Fiscal Policy in the New Neoclassical Synthesis

Ludger Linnemann[*]and Andreas Schabert[†]

December 5, 2000

---

[*]Corresponding author. University of Cologne, Department of Economics (Staatswiss. Seminar), D-50923 Koeln,, Germany, email: linnemann@wiso.uni-koeln.de, fax: +49/221/470-5077, tel: +49/221/470-2999.

[†]University of Cologne.

Abstract: A sticky-price model is presented to analyze the cyclical effects of fiscal shocks under different monetary policy regimes. Price stickiness has the consequence that changes in the price-marginal-cost markup affect labor demand and can either counteract or enhance the wealth effect on labor supply. The direction of this markup effect depends on the monetary policy regime; when the central bank targets money, fiscal expansions are contractive, while when it targets interest rates via a Taylor rule output, wages, and, initially, even consumption can rise. However, stickiness alone is not sufficient to explain the persistent rise in consumption that recent empirical studies find.

Ludger Linnemann and Andreas Schabert

University of Cologne

Department of Economics (Staatswiss. Seminar)

Albertus Magnus Platz

D-50923 Koeln

Germany

tel +49/221/470-2999

fax +49/221/470-5077

e-mail linnemann@wiso.uni-koeln.de

1 Introduction

What are the effects of changes in government expenditure on the business cycle? Historically, two different and mutually incompatible strands of theories have been advanced to answer this question. Broadly characterized, there is the Keynesian tradition, on the one hand, as captured in the familiar textbook IS-LM-Phillips-Curve model, with its focus on the relevance of aggregate demand disturbances on cyclical conditions. Expansionary fiscal policy, like any exogenous increase in aggregate demand, in this view allows demand constrained firms to sell more output, thus boosting income, employment, and, by the multiplier effect, consumption, because the inflexibility of goods prices that prevails in the short-run makes output demand determined; in other words, there is a non-vertical short-run aggregate supply curve which is upward sloping because prices are temporarily sticky and adjust only gradually, as typically captured in some version of a Phillips-Curve specification. In the following, we will call this mechanism the 'aggregate demand effect' of fiscal policy for short; see Taylor (2000) for a recent discussion.

On the other hand, the effects of fiscal policy have been studied more recently in purely real dynamic general equilibrium models with optimizing agents and fully flexible prices, e.g. Baxter and King (1993). Here, the central mechanism by which fiscal policy influences the private economy is the negative wealth effect implied by the tax financing of rising government expenditure which, with standard preferences, induces an increase in labor supply, thus raising output and employment and depressing private consumption. This chain of events, which we will sometimes simply abbreviate as the 'wealth effect' in what follows, is thoroughly different from the aggregate demand effect story, as any change in output and employment induced by fiscal policy is due to the optimal response of household labor supply. Consequently, the predictions of the neoclassical general equilibrium model are directly opposed to those of the Keynesian theory with respect to some important variables like wages and private consumption.

Both theories may be regarded as less than fully satisfactory due to debatable assumptions on which they are built. On the one hand, traditional IS-LM theorizing nowadays seems outdated to most researchers due to its lack of conventional microfoundations and rational expectations. On the other hand, the more recent real general equilibrium models may be inappropriate, too, because of their neglect of any frictions in the goods or labor market; particularly, there is a large and growing body of evidence in favor of temporary price stickiness at business cycle frequencies (see the survey in Taylor, 1999) which points to an important role for nominal variables to play in any business cycle theory. In related research, namely the literature on the transmission of monetary policy, a recent consensus model seems to have emerged, which is labelled either 'New Neoclassical Synthesis' (by Goodfriend and King, 1997), or interchangeably 'New-Keynesianism' (by, among others, Hairault and Portier, 1993), or 'Neo-Monetarism' (by Kimball, 1995), or 'Optimizing IS-LM' model (by McCallum and Nelson, 1999, and Casares and McCallum, 2000); henceforth, we prefer the term New Neoclassical Synthesis which we will abbreviate by NNS. The gist of this approach is the combination of an explicitly dynamic representative agent

optimizing general equilibrium framework with short-run nominal frictions, particularly temporary stickiness of nominal goods prices, hence with a strong influence of monetary policy on real aggregates over the business cycle. Recent research in this area, particularly that by McCallum and Nelson (1999), has shown that much of the intuition gained from the simple IS-LM model carries over to the NNS model as far as the effects of monetary policy are concerned. Indeed, a (very) stylized version of this model has become the basic workhorse in the literature on monetary policy; see the survey by Clarida et al. (1999).

But if price stickiness is, as perceived in a large literature, the main reason why monetary policy matters, the question naturally arises whether this has any implications for the understanding of the way fiscal policy works. This is what the present paper intends to contribute. One of the questions that we pursue by this approach is in how far fiscal policy in a typical NNS model can serve as a microfoundation for the intuition conveyed by the IS-LM framework, thus complementing the work that McCallum and Nelson (1999) have done for the case of monetary policy. Specifically, we model a monetary economy with a cash-in-advance constraint where optimizing households accumulate capital subject to adjustment costs. Firms are assumed to be monopolistic competitors striving to realize a constant markup of product prices over marginal costs, which is hampered by the presence of the type of price stickiness originally presented in Calvo (1983), i.e. a stochastically arriving temporary inability on the part of a subset of all firms to change their output prices as they desire in any given period. The government collects lump-sum taxes and seignorage and uses the receipts to purchase goods; in one variant of the model these may provide utility to the representative household, who finds government consumption to be an imperfect substitute for private consumption. Fiscal policy is modelled as a serially correlated exogenous increase in real government expenditures. In addition, we allow a monetary authority to endogenously react to the fiscal stance by adjusting nominal interest rates according to a feedback rule of the type advocated in Taylor (1993) and analyzed in a large monetary policy literature thereafter (see, e.g., the contributions in Taylor, 1999).

Our theoretical results allow us to take a position on some unresolved issues. Particularly, by considering the interaction of fiscal with monetary policies, we obtain a possibility to interpret some empirical results that have been reported in the literature. In principle, empirical evidence could be expected to be useful for the purpose of distinguishing between different theories of how fiscal policy works. This is because Keynesian and neoclassical theories, while both predicting rising output and employment in response to temporary fiscal expansions, have markedly different implications for the responses of some other variables, particularly for private consumption and real wages. In the Keynesian story, private consumption should rise with government spending because income rises, due to the aggregate demand effect, and exerts the usual multiplier effect. Real wages should rise, too, in this view, as typical Phillips-Curves posit that because rising aggregate demand leads to output being above its natural rate, the consequence are nominal wage increases which in turn let goods prices rise. Both responses are predicted to be of the opposite sign in neoclassical general equilibrium models, because the wealth effect depresses household demand for leisure and private consumption, and rising labor supply leads to decreasing

marginal productivity of that production factor, thus lowering real wages.[1] Consequently, the empirical responses of private consumption and real wages could discriminate between the plausibility of alternative models.

Unfortunately, the empirical literature has produced different and mutually incompatible results concerning the reaction of these key variables to government spending shocks. The main reason for the opposing results seems to stem from differences in the empirical methods used. There are basically two approaches: Ramey and Shapiro (1998) and the subsequent refinements by Edelberg et al. (1998) and Burnside et al. (1999) consider government spending in specific historical episodes, such as the Korean war and the Reagan military buildup in the early 50ies and 80ies, respectively, as dictated by unique political constellations, hence not merely being made in response to economic conditions themselves and thus exogenous in a statistical sense. Using dummy variables for the historical episodes to represent exogenous fiscal spending surges, these studies find consistently that real wages fall while employment rises, and Ramey and Shapiro (1998) and Edelberg et al. (1998) also find decreasing private consumption. The second empirical pocedure used to assess the effects of spending shocks is the VAR innovations approach, with various auxiliary assumptions intended to identify truly exogenous components of government expenditure changes. These studies broadly produce the opposite result: Rotemberg and Woodford (1992) and Fatas and Mihov (2000) find that most measures of real wages increase after positive fiscal shocks, along with output and employment, and the latter authors also report, in accordance with Blanchard and Perotti (1999) and Mountford and Uhlig (2000), that private consumption rises robustly with public spending.

In our model, not only can any type of real wage response to a government expenditure shock arise as a function of the postulated degree of price stickiness, but the probability of occurrence of a specific sign of the real wage response depends on the way monetary policy is conducted. The reason is that nominal price stickiness introduces a way for the markup of price over marginal cost to vary inversely with employment. Thus, there is a wedge between the real wage and the marginal product of labor which is larger when output and employment are above normal, e.g. because a fiscal expansion has stimulated labor supply. Hence, price stickiness allows a second channel through which fiscal shocks can have effects on the real wage, in that the labor supply response due to the wealth effect is supplemented by a labor demand effect due to a declining markup. This effect drives the results in Rotemberg and Woodford (1992), who present a purely real model where a countercyclical markup arises because collusion between oligopolistic firms is weaker in expansions. In our model, the result arises because some firms cannot immediately adjust prices, which seems a less controversial assumption empirically.

