The role of fiscal policy in Japan: a quantitative study

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Abstract

This paper analyzes the role of fiscal policy in the recent slowdown in Japan. A dynamic general equilibrium model is developed in which fiscal policy can have both expansionary effects (through increasing returns) and contractionary effects (through the increase of public debt and tax burden). A version of the model is calibrated to the Japanese economy and is used to measure the importance of both these effects. We find that, under a wide range of parameters, net expansionary effects are quantitatively small, thus suggesting a limited role for fiscal stabilization

Key words: Business Cycles, Fiscal Stabilization, Government Spending, Recession

JEL Classification: E62, E65

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1 Introduction

> "In order to prevent another economic slowdown a supplementary budget will probably be approved for Japan this fall [..] Many believe to achieve the .5% growth target such a budget must be implemented" [1] .

> "(In Japan) when the government throws money at the economy it grows, and when in doesn't throw money it ceases to grow" [2]

During the last few years Japan has endured a period of slow growth that has culminated in the deep and prolonged recession of 1998-99 in which output has experienced almost a 5% drop (see fig. 1 below). Although structural problems such as the banking sector crisis and the failure of the "Japanese growth model" are often indicated as the main causes of the decline in the growth trend, there is also the perception that macroeconomic support through fiscal policy might play an important role in getting Japan out of cyclical slumps like the recent recession (see for example Krugman 1999). As summarized by the quotes above though, there is a debate among economists and policy makers on the effectiveness and the desirability of this support.

FIGURE 1 APPROXIMATELY HERE

This paper develops a dynamic general equilibrium model that can be used to understand and evaluate the macroeconomic effects of fiscal policy on Japanese business cycles taking into account a variety of effects. The model is similar to the one proposed by Devereux, Head and Lapham (1996). This model differs

[1] Nakamoto M. , Financial Times, April 29, 1999, p.12.

[2] Strom, S. , The New York Times, March 14, 2000, p. C20

from the standard neoclassical growth model in one important aspect: the presence of increasing returns form specialization. This feature implies that fiscal policy can have additional expansionary effects. In particular, as in the standard growth model, fiscal spending causes an initial raise in output due to an increase in labor supply. The initial raise in output causes the entry of new firms and that, due to the return to specialization, can increase total factor productivity and therefore prolong the expansion.

On the other hand, like in the standard neoclassical model, contractionary effects of increase in government spending, through the increase of public debt and expected tax burden and through the crowding out of private investment are taken into account. The parameters of the model are set to reproduce certain long run features of the Japanese economy and the actual fiscal policy followed by Japanese authorities is captured in a simple form by measuring a relation between fiscal variables and GDP.

It is shown that the model is quite successful in reproducing the main features of the Japanese business cycle and thus it is used to measure the magnitude of the effects of fiscal stabilization. Under a wide range of possible parameterizations the model predicts that fiscal policy has a very limited role in stabilizing the economy. Policy experiments are conducted in order to establish how much more growth would have been achieved under a more vigorous fiscal stimulus. It is found that a permanent increase of government spending during the last two years of recession would have had left output almost unchanged but increase the public debt to output ratio by more than 10%.

The paper is organized as follows.

Section 2 lays out the model and in section 3 the calibration procedure and the solution method is discussed. In section 4 the predictions of the model are compared with the actual Japanese macroeconomic data. In section 5 the results of policy experiments are reported and section 6 reports the result of sensitivity analysis to different values for the parameters. Section 7 concludes.

2 The model

2.1 The Economy

Time is discrete. In each period there is a measure 1 of infinitely lived identical consumers each endowed with 1 unit of time. Although in the calibration section growth will be taken into account here we will focus on a stationary environment. Preferences are given by

$$E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, 1 - L_t) \tag{1}$$

where $U(.,.)$ is a continuously differentiable, concave function, β is the individual discount factor, C_t, L_t are per capita consumption and labor respectively and E_t is the expectation operator with respect to the informations available at time t.

There is a single final good that can be used for consumption or investment.

It is produced with a continuum of measure N_t differentiated intermediate inputs, indexed by i, and its production function is

$$Y_t = \left(\int_0^{N_t} y_t(i)^{\theta} di \right)^{\frac{1}{\theta}} \tag{2}$$

where $y_t(i)$ is the quantity of the intermediate good of type i used for the production of the final good, $\theta > 0$ is a parameter determining the substitutability of intermediate inputs and Y_t is per capita production of the final good.

Each intermediate goods is produced using capital and labor and the production function is given by

$$y_t(i) = Z_t k_t(i)^{\alpha} l_t(i)^{1-\alpha} - \phi \tag{3}$$

where ϕ is a fixed cost of production, α is a parameter determining the capital share in production, $k(i)$ and $l(i)$ are capital and labor used in the production of intermediate good i, Z_t is an exogenous, common to the production of all intermediate goods, productivity shock, that follows a first order autoregressive process.

2.2 Firms problem

Final goods producing firms are perfectly competitive and they solve the following problem

$$\max_{y(i)} P_t \left(\int_0^{N_t} y_t(i)^{\theta} di \right)^{\frac{1}{\theta}} - \int_0^{N_t} y_t(i) p_t(i) di \tag{4}$$

where P_t is the price of the final good and $p_t(i)$ is the price of intermediate good i. The final good is taken to be the numeraire and thus its price will be normalized to 1.

