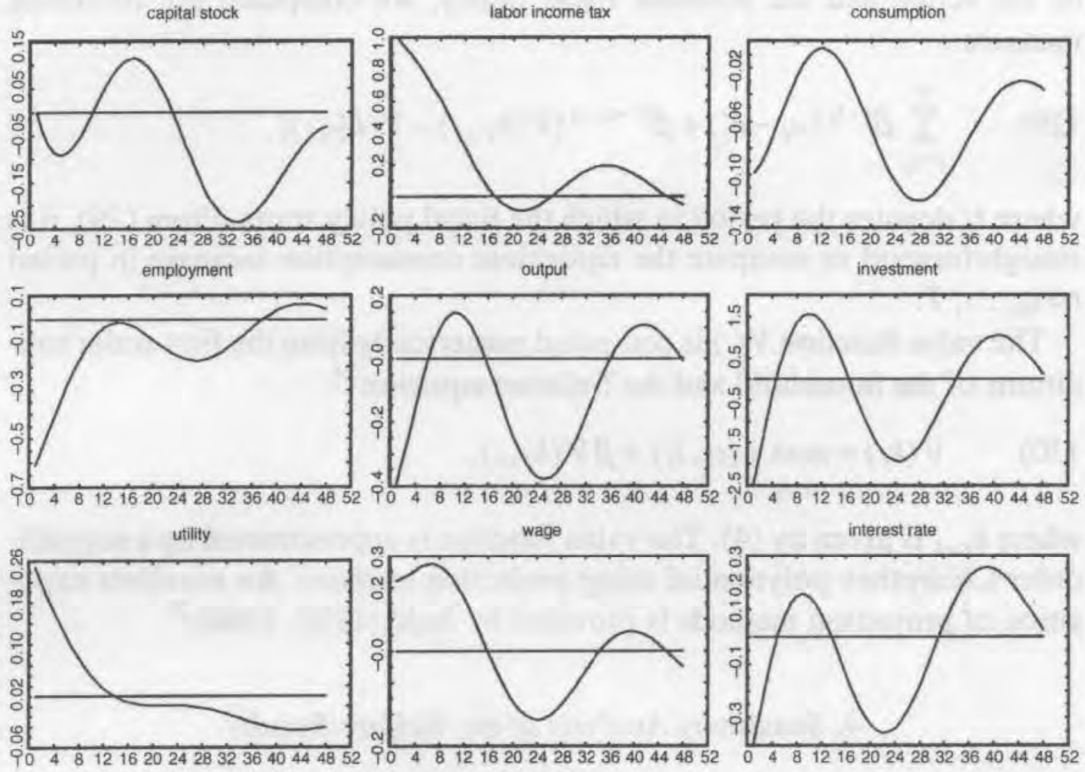
In order to calculate the quantitative effects of fiscal policies, the dynamics of the macroeconomic variables are calculated from the model of section 2 for the actual government policy in Germany in 1972–1989. In a first step, the decision functions of the households and firms are calculated for the calibrated model. Investment i_t, employment n_t, and private consumption c_t^P are functions of the state variables of the economy, consisting of the capital stock k_t, the technology level z_t, government consumption G_t, the labor income tax rate θ_t, and the capital income tax rate τ_t. During the SPD government period of 1972–1983, for example, the household's decision functions are given by (a hat over the variable denotes percentage change):

$$\hat{k}_{t+1} = 0.977\,\hat{k}_t + 0.152\,\hat{z}_t - 0.014\,\hat{G}_t - 0.066\,\hat{\theta}_t + 0.017\,\hat{\tau}_t\,, \tag{26}$$

$$\hat{c}_t = 0.485\,\hat{k}_t + 0.465\,\hat{z}_t - 0.105\,\hat{G}_t + 0.001\,\hat{\theta}_t - 0.089\,\hat{\tau}_t\,, \tag{27}$$

$$\hat{n}_t = -0.093\,\hat{k}_t + 0.741\,\hat{z}_t - 0.016\,\hat{G}_t - 0.778\,\hat{\theta}_t + 0.101\,\hat{\tau}_t\,. \tag{28}$$

Figure 4
Impulse Response Functions to a Labor Income Tax Shock



Second, the technology and policy innovations $\{\varepsilon_t\}_{1973.i}^{1983.i}$ and $\{\varepsilon_t\}_{1983.ii}^{1989.iv}$ are estimated with the help of the vector autoregression (23) and (24) for the two subperiods, respectively. Third, the state variables $(k_{t_0}, z_{t_0}, G_{t_0}, \theta_{t_0}, \tau_{t_0})$ in the starting periods of the SPD and CDU governments, t_0=1972.iv and t_0=1983.ii, are estimated from the German data. Fourth, the dynamics of the macroeconomic variables are computed with the help of the model in section 2 using the actual time series data for the shocks $\{\varepsilon_t\}_{1973.i}^{1989.iv}$ and the initial state values as an input. Fifth, the resulting time series for the capital stock, output, employment, and utility are compared to the case of no stabilization policy, $\{(\varepsilon_{gt}, \varepsilon_{\theta t}, \varepsilon_{\tau t})'\}_{1973.i}^{1989.iv}=0$.