However, sticky prices do not only provide an alternative microfoundation for a markup

---

[1] The latter effect could be overridden if there were increasing returns to scale of an important size (as assumed in Devereux et al., 1996), which is, however, empirically doubtful in the light of recent evidence (see Basu and Fernald, 1997). The effect need also not arise in the neoclassical multisector model by Ramey and Shapiro (1998).

effect in our model. More importantly, the presence of stickiness gives a role for nominal variables to play in our story, such that the interaction of fiscal and monetary policy becomes crucial.[2] Particularly, the markup only declines in response to a positive fiscal shock in our model when the central bank does not fix the nominal money supply, but if it instead follows a Taylor (1993)-style feedback rule in setting the short-run nominal interest rate in response to developments of inflation and possibly output. The reason is that with price stickiness the markup is negatively related to the inflation rate, and fiscal expansions require falling prices when the nominal money stock is fixed, while they set forth rising prices when money is endogenous and the central bank sets nominal interest rates according to a Taylor rule. Ultimately, the effect of fiscal policy on wages depends on the monetary policy rule.

This having said, it is important to note that, even with an accomodative monetary policy, the markup-induced labor demand effect just described is not identical to the aggregate demand effect of fiscal policy in the sense the term was used above to convey the intuition for the working of the IS-LM model. On the contrary, in our model there is no such thing as an aggregate demand effect because, as we demonstrate, the only reason for output and employment to rise in the first place in response to a fiscal shock is the wealth effect on labor supply, as in the purely neoclassical model by Baxter and King (1993). Switching off the wealth effect leads to a model where fiscal policy has no effect other than crowding out private consumption one for one, leaving output unaltered. This is the 'neoclassical' side of the model, and it is entirely unaffected by the degree of price stickiness, as well as by different monetary policy rules.

One important consequence of this is that our NNS model is in conflict with much of the empirical evidence in that it cannot generally produce a positive reaction of private consumption to government spending shocks. In a model where events are driven by the wealth effect, private consumption should be expected to fall when public consumption rises, as the representative agent feels having become poorer. We discuss two possibilities to overturn this effect and thus to produce a positive consumption response: one is through the Taylor rule-style monetary policy, by which endogenously expanding nominal money exerts a counterbalancing effect on private consumption for some parameter constellations; basically, when the central bank sets interest rates according to the Taylor rule, it provides endogenous seignorage to the government which alleviates the effects from the financing side of the budget expansion on private consumption partially. However, this effect is not very strong in our model and can, at most, make private consumption rise in the first period following the spending shock, before the wealth effect again dominates. The second possibility is to have public consumption enter the representative household's utility function; indeed, we present a version of our model where private and public consumption both provide utility and the elasticity of substitution between the two is constant and

---

[2]Though we emphasize the policy interaction, it should be noted that the paper is not intended to add to the recent literature on the fiscal theory of price determination (see, e.g., Woodford, 1994, Sims, 1994, Canozeri et al., 1998). In contrast to this approach, we apply a conventional Ricardian regime and disregard any further restrictions on fiscal policy.

finite. If the elasticity of substitution is below some specified value, an increase in public spending can raise the marginal utility of private consumption, which will consequently rise, too. However, a low elasticity of substitution implies a comparatively strong wealth effect, hence relatively large additional labor input and strongly diminishing returns, which put pressure on wages. For our preferred parametrization, no degree of price stickiness and hence no induced markup decline is large enough to offset this influence. As a consequence, while the model can separately explain why real wages *or* consumption rise in response to fiscal shocks, it cannot explain why they rise *both*. Thus, in sum, though equipped with some features prominent in the Keynesian literature, the way fiscal shocks work in our NNS model is fundamentally more reminiscent of the neoclassical story.

The rest of this paper is organized as follows. Section 2 describes the model and, in section 2.5, its parameterization, and section 3 presents the results by displaying impulse responses and some sensitivity analysis with respect to important parameters. In order to clearly work out the dependance of results on different assumptions, we first explore in section 3.1 the case of fiscal policy with a central bank that exogenously fixes the nominal money stock, and then do the same for the case of the central bank following a Taylor rule in section 3.2. Section 4 concludes.

2 The Model

In this section we present a sticky price model which allows the analysis of fiscal policy shocks. The latter are identified with innovations to government expenditures which are financed in a lump-sum fashion. Money demand is introduced via a cash-in-advance constraint. Firms are assumed to be monopolistically competitive and to adjust prices according to Calvo's (1983) price staggering formulation. We further introduce adjustment costs of capital as to generate reasonable investment reactions (see Casares and McCallum, 2000). Monetary policy is specified either as exogenous money growth or by a Taylor rule.

2.1 Households

Throughout the paper, nominal variables are denoted by upper-case letters, while real variables are denoted by lower-case letters. The typical household is infinitely lived, with preferences given by the expected value of a discounted stream of instantaneous utility $u(.)$:

$$E_0 \left[\sum_{t=0}^{\infty} \beta^t u(c_t^p, 1 - l_t) \right], \quad \beta \in (0,1), \tag{1}$$

where E_0 is the expectation operator conditional on the time 0 information set and β is the discount factor. Instantaneous utility $u(.)$ depends on a Cobb-Douglas bundle of private consumption c^p and leisure $1 - l$, where l is working time. We assume constant relative risk aversion (CRRA):

$$u(c_t^p, 1 - l_t) = \frac{[(c_t^p)^\gamma (1 - l_t)^{1-\gamma}]^{1-\sigma} - 1}{1 - \sigma}, \quad \gamma \in (0,1), \quad 0 \le \theta \le 1. \tag{2}$$

7

At the beginning of period t, the representative household owns the entire stock of money M_t in the economy. It must decide how much of this cash holdings to keep for contemporaneous consumption expenditures:

$$P_t c_t^p \leq M_t + P_t \tau_t, \tag{3}$$

where P and τ denote the aggregate price level and lump-sum government transfers, respectively. The cash-in-advance constraint in (3) implies that only investment is a credit goods in this economy. This ensures that, in a variant to be explored later, when government expenditures enter the utility function, they are treated perfectly symmetrically to private consumption in that they are included in the cash-in-advance constraint. The household receives dividends - and the rental rate r on physical capital k as additional flows from monopolistically competitive firms indexed by $i \in (0,1)$. In period t the household chooses consumption c_t^p and investment expenditures e_t, nominal money holdings M_{t+1}, and nominal riskless one-period pure discount bond holdings $(1+i_{t+1})^{-1}B_{t+1}$.

$$M_{t+1} + (1+i_{t+1})^{-1} B_{t+1} \tag{4}$$
$$= P_t r_t k_t + B_t + M_t + P_t \tau_t - P_t(c_t^p + e_t) + \int_0^1 {}_{it} di.$$

The household maximizes (1) subject to its cash-in-advance constraint (3), its budget constraint (4), and the following condition for the accumulation of physical capital:

$$k_{t+1} = \Phi\left(\frac{e_t}{k_t}\right) k_t + (1-\delta) k_t, \tag{5}$$

where δ denotes the depreciation rate of capital and $\Phi(.)$ the adjustment cost function.[3] This function is identical to the one used in, e.g., Bernanke et al. (1999), and is increasing and concave. Accordingly, investment expenditures e yield a gross output of new capital goods $\Phi(e/k) k$. The inclusion of adjustment costs permits to analyze the cyclical behavior of the price q of physical capital.[4] The household's first order conditions for private consumption, labor supply, investment expenditures and for physical capital are given by

$$\lambda_t = \gamma \frac{\left[(c_t^p)^\gamma (1-l_t)^{1-\gamma}\right]^{1-\sigma}}{c_t^p(1+i_t)}, \tag{6}$$

$$w_t \lambda_t = (1-\gamma) \frac{\left[(c_t^p)^\gamma (1-l_t)^{1-\gamma}\right]^{1-\sigma}}{(1-l_t)}, \tag{7}$$

$$\frac{\lambda_t}{\beta} = E_t\left[\lambda_{t+1}\frac{1+i_{t+1}}{\pi_{t+1}}\right], \tag{8}$$

$$q_t = \Phi'\left(\frac{e_t}{k_t}\right)^{-1}, \tag{9}$$

---

[3]The introduction of a similar adjustment cost function is suggested by Casares and McCallum (2000) in order to generate reasonable investment responses in a sticky price model.

[4]The function Φ is chosen to obtain a steady state value of the capital price q equal to one.

$$\frac{q_t}{\beta} = E_t \left[\frac{\lambda_{t+1}}{\lambda_t} \left(r_{t+1} + q_{t+1} \left(\Phi \left(\frac{e_{t+1}}{k_{t+1}} \right) - \Phi' \frac{e_{t+1}}{k_{t+1}} + (1 - \delta) \right) \right) \right], \tag{10}$$

where λ and π denote the Lagrange multiplier for the budget constraint and the gross inflation rate, respectively. Furthermore, in an optimum the cash-in-advance constraint (3) holds with equality for $i > 0$. Regarding the household's assets, the optimal choices must also satisfy the following transversality conditions:

$$\lim_{t \to \infty} \beta^t u_{c_t} x_t = 0, \quad \text{for } x = k, m, b. \tag{11}$$

2.2 Production

The final good which is consumed and invested in the stock of physical capital is an aggregate of a continuum of differentiated goods produced by monopolistically competitive firms indexed with $i \in (0, 1)$. The aggregator of differentiated goods is defined as follows:

$$y_t = \left[\int_0^1 y_{it}^{\frac{(\epsilon-1)}{\epsilon}} di \right]^{\frac{\epsilon}{\epsilon-1}}, \quad \text{with } \epsilon > 1, \tag{12}$$

where y is the number of units of the final good, y_i the amount produced by firm i, and ϵ the constant elasticity of substitution between these differentiated goods. Let P_i and P denote the price of good i set by firm i and the price index for the final good. The demand for each differentiated good is derived by minimizing the total costs of obtaining y subject to (12):

$$y_{it} = \left(\frac{P_{it}}{P_t} \right)^{-\epsilon} y_t. \tag{13}$$

Hence, the demand for good i increases with aggregate output and decreases in its relative price. For the price index P of the final good cost minimization implies

$$P_t = \left[\int_0^1 P_{it}^{(1-\epsilon)} di \right]^{\frac{1}{1-\epsilon}}. \tag{14}$$

A monopolistically competitive firm i produces good i using labor and physical capital according to the following technology with fixed costs of production κ:

$$y_{it} = \begin{cases} k_{it}^\alpha l_{it}^{1-\alpha} - \kappa, & \text{if } k_{it}^\alpha l_{it}^{1-\alpha} > \kappa \\ 0 & \text{otherwise} \end{cases} \quad \text{with } 0 < \alpha < 1, \tag{15}$$

Entry and exit into the production sector is ruled out; in the steady state, there will be zero profits because we impose a scale elasticity equal to the markup such that any excess of revenue over factor costs will be absorbed by fixed costs. The firms rent labor and capital in perfectly competitive factor markets. Cost minimization for given aggregate prices leads to real marginal costs mc which only depend on the real factor prices:

$$mc_t(w_t, r_t) = \alpha^{-\alpha}(1 - \alpha)^{-(1-\alpha)} w_t^{1-\alpha} r_t^\alpha. \tag{16}$$

9

We introduce a nominal stickiness in form of staggered price setting as developed by Calvo (1983). Each period firms may reset their prices with the probability $1 - \phi$ independent of the time elapsed since the last price setting. The fraction ϕ of firms are assumed to adjust their previous period's prices according to the following simple rule:

$$P_{it} = \overline{\pi} P_{it-1}, \tag{17}$$

where $\overline{\pi}$ denotes the average of the inflation rate $\pi_t = P_t/P_{t-1}$. In each period a measure $1 - \phi$ of randomly selected firms set new prices $\widetilde{P}_{it}$ in order to maximize the value of their shares

$$\max_{\widetilde{P}_{it}} E_t \left[\sum_{s=0}^{\infty} (\beta\phi)^s \vartheta_{t,t+s} \left(\overline{\pi}^s \widetilde{P}_{it} y_{it+s} - P_{t+s} mc_{t+s}(y_{it+s} + \kappa) \right) \right], \tag{18}$$

$$\text{subject to } y_{it+s} = \left(\overline{\pi}^s \widetilde{P}_{it} \right)^{-\epsilon} P_{t+s}^{\epsilon} y_{t+s}.$$

Since the firms are owned by the households, the weights $\vartheta_{t,t+s}$ of dividend payments consist of the marginal utilities of consumption: $\vartheta_{t,t+s} = \frac{\lambda_{t+s}}{\lambda_t} \frac{P_t}{P_{t+s}}$. The first order condition for the optimal price setting of flex-price producers is given by

$$\widetilde{P}_{it} = \frac{\epsilon}{\epsilon - 1} \frac{\sum_{s=0}^{\infty} (\beta\phi)^s E_t \left[\vartheta_{t,t+s} y_{t+s} P_{t+s}^{\epsilon+1} \overline{\pi}^{-\epsilon s} mc_{t+s} \right]}{\sum_{s=0}^{\infty} (\beta\phi)^s E_t \left[\vartheta_{t,t+s} y_{t+s} P_{t+s}^{\epsilon} \overline{\pi}^{(1-\epsilon)s} \right]}. \tag{19}$$

Using the simple price rule for the fraction ϕ of the firms (17), the price index for the final good as defined in (14) evolves recursively over time

$$P_t = \left[\phi \left(\overline{\pi} P_{t-1} \right)^{1-\epsilon} + (1-\phi) \widetilde{P}_t^{1-\epsilon} \right]^{\frac{1}{1-\epsilon}}. \tag{20}$$

In the case of flexible prices ($\phi = 0$) we obtain: $P_{it} = P_t mc_t \epsilon/(\epsilon - 1)$. Hence, in a symmetric equilibrium real marginal costs mc are constant over time when prices are flexible ($mc_t = (\epsilon - 1)/\epsilon$), while they vary in the sticky price version of the model. In the latter case the inflation rate evolves according to

$$\widehat{\pi}_t = (1 - \phi)(1 - \beta\phi)\phi^{-1} \widehat{mc}_t + \beta E_t[\widehat{\pi}_{t+1}];$$

here and in what follows for any variable x the notation $\widehat{x}_t$ means the percent deviation of x_t from its steady state value $\overline{x}_t$: $\widehat{x}_t = \log(x_t/\overline{x}_t)$. At the end of the period the nominal profits - $_{it} = P_{it} y_{it} - P_t mc_t(y_{it} + \kappa)$ of firm i are distributed to the household which owns the firm. All firms face the same identical production technology and the same costs for their factor inputs. In view of this symmetry the cost minimizing factor demand schedules can be written in aggregate quantities

$$w_t = mc_t \left(1 - \alpha \right) k_t^{\alpha} l_t^{-\alpha}, \tag{21}$$

$$r_t = mc_t \alpha k_t^{\alpha-1} l_t^{1-\alpha}. \tag{22}$$

2.3 Fiscal and Monetary Policies

We consider two kinds of public liabilities, i.e. monetary balances and one-period discount bonds. That is, the amount of borrowing in period t is $E_t\left[(1+i_{t+1})^{-1}\right]B_{t+1}$ and the amount to be repaid in period $t+1$ is B_{t+1}. The revenues of issuing public liabilities (debt and money) net of government spending g is transferred in a lump-sum way (τ) to the households. The government's budget constraint is given by

$$P_t\tau_t + P_t g_t + M_t + B_t = (1+i_{t+1})^{-1}B_{t+1} + M_{t+1}. \tag{23}$$

We set the amount of bonds equal to zero in every period. Hence, the government's period-by-period budget constraint (23) can then be rewritten as

$$P_t(\tau_t + g_t) = M_{t+1} - M_t. \tag{24}$$

We assume that the monetary authority sets the short run nominal interest rate according to a Taylor rule.

$$\widehat{i}_t = \rho_i \widehat{i}_{t-1} + \rho_\pi \widehat{\pi}_{t-t} + \rho_y \widehat{y}_{t-1}. \tag{25}$$

The occurrence of lagged values of the deviations of the variables on the right hand side reflects the critique made by McCallum (1999) that for a policy rule to be operational the central bank should in fact be able to observe the variables it is assumed to respond to before it comes to making decisions; Taylor rules with lagged variables are analyzed in Rotemberg and Woodford (1999), too. Alternatively, we assume that the monetary authority directly controls the growth rate χ of the monetary aggregate: $\chi_t = M_{t+1}/M_t$. Real government expenditures follow a first order autoregressive process:

$$\log g_t = \rho_g \log g_{t-1} + (1-\rho_i)\log \overline{g} + \varepsilon_t, \tag{26}$$

where $\overline{g}$ denotes the amount of government expenditures in steady state. The autoregressive parameter ρ_g is between zero and one and the innovations ε are i.i.d. with a constant variance σ_ε^2.