3.2. Computation of the Value Function

Comparing the welfare effects of the actual fiscal policy with those of constant government consumption and tax rates, one has to correct for the difference in the last period's end-of-period capital stock implied by these two policies. Let T denote the last period. The actual and the constant fiscal policy imply utility u_T and u'_T in period T and capital stock k_{T+1} and k'_{T+1}, re-

spectively. Let $V(k_t)$ denote the value function of a household in period t as a function of the capital stock. In order to compare the welfare effects of the actual and the constant fiscal policy, we computed the following measure:

$$(29) \qquad \sum_{t=t_0}^{T} \beta^{t-t_0}(u_t - u_t') + \beta^{T-t_0+1}[V(k_{T+1}) - V(k_{T+1}')],$$

where t_0 denotes the period in which the fiscal policy starts. From (29), it is straightforward to compute the equivalent consumption increase in period $t=t_0, \ldots, T$.

The value function $V(\cdot)$ is computed numerically from the first-order conditions of the household and the Bellman equation[24]:

$$(30) \qquad V(k_t) = \max_{c_t, l_t} u(c_t, l_t) + \beta V(k_{t+1}),$$

where k_{t+1} is given by (4). The value function is approximated by a seventh-order Chebyshev polynomial using *projection methods*. An excellent exposition of projection methods is provided by Judd (1992, 1998)[25].

4. Sensitivity Analysis of the Welfare Results

In this subsection, the sensitivity of the welfare results in section 4 is reported. It is shown that the welfare effect of the two government's fiscal policy is robust, irrespective of the choice of parameter values of the intertemporal elasticity of substitution $1/\sigma$ and the substitutability parameter ψ of private and public consumption.

Table 5 reports the welfare measure δ_c as defined in equation (25) resulting from a change in σ. All other parameters are chosen as in the benchmark case presented in table 1. Table 6 reports the values of δ_c for a change in ψ. Again, the other parameters are chosen as in the benchmark case.

Table 5
Sensitivity of δ_c with Respect to σ

σ	1	2	4
SPD	0.733%	0.819%	0.960%
CDU	0.031%	0.037%	0.040%

Table 6
Sensitivity of δ_c with Respect to ψ

ψ	0	0.5	1
SPD	0.731%	0.819%	0.920%
CDU	0.074%	0.037%	0.123%

[24] The GAUSS computer program is available from the authors upon request.

[25] Heer would like to thank Kenneth Judd for sending him the final draft of his forthcoming textbook on Numerical Methods in Economics.

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Abstract

The performance of German government parties is compared with respect to their success in stabilizing the economy. The government party is assumed to be able to adjust government consumption and taxes on labor and capital income over the business cycle. The stabilization policies of the governments formed by the Social Democrats in the years 1972 to 1983 and the Christian Democrats in the years 1983 to 1989 prior to German unification are compared to the case where fiscal policies are constant. Quantitative implications of the different policies are calculated from a business cycle model. Stabilization efforts over the business cycle are shown to have resulted in welfare gains for the Social Democrats, amounting to an equivalent annual consumption increase of approximately 0.8%, while they have resulted in a negligible welfare change for the Christian Democrats.

Kurzfassung

Diese Studie vergleicht die Stabilisierungspolitik der deutschen Regierungsparteien. Dabei wird unterstellt, daß die Regierungspartei Konjunkturschwankungen mit Hilfe von konsumtiven Staatsausgaben und einer Einkommensteuer auf Arbeit und Kapital glätten kann. Die Stabilisierungspolitik der Sozialdemokraten in den Jahren 1972–1983 und der Christdemokraten in den Jahren 1983–1989 werden jeweils mit einer über den Zyklus konstanten Fiskalpolitik verglichen und in einem allgemeinen Gleichgewichtsmodell quantitativ evaluiert. Die Konjunkturpolitik der Sozialdemokraten hat zu Wohlfahrtsgewinnen geführt, die einer äquivalenten Konsumerhöhung von ungefähr 0,8% entsprechen, während die Konjunkturpolitik der Christdemokraten zu keiner nennenswerten Veränderung der Wohlfahrt geführt hat.

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