2.4 Rational Expectations Equilibrium

In order to induce stationarity, the model is expressed in real terms, with $m_t = M_t/P_t$. The endogenous state of the economy is represented by values taken by k, m, i. We restrict our attention to equilibria with positive values of the nominal interest rate so that the household's cash-in-advance constraint (3) always binds. A rational expectations equilibrium, then, consists of an allocation $\{c_t^p, e_t, l_t, k_{t+1}, m_{t+1}, \tau_t, g_t\}_{t=0}^\infty$ and a sequence of prices and costates $\{\pi_t, w_t, r_t, mc_t, q_t, \lambda_t\}_{t=0}^\infty$ such that (i) the household's first order conditions (6)-(10) together with the cash-in-advance constraint (3), the capital accumulation equation (5) and the transversality conditions are satisfied; (ii) the factor demand conditions (21) and (22) as well as the pricing equations (19) and (20) are fulfilled; (iii) the government budget constraint (24) is satisfied, while the nominal interest rate is given by the rule (25);

(iv) the market for final output clears: $y_t = c_t^p + e_t + g_t$.

2.5   Model Parametrization

The model's equilibrium conditions are linearized around a non-stochastic steady state and the resulting approximate linear system is solved relying on the methods in Uhlig (1999). For that purpose, we have to supply parameters that characterize the steady state of the model. The values for the preference and technology parameters are fairly standard in the business cycle literature; see, e.g., Christiano and Eichenbaum (1992). The discount factor of households β is set equal to $1.03^{-0.25}$. The production elasticity of capital α is set equal to 0.36. Quarterly depreciation of physical capital δ is assigned a value of 0.0212. Steady state labor input is equal to 0.33 implying a value of 0.2925 for the consumption expenditure share in the utility function, γ. The parameter σ which governs the risk aversion of the household is set to 2.

The elasticity of the price of capital with respect to the investment ratio, $\Phi'' \cdot (\frac{e}{k})/\Phi'$, is set to -0.25. This value is taken from Bernanke et al. (1999) who also identify monetary policy shocks with innovations to the nominal interest rate. Following Christiano et al. (1997), the price elasticity of demand ϵ is assigned a value of 6, implying a mark-up equal to 1.2. The fixed cost parameter is scaled to $\kappa = y/(\epsilon - 1)$ so that in a steady state the elasticity of scale is equal to the markup, thus entailing zero profits. The probability for a firm to be allowed to reset its price in a given period, $1 - \phi$, is assigned a value of 0.25. This value is conservative with respect to the estimates by Gali and Gertler (1999) and is consistent with an average period of three quarters between price adjustments. The long-run share of government expenditures $g/y = 21\%$ is taken from Edelberg et al. (1998). The parameter ρ_g of the AR1 process is set equal to 0.9. The steady state inflation rate is estimated to be 1.0189.

A well known phenomenon associated with interest rate rules is the occurrence of real indeterminacy of rational expectation equilibria in monetary business cycle models. As shown Kerr and King (1996), uniqueness of rational expectation equilibria crucially depends on the state contingency of the central bank's interest rate setting behavior. Conventionally, a central bank's policy is called passive (active) when the partial derivative of the nominal interest rate rule with respect to the expected inflation rate is less (larger) than one. Regarding a simple expectational IS-LM model, one typically finds that an active monetary policy is required to ensure equilibrium uniqueness. What is essentially needed for this is to raise not only the nominal interest rate but even the real interest rate in response to higher expected inflation. Consequently, we set the parameter ρ_π governing this response equal to 1.5 which is also suggested in Taylor's (1993) famous discussion of interest rate feedback rules. In accordance with Christiano and Gust (1999) and Rotemberg and Woodford (1999), our results reveal that an active policy is not sufficient for uniqueness in standard dynamic general equilibrium models and needs to be supplemented by a high autocorrelation of nominal interest rates. In order to achieve uniqueness, we henceforth apply a value of 0.97 for the autoregressive parameter ρ_i in our interest rate rule, while ρ_y is set to zero. The following table gives an overview over

parameter choices.

Table 1: Values of Preference and Technological Parameters

Parameter	Descriptions	Value
α	production elasticity of capital	0.36
σ	relative risk aversion	2
ϵ	substitution elasticity of differentiated goods	6
β	discount rate	0.9926
δ	depreciation rate of physical capital	0.0212
$\Phi''\frac{c}{k}/\Phi'$	elasticity of capital adjustment cost	-0.25
g/y	government expenditure share	0.21
$\bar{l}$	steady state labor supply	0.33
ρ_g	autoregressive shock parameter	0.9
$\overline{\pi}$	steady state inflation	1.0189
$1-\phi$	probability of price adjustment	0.25
ρ_i, ρ_π, ρ_y	Taylor rule parameters	0.97, 1.5, 0

3 Results

We present our results by discussing impulse response functions to unanticipated govern-
ment expenditure shocks for two versions of the model which are distinguished by the way
monetary policy is conducted. Subsection 3.1 analyzes the case of an exogenous growth
path of the nominal money supply which is thus unchanged by fiscal actions, whereafter
subsection 3.2 does the same for the case of the central bank following a Taylor rule in
setting nominal interest rates. This type of presentation is to most clearly expose our
main point, the importance of the interactions between fiscal policy and the monetary
policy regime. In our model, this importance stems from the fact that we can distinguish
two channels by which fiscal policy impacts on the economy: the wealth effect by which
fiscal policy influences labor supply, and the markup effect implied by price staggering
by which government demand shifts labor demand. When nominal money is exogenous
and constant, then, concerning the determination of output and employment, both ef-
fects counteract each other, while when the central bank sets interest rates according to a
feedback rule, they work in the same direction.

3.1 Exogenous money

In this section, we assume that the nominal money stock is constant and exogenous. In
figure 1, we present the model's impulse responses to an unanticipated one percent increase
in government expenditure in period one, with an autoregressive parameter of the shock
process equal to 0.9. The figure gives the variables' percentage response for the first twenty

quarters following the impulse. Most notably, output, private consumption, investment, and labor input fall on impact while the nominal interest rate rises; real factor prices decline and, consequently, the markup μ of price over marginal cost which is equal to the inverse of real marginal cost, $\mu_t = 1/mc_t$, rises. While the nominal money stock is unchanged by assumption, real money $m_t = M_t/P_t$ rises because inflation declines.
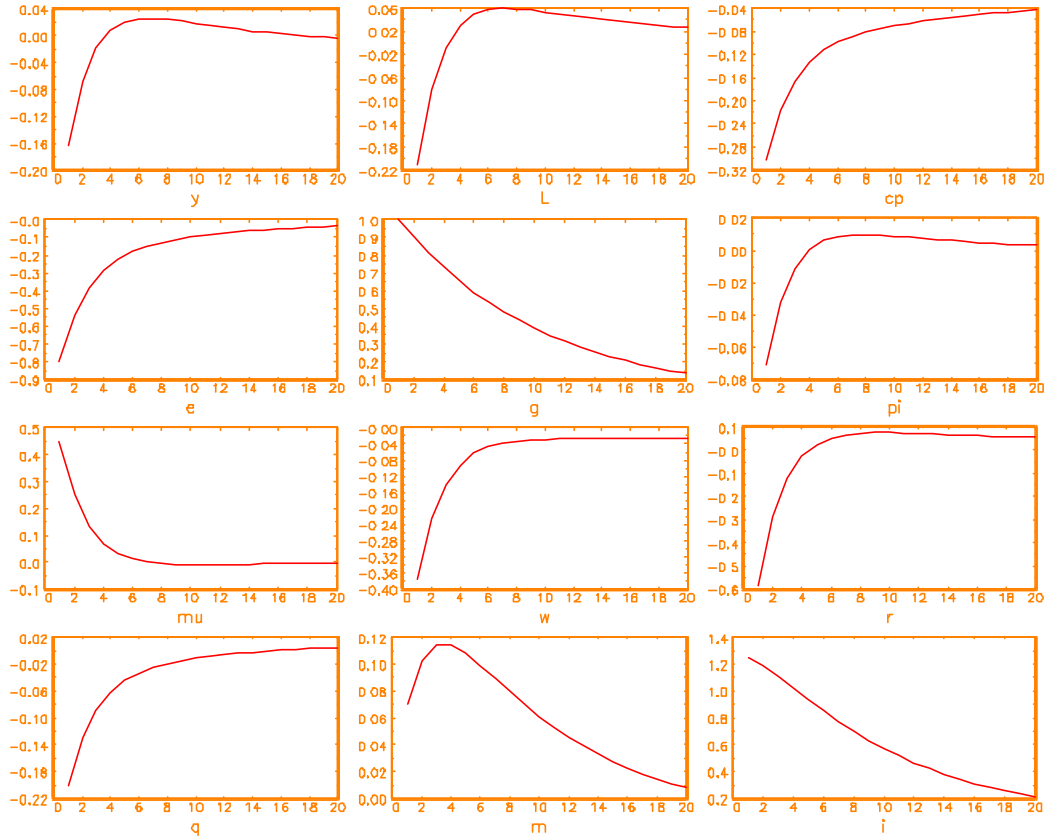

Figure 1: Percentage impulse responses to one percent government demand shock, exogenous money growth.

The drop in labor input and, consequently, output, is somewhat surprising: on the one hand, real demand shocks in the presence of sticky prices are usually alleged to raise output and labor, and, on the other hand, the wealth effect should be expected to *increase* labor input, too. The basic mechanism at work in all general equilibrium models of fiscal policy is the wealth effect, according to which surges in private spending are associated with a reduction in the resources available to the private sector for use as consumption or investment, whence the representative household is expected to reduce her demand for consumption goods as well as for leisure, thus raising labor supply and output. This mechanism, described in more detail in Baxter and King (1993), is supplemented here by monopolistic competition and sticky prices, which according to some authors, e.g. Mankiw

14

(1988), or Dixon and Lawler (1996), should provide a separate source for the expansionary effects of fiscal policy. The alleged effect, namely, of additional government demand in a regime with sticky prices, is to relieve the demand constraint of monopolistically competitive firms, who because of their positive markups of price over marginal cost find it profitable to supply more output even though they are partially unable to raise prices in response to rising factor prices. Obviously, none of these explanations seems to fit the results displayed in figure 1.

The reason is that the wealth effect and price stickiness work in opposite directions in this model. It remains true, in the model displayed in figure 1 as in all variants to be presented later, that the wealth effect is central to the understanding of fiscal policy effects. This can easily be checked (see Finn, 1998) if private consumption c_t^p in the utility function of the representative agent (2) is replaced by total consumption c_t as an aggregate of private and public consumption, $c_t = c_t^p + g_t$, i.e. by assuming that private consumption and government expenditures are perfect substitutes. In that case, the wealth effect is switched off and the only effect of a fiscal expansion is to reduce private consumption one for one, while all other variables are unchanged. Thus, the existence of a wealth effect is necessary for the model to show any interesting responses at all. This holds for all variants of the model we consider, irrespective of parameter choices and specifications.

Given the existence of a wealth effect, with fully flexible prices and leisure a normal good, one would then expect labor input to rise, thus enabling a positive output response. This consequence of the wealth effect is, however, counteracted here by the presence of price stickiness. With some prices not able to adjust immediately, the markup of price over marginal cost, μ_t, is negatively related to inflation, as stressed by Goodfriend and King (1997), because changing factor prices cannot be passed instantly through to goods prices. As the markup is the wedge between the real wage and the marginal product of labor, the ceteris paribus effect of an increase in the markup is a reduction in the real wage brought about by diminished labor demand at all wage levels. But with a given stock of nominal money, prices must necessarily decline in this model. This can be demonstrated by inserting the government budget constraint (24) into the cash in advance constraint (3), resulting in

$$(g_t + c_t^p) = M_{t+1}/P_t. \tag{27}$$

If the wealth effect were the only mechanism here, a rise in g initially implies falling private consumption and rising labor supply, whence, given investment, output and the left hand side of 27 should expand.[5] Hence, with future nominal money given, the price level must decline in order to let real money M_{t+1}/P_t rise, too. But this sets in motion a further effect, because falling prices with staggering are equivalent to a rise in the markup of those firms who are temporarily unable to decrease their output prices while the factor prices they face decline. This markup rise is a negative labor demand effect in the sense just described. As a consequence, the real wage is reduced sharply, which lowers the incentive

---

[5]The argument makes use of the result that the response of investment, due to the presence of adjustment costs, is not so strongly negative that output must fall.

to work and thus reduces labor supply. The influences of labor supply and demand hence work in opposite directions here with respect to labor input, while they mutually reinforce each other to unambiguously lower wages.

For our preferred parametrization shown in figure 1, the markup effect overcompensates the wealth effect, such that falling employment and output result. The discussion in the preceding paragraph suggests that this result should be sensitive to the degree of price stickiness chosen. Indeed, as figure 2 shows, it holds for any but very low values of the price stickiness parameter ϕ in this model variant with exogenous money growth. In figure 2, we show the magnitude of the initial response (i.e., the impact effect in the period of the shock) of some central variables as a function of this parameter.
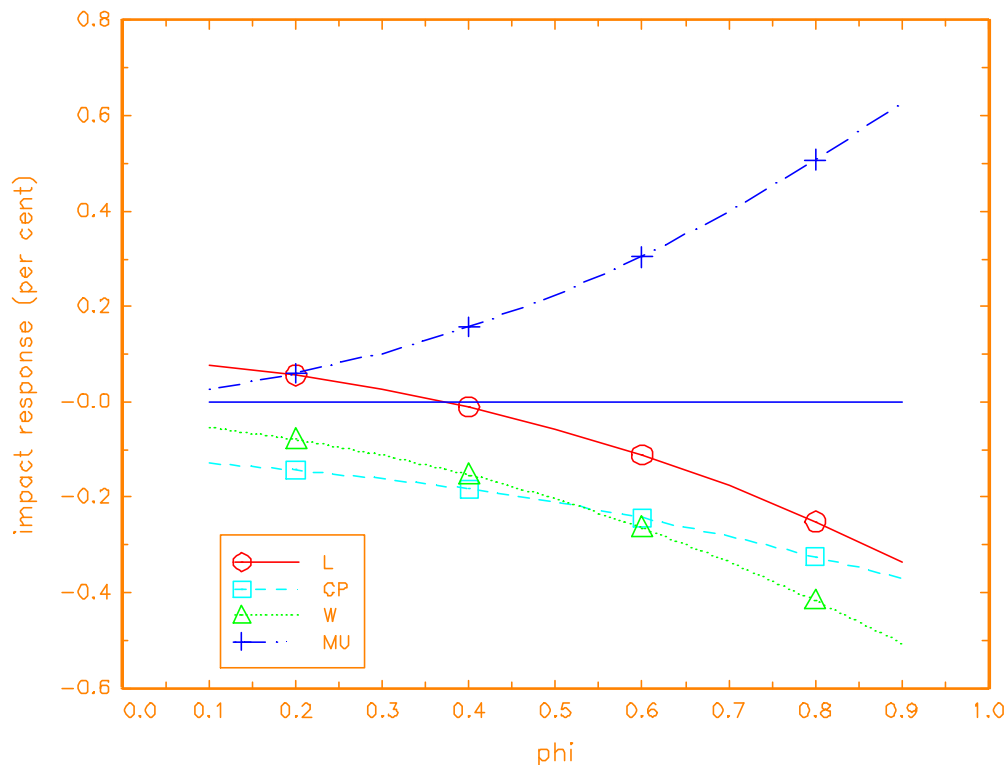

Figure 2: First period responses as a function of price rigidity parameter, exogenous money growth model.

Obviously, in this model with exogenous nominal money, price rigidity must be very low in order to conclude that fiscal policy has expansionary effects on labor and output; recall that the average delay between any two price adjustments is $\phi/(1 - \phi)$, so that prices must be flexible enough to be reset more than once per quarter on average in order that the wealth effect on labor dominates. For price rigidity in a realistic range,

jugded by the results in Gali and Gertler (1999), the markup rises so strongly that the resulting wage decrease discourages additional labor supply. Note, from figure 2, that private consumption decreases for any degree of the price stickiness parameter, a direct consequence of the wealth effect to which we will return below.

For a realistic extent of slow price adjustment, the model variant presented so far delivers just the opposite of what one would expect if it were truly just capturing some modernized version of the working of IS-LM models. The very presence of price stickiness, often alleged to be a source for large output effects of demand shocks, has on the contrary been shown to lead to output decreases for empirically plausible parameter values. Furthermore, some other of the model's implications are in stark contrast to much of the received empirical evidence cited in the introduction, which points to positive effects of fiscal expansions on output, consumption, and real wages. Thus, the conclusion so far is that while NNS models like ours have been found useful to give a microfoundation to models usable for the analysis of monetary policy, the same does not seem to be true for fiscal policy. However, this might be due to an inadequate representation of the interaction between fiscal and monetary policies in the model variant discussed so far. This is what we turn to now.

3.2 Interest rate rules

The model of the preceding subsection has taken the nominal stock of money to be exogenously given and growing at a constant rate. The recent literature, however, has seen a strongly growing occupation with explicit models of interest rate policy, where the central bank is assumed to control the short term nominal rate according to some rule that typically implies feedback between the state of the economy and the target rate. In this section, we take up this issue and study the effects of fiscal shocks when the central bank follows a state contingent rule in setting interest rates. In the context of fiscal policy, the difference between the two specifications of central bank behavior is crucial if there is a friction present that makes it possible for nominal variables to influence the real economy, as is the case in the present model through nominal price stickiness. If monetary policy is conducted in terms of a feedback rule for the nominal interest rate, then the nominal money stock is endogenous, of course, and adjusts in response to disturbances like fiscal policy. We explore the implications for the effects of fiscal shocks in the following subsections.

3.2.1 Baseline results

Figure 3 displays percentage impulse responses of a one percent government demand shock in the Taylor rule model with parameters $\rho_i = 0.97, \rho_\pi = 1.5$ and $\rho_y = 0$. These parameter choices have been justified above in section 2.5, where it was argued that our aim to specify a model without the occurrence of real indeterminacy constrains the set of feasible parameters. Note that, similar to Rotemberg and Woodford (1999), we find our choice more severely restricted than has been reported for some recently published NNS-type models, in particular Clarida et al. (1999, 2000).
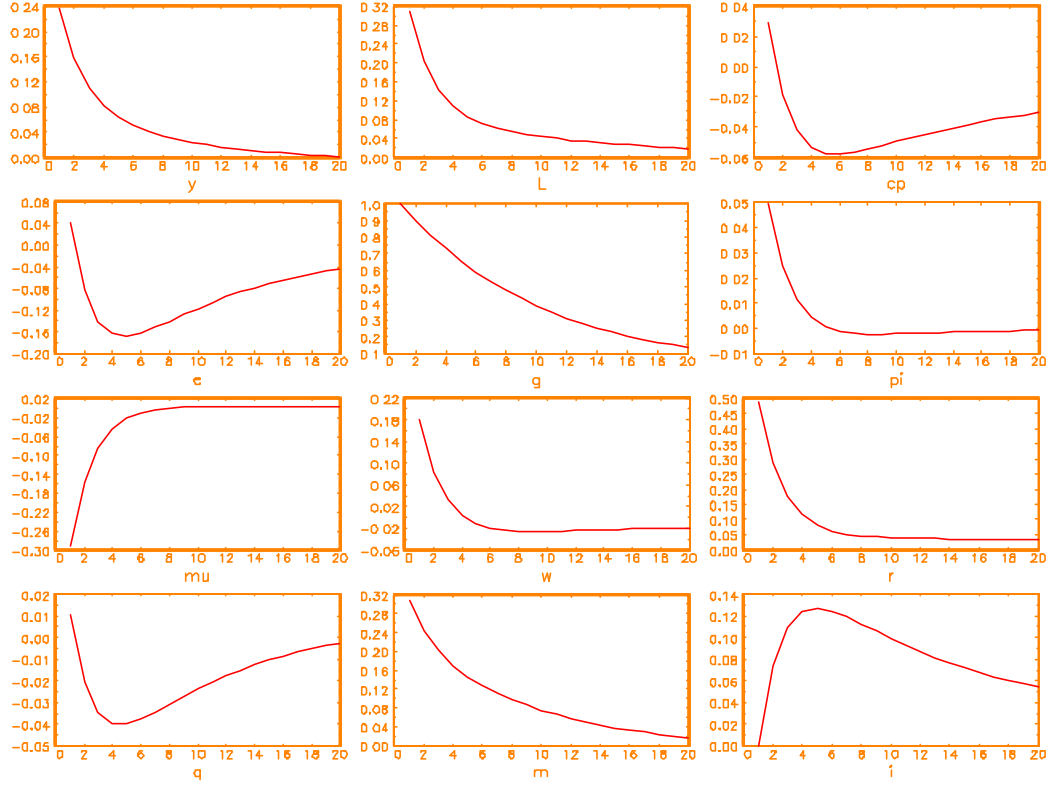
17

Figure 3: Percentage impulse responses to one percent government demand shock, Taylor rule model.

Obviously, results are in stark contrast to those obtained in the model with exogenous money. In particular, the fiscal spending shock now has a strong expansionary effect on output and employment. Interestingly, even private consumption and investment rise in the first period when the shock arrives, but afterwards their responses turn persistently negative. The real wage and the real capital rental rate display relatively large increases, as does real marginal cost, consequently, while inflation rises slightly. The nominal interest rate is increased by a very small amount only which is clearly due to the assumed interest rate smoothing behavior of the central bank. Real money rises strongly, almost four times as large on impact as in the case of exogenous nominal money; combined with the positive but quantitatively small inflation response, this shows that the nominal money stock in the Taylor rule model is expanded strongly and about as much as output.

Why has a government demand shock so markedly different effects in this model compared to the exogenous money growth model of the previous subsection? Like before, the explanation must start with the wealth effect, as there would be no response other than crowding out of private consumption if the wealth effect were eliminated through the as-

18

sumption of perfect substitutability between private and public consumption. Therefore, the initial reaction of the representative agent to a government expenditure shock is a ceteris paribus increase in labor supply and a reduction in private consumption. But now money is endogenous, which has the important consequence that the equilibrium price level has to rise, so that a gradual adjustment of inflation lowers the markup and thus exerts an expansionary labor demand effect. To see this, consider again equation (27). In the present Taylor rule model, the nominal interest rate rises by far not as much as in the exogenous money model of the previous section, as the central bank tends to smooth interest rates strongly. This means that private consumption falls by less than in the fixed money model, such that $c_t^p + g_t$ is increased more; consequently, real money M_{t+1}/P_t has to rise more here, too. In principle, this could be brought about by a price level that falls more than in the constant money model. But this is impossible, since it would imply a larger markup increase and, hence, a stronger contractive labor demand effect, which is in contradiction to the statement that the output effect be larger than in the other model.[6] Thus, the necessary increase in real money is realized through rising future nominal money. This has the usual effects of an anticipated increase in the nominal money supply, most notably an increase in the equilibrium price level and hence in inflation. This, eventually, reduces the markup, implying a positive labor demand effect. By the interaction of wealth effect and markup effect, labor input rises unambiguosly, while real wages may rise or fall depending on parameter values.

Particularly, the degree of price rigidity can be expected to have a decisive influence here. Again, the impact effects of a fiscal expansion are displayed in figure 4 as a function of the degree of price rigidity, ϕ. For the variables shown, the impact effects point in exactly the opposite direction than was the case in the model with an exogenous money supply. More stickiness in nominal goods prices (a higher value of ϕ) leads to larger responses of labor, consumption and real wages, and to larger declines of the markup. Moreover, although labor rises relatively strongly, this coincides for most parameter values with *rising* rather than falling real wages due to the strong reduction in the markup; private consumption, in contrast, initially falls for modest price stickiness and experiences a short-lived first period increase only with larger values of ϕ, even if these are in the range found empirically plausible by Gali and Gertler (1999).

What remains to be explained is the positive first period response of private consumption. The rise in the nominal money stock has a transfer effect on the representative household's wealth, thus partially offsetting the negative wealth effect of additional government spending. In other words, the combination of an increase in money demand with a central bank that sets and smoothes nominal interest rates allows the government to finance part of the expenditure shock by seignorage, which in a sticky-price model has, ceteris paribus, the usual expansionary effects. Which of the opposing channels, wealth effect or seignorage effect, dominates the response of private consumption is thus a question

---

[6]Again, this argument equates output with the sum of private consumption and government spending, tacitly taken as given that the investment response is too weak to alter the conclusion.
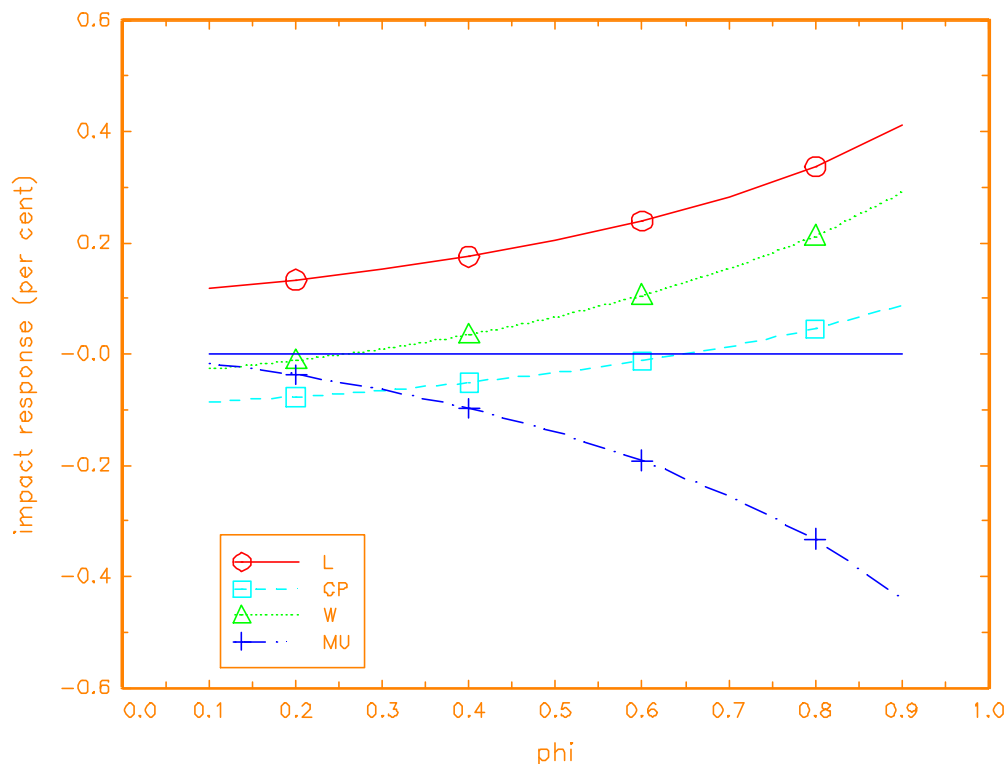
Figure 4: First period impulse responses as a function of price rigidity parameter, Taylor rule model.

of parameter constellations. A larger degree of price stickiness opens the way for a more positive (or less negative) private consumption response because it implies a larger output effect via the markup mechanism described above, thus entailing a larger expansion of nominal and real money. Hence, by the seignorage channel just described, consumption may initially rise. However, as the government demand shock we study is autocorrelated with an autoregressive parameter of 0.9 and thus quite persistent, whereas the resulting output expansion is much less persistent, the negative wealth effect on private consumption must eventually dominate, which in our benchmark parameterization shown above in figure 3 is the case already after the first period.

The model's success in terms of its ability to mimick empirically estimated effects of government demand shocks and to serve as a microfoundation for IS-LM style analyses of short-run fiscal policy effects is thus mixed: it surely can explain positive output and employment effects, which, for a wide variety of parameter values, are even associated with real wage increases, as part of the empirical literature finds plausible. Nonetheless, a positive private consumption response, which is a robust feature of some recent empirical

VARs, can hardly be obtained, as consumption can only rise with relatively extreme price stickiness, and even then only for a short period of time. The next subsection analyzes consumption in more detail.

3.2.2 Consumption and real wages.

The model is so far not able to produce a reasonably persistent positive private consumption response, because the wealth effect of government spending which underlies its mechanism must sooner or later dominate, at least for quite persistent shocks like the one we specified using an autoregressive parameter for the shock process of 0.9. However, an obvious way around this problem is to make government spending an argument of the representative household's utility function. This is a thoroughly sensible assumption, since governments typically do not produce only waste, but supply goods which are of value to the household and which are, moreover, more or less substitutable with private spendings; examples comprise schools, roads, local public utilities, etc. If, however, the household's elasticity of substitution between private and public consumption is sufficiently low, an increase in public spending can increase the marginal utility of private consumption and, therefore, private consumption itself. Consider the replacement of private consumption c_t^p in the utility function by a constant elasticity of substitution aggregate c_t of private consumption and government consumption g_t,

$$c_t = \left[b \cdot (c_t^p)^{\left(\frac{z-1}{z}\right)} + (1-b) \cdot g_t^{\left(\frac{z-1}{z}\right)} \right]^{\frac{z}{z-1}}, \qquad b \in (0;1), \quad z > 0,$$

where z is the elasticity of substitution between private and public consumption. Then, the sign of the derivative of the marginal utility of private consumption with respect to government consumption is equal to the sign of $\gamma(1-\sigma) - (z-1)/z$. In the benchmark parameterization of the model, we chose $\sigma = 2$ and calibrated γ just below 0.3, such that a government demand shock will raise private consumption if the elasticity of substitution is less than about 0.77. Figure 5 shows the impulse responses of private consumption and the real wage to a one percent government demand shock for the benchmark parameter choice of the preceding subsection combined with $b = 0.5$ and $z \in \{0.3, 0.6\}$.

Clearly, as expected, consumption now reacts markedly positively and quite persistently to the fiscal expansion, because the utility function implies weak substitution between public and private consumption, such that the household's desire to limit changes in the relation between the two and thus expand private spending is stronger than the wealth effect which tends to reduce it. Obviously, the effect is the stronger the less substitutability there is. While this is an easy method to generate positive consumption responses to fiscal shocks, and thus to bring one of the model's properties more in line with empirical results, figure 5 also shows the flip side of this achievement: the real wage has to fall, and the amount of its decline is larger with a smaller elasticity of substitution; thus, the more positive is the consumption response, the more pronouncedly negative is by implication the real wage response.
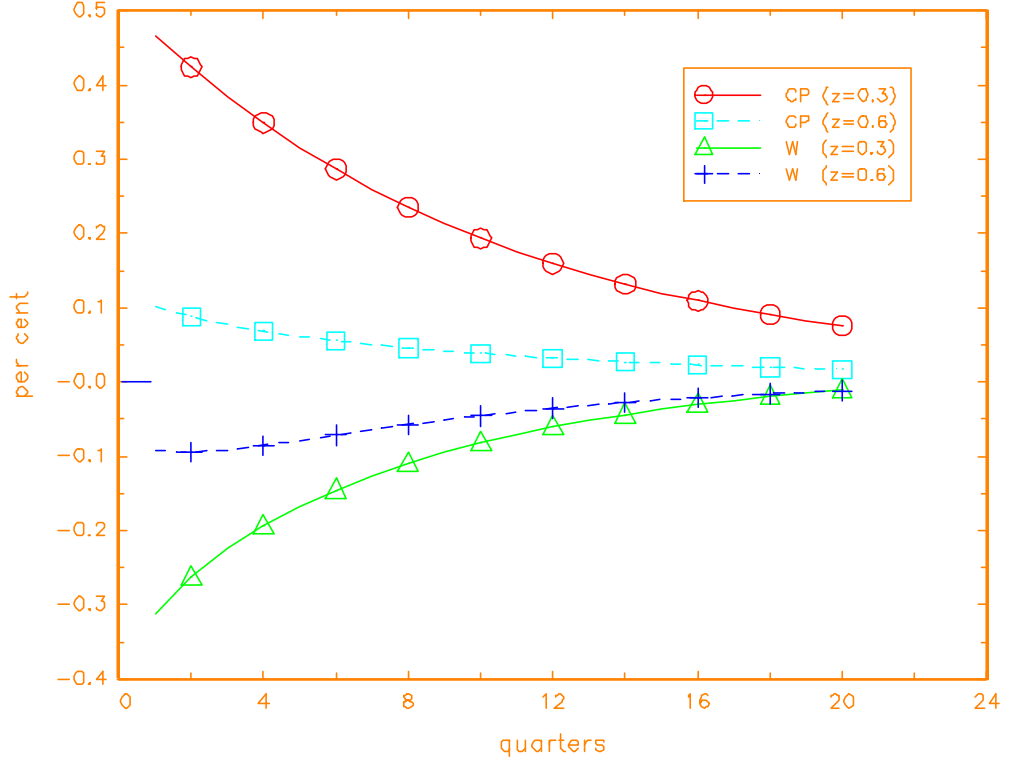
Figure 5: Percentage impulse responses to one per cent government demand shock, Taylor rule model

The explanation is that substitutability between private and public consumption diminishes the size of the wealth effect (the wealth effect is nil if there is perfect substitution). The household who receives utility from the government's expenditure feels herself less impoverished by the additional transfer of resources to the state if she can easily substitute the private spending foregone by the public goods which are now poured out more generously to her. But this argument is applicable to leisure demand as well, which implies that labor supply will rise more when the elasticity of substitution is lower. Hence, marginal productivity decreases more in this case and the real wage decline has to be larger. In particular, the markup effect which, as shown above, could in principle counteract the influence of marginal productivity, is even smaller when substitutability is lower, because the increased labor supply holds down marginal costs of the representative firm such that the markup of temporarily non-price adjusting firms is eroded less strongly.

In this model, hence, there is a tradeoff between having private consumption rise and having real wages rise. While defendable parameter choices allow to let the two react positively to fiscal shocks one at a time, the crucial parameters being the substitution

elasticity for private consumption and the degree of price stickiness for the wage, the combined result of both variables rising is not possible for our specification. This, again, points to the fact that, despite New Keynesian assumptions such as monopolistic competition and price staggering, the model is predominantly neoclassical in that it heavily relies on the wealth effect as its central mechanism. Therefore, its working is quite far detached from what one would expect from a modernized version of IS-LM.

4 Conclusion

In this paper, we have investigated the effects of fiscal policy in an environment of sticky prices. The reason for doing so was twofold: one question we pursued was to what extent monopolistic competition between firms and staggered price adjustment makes the effects of fiscal policy look Keynesian, i.e. raise output, employment, real wages and consumption temporarily. The other question was what kind of influence the specification of the monetary policy regime has on the results once money begins to matter because of price stickiness.

We find that monetary policy behavior is crucial for understanding fiscal policy effects. In particular, for our preferred parameterization of the model, fiscal policy is only expansionary at all if the central bank adheres to a Taylor rule-style policy in setting nominal interest rates. In that case, output and employment rise, while the same is true for real wages and private consumption, but only for a limited number of periods following the shock. The result regarding the real wage is due to the effect fiscal policy has on the price level in our economy; when it is able to raise prices, as is the case when the central bank accomodates money demand by targeting interest rates, then inflation will erode the markup and labor demand will rise at all wage levels. While this has admittedly a Keynesian flavor, the same is not true for the private consumption, which experiences only a one-period expansion before perstently falling; the latter result could be reversed by making government expenditure an imperfect substitute for private consumption in the utility function, but this works only at the expense of having fiscal shocks strongly depress real wages. As a result, we conclude that even with sticky prices and a monetary authority that targets nominal interest rates, there is no aggregate demand effect of fiscal policy in our model that could remind in any precise way of the Keynesian story.

Finally, we should comment on why this result is in contrast to part of the literature. In several recent papers, e.g. Clarida et al. (1999, 2000), a stylized version of an NNS-type model has been presented consisting of three basic ingredients: a Taylor rule for nominal interest rates, an 'expectational IS equation', i.e. a first order condition for consumption coupled with market clearing, and a Phillips-curve equation, e.g. the one resulting from the Calvo (1983)-type model that we used above, too. A graphical and verbal presentation of the workings of such a model is given by Taylor (2000), where he emphasizes the usefulness of a model of this type for what he calls 'new normative macroeconomics' and by which he means the quantitative exploration of macro policies in small dynamic stochastic models.

We do not doubt the usefulness of small-scale NNS models of the three equation vari-

ety for the purpose of analyzing monetary policy, which is the objective in Clarida et al. (1999, 2000). However, we think it misleading to couch discussions of fiscal policy in the same stylized framework, as does Taylor (2000) when he describes the working of a government spending shock to 'shift the AD [aggregate demand] curve'. As we demonstrated above, the assumptions of sticky prices and a Taylor rule are not enough to produce results that deviate much from the neoclassical benchmark elaborated on by, e.g., Baxter and King (1993) for the basic mechanism by which the model works is still the neoclassical wealth effect on labor supply, even if in some parameter constellations, or through endogenous monetary policy, this may sometimes be attenuated or even overcompensated. Yet this mechanism is missing from the three equation models just cited because there is no consideration at all of labor supply issues. Consequently, the description of fiscal policy effects in these models based on aggregate demand effects is misleading unless one argues that there is an implicit assumption of underutilized labor resources which make labor supply considerations irrelevant, as is sometimes suggested in textbook versions of IS-LM models. In that case, however, the existence of chronic underemployment should rather be modelled directly rather than just used as a justification for short-cutting the way fiscal policy works.

5 References

Basu, S., and J.G. Fernald, , 1997, Returns to Scale in U.S. Production: Estimates and Implications, Journal of Political Economy, vol. 105, 249-283.

Bernanke, B.S., M. Gertler, and S. Gilchrist, 1999, The Financial Accelerator in a Quantitative Business Cycle Framework, in: Handbook of Macroeconomics, Chapter 21, edited by J.B. Taylor and M. Woodford, Amsterdam: Elsevier.

Baxter, M., and R.G. King, 1993, Fiscal Policy in General Equilibrium, American Economic Review, vol. 83, 315-334.

Blanchard, O.J., and R. Perotti, 1999, An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output, Working paper.

Burnside, C., M. Eichenbaum, and J.D.M. Fischer, 1998, Assessing the effects of fiscal shocks, Working paper.

Calvo, G., 1983, Staggered Prices in a Utility-Maximizing Framework, Journal of Monetary Economics, vol. 12, 383-398.

Canozeri, M., Crumby, R., and B., Diba, 1998, Is the Price Level Determined by the Needs of Fiscal Solvency? CEPR Working Paper no. 1772.

Casares, M., and B.T. McCallum, 2000, An Optimizing IS-LM Framework with Endogenous Investment, NBER Working Paper, no. 7908.

Christiano, J.L., and M. Eichenbaum, 1992, Liquidity Effects and the Monetary Transmission Mechanism, American Economic Review, vol. 82, 346-53.

Christiano, J.L., M. Eichenbaum, and C. Evans, 1997, Sticky price and Limited Participation Models of Money: A Comparison, European Economic Review, vol. 41, 1201-49.

Christiano, J.L., and G. Gust, 1999, Taylor Rules in a Limited Parizipation Model, in: Monetary Policy Rules, edited by J.B. Taylor, University of Chicago Press.

Clarida, R., J. Gali, and M. Gertler, 1999, The Science of Monetary Policy: A New Keynesian Perspective, Journal of Economic Literature, vol. XXXVII, 1661-1707.

Clarida, R., J. Gali, and M. Gertler, 2000, Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory, Quarterly Journal of Economics, vol. CXL, 147-180.

Devereux, M.B., A.C. Head, and B.L. Lapham, 1996, Monopolistic Competition, Increasing Returns, and the Effects of Government Spending, Journal of Money, Credit, and Banking, vol. 28, 233- 254.

Dixon, H., and P. Lawler, 1996, Imperfect Competition and the Fiscal Multiplier, Scandinavian Journal of Economics, vol. 98, 219-231.

Edelberg, W., M. Eichenbaum, and J.D.M. Fisher, 1999, Understanding the Effects of Shocks to Government Purchases, Review of Economic Dynamics, 166-206.

Fatas, A., and I. Mihov, 2000, Fiscal Policy and Business Cycles: An Empirical Investigation, Working paper.

Finn, M.G., 1998, Cyclical Effects of Government's employment and goods purchases, International Economic Review, vol. 39, 635-657.

Gali, J., and M. Gertler, 1999, Inflation Dynamics: A Structural Econometric Analysis, Journal of Monetary Economics, vol. 44, 195-222.

Goodfriend, M., and R.G. King, 1997, The New Neoclassical Synthesis and the Role of Monetary Policy, NBER Macroeconomics Annual, 231-283.

Hairault, J.O., and F. Portier, 1993, Money, New-Keynesian Macroeconomics, and the Business Cycle, European Economic Review, vol. 37, 1533-1568.

Kerr, W., and R.G. King, 1996, Limits on Interest Rate Rules in the IS Model, Federal Reseve Bank of Richmond Economic Quarterly, vol. 82, 47-75.

Kimball, M.S., 1995, The quantitative analytics of the basic neomonetarist model, Journal of Money, Credit, and Banking, vol. 27, 1241-1289.

Mankiw, N.G., 1988, Imperfect Competition and the Keynesian Cross, Economics Letters, vol. 26, 7-14.

McCallum, B.T., 1999, Issues in the Design of Monetary Policy Rules, in: Handbook of Macroeconomics, Chapter 23, edited by J.B. Taylor and M. Woodford, Amsterdam: Elsevier.

McCallum, B.T., and E. Nelson, 1999, An Optimizing IS-LM Specification for Monetary Policy and Business Cycle Analysis, Journal of Money, Credit, and Banking, vol. 31, 296-316.

Mountford, A., and H. Uhlig, 2000, What are the Effects of Fiscal Policy Shocks?, Working paper.

Ramey, V.A., and M.D. Shapiro, 1998, Costly Capital Reallocation and the Effects of Government Spending, Carnegie-Rochester Conference Series on Public Policy, vol. 48, 145-194.

Rotemberg, J.J., and M. Woodford, 1992, Oligopolistic Pricing and the Effects of Aggregate Demand on Economic Activity, Journal of Political Economy, vol. 100, 1153-1207.

Rotemberg, J.J., and M. Woodford, 1997, An Optimization-based Econometric Framework for the Evaluation of Monetary Policy, NBER Macroeconomics Annual, 297-346.

Rotemberg, J.J., and M. Woodford, 1999, Interest Rate Rules in an Estimated Sticky Price Model, in: Monetary Policy Rules, edited by J.B. Taylor, University of Chicago Press.

Sims, C., 1994, A Simple Model of the Determination of the Price Level and the Interaction of Monetary and Fiscal Policy, Economic Theory, vol. 4., 381-399.

Taylor, J.B., 1993, Discretion versus Policy Rules in Practice, Carnegie-Rochester Conference series on Public Policy, vol. 39, 195-214.

Taylor, J.B., 1999, Staggered price and wage setting in macroeconomics, in: Handbook of Macroeconomics, Chapter 15, edited by J.B. Taylor and M. Woodford, Amsterdam: Elsevier.

Taylor, J.B., 2000, Reassessing Discretionary Fiscal Policy, Journal of Economic Perspectives, vol 14, 21-36.

Uhlig, H., 1999, A Toolkit for Analysing Nonlinear Dynamic Stochastic Models Easily, in: Computational Methods for the Study of Dynamic Economies, edited by R. Marimon and A. Scott, Oxford: Oxford University Press.

Woodford, M., 1994, Monetary Policy and Price Level Determinacy in a Cash-in-advance Economy, Economic Theory, vol. 4., 345-380.