Profit maximization yields the following demand for each intermediate good

$$D(p_t(i), Y_t) = p_t(i)^{\frac{1}{\theta-1}} Y_t \tag{5}$$

Substituting the demand in to the cost function and imposing the zero profit condition that must hold in equilibrium (unit cost equal to unit revenues) we can derive an expression for the price of the final good in function of the intermediate good prices

$$1 = \left(\int_0^{N_t} p_t(i)^{\frac{\theta}{\theta-1}} \right)^{\frac{\theta-1}{\theta}} \tag{6}$$

Intermediate good producers are monopolistic competitors. There is free entry in each period. We will focus on symmetric equilibria in which all firms producing intermediate goods take identical actions and therefore we will omit the index i when describing the problem of the firm. Notice that when output of each intermediate producer is given by y_t , from equation (2) output of the final good can be written as

$$Y_t = y_t N_t^{\frac{1}{\theta}} \tag{7}$$

so if $\theta < 1$ the aggregate production function displays increasing returns in the measure of firms. These increasing returns , often labeled as returns from specialization, have been used extensively in trade and endogenous growth theory (see Krugman, 1979 and Romer, 1987). Producers set their price so to maximize their profits. It is convenient to break the problem in two parts. The first part is the cost minimization given a demand y_t and can be written as

$$\min_{k_t, l_t} w_t l_t + r_t k_t \tag{8}$$

$$s.t. \qquad y_t = Z_t {k_t}^{\alpha} {l_t}^{1-\alpha} - \phi$$

where w_t ,r_t are the real wage and the rental rate of capital (in units of the final good).

The solution to this problem yields a cost function

$$\Gamma(w_t, r_t, y_t) = \Gamma_1(w_t, r_t)\,(y_t + \phi) \tag{9}$$

and factor demand for intermediate producers

$$k_t = A \left(\frac{w_t}{r_t}\right)^{1-\alpha} \frac{(y_t + \phi)}{Z_t} \tag{10}$$

$$l_t = B \left(\frac{r_t}{w_t}\right)^{\alpha} \frac{(y_t + \phi)}{Z_t} \tag{11}$$

where

$$\Gamma_1(w_t, r_t) = (A+B)\frac{r_t^{\alpha} w_t^{1-\alpha}}{Z_t}$$

$$A = \left(\frac{\alpha}{1-\alpha}\right)^{1-\alpha}$$

$$B = \left(\frac{1-\alpha}{\alpha}\right)^{\alpha}$$

The second part of the problem is the choice of the price. Profit maximization implies price is a constant markup over unit cost.

$$p_t = \frac{1}{\theta}\Gamma_1(w_t, r_t) \tag{12}$$

Finally the assumption of free entry also implies that current profits (π_t) from firms producing intermediate goods will be 0 in every period that is

$$\pi_t = p_t D(p_t, Y_t) - \Gamma_1(w_t, r_t) = 0 \tag{13}$$

or substituting 5 in 13

$$p_t^{\frac{\theta}{\theta-1}} Y_t - \Gamma_1(w_t, r_t)\left(p_t^{\frac{\theta}{\theta-1}} Y_t + \phi\right) = 0 \tag{14}$$

2.3 Government

The government purchases an amount G_t of final goods each period and purchases is assumed to follow a first order autoregressive process plus a fiscal policy reaction term

$$\log(G_t) - \log(\bar{G}_t) \tag{15}$$

$$= \gamma\left[\log(G_{t-1}) - \log(\bar{G}_{t-1})\right] + \chi E(\log(Y_t) - \log(\bar{Y}_t))|\Omega_t) + \varepsilon_t^g$$

$$\varepsilon_t^g \rightsquigarrow N(0, \sigma_{\varepsilon^g}^2)$$

where $\bar{G}_t$ is the growth trend of public spending, $\bar{Y}_t$ is the growth trend of output, γ is a parameter determining the persistence of spending, the parameter χ measure the sensitivity of public spending to deviations of expected current output (on the basis on the time t information set Ω_t) from its growth path ($\bar{Y}_t$) and ε^g is a stochastic fiscal policy shock that is distributed independently across time and is independent from variables contained in Ω_t. Other expenditures are lump sum subsidies and transfers to household that we denote with S_t. Expenditures are financed with labor, capital and consumption taxes, by raising lump sump taxes T_t or by issuing real bonds denominated in the final good. The government budget constraint is therefore

$$\tau_t^c C_t + \tau_t^l w_t L_t + \tau_t^k r_t K_t + q_{t,t+1} B_{t+1} + T_t = B_t + G_t + S_t \tag{16}$$

$$B_0 \qquad given$$

where B_t is the stock of outstanding government bond, $q_{t,t+1}$ is the time t price of one unit of consumption in time $t+1$and $\tau_t^c, \tau_t^l, \tau_t^k$ are the tax rates on consumption, labor and capital respectively. A government policy is defined to be a list of sequences for $\tau_t^c, \tau_t^l, \tau_t^k, B_t, G_t, T_t, S_t$.

2.4 Household problem

There are two assets available to households: capital and one period real government bonds. The household problem is thus

$$\max E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, 1 - L_t) \tag{17}$$

$s.t.$

$$(1+\tau_t^c)C_t + X_t + q_{t,t+1}B_{t+1} \tag{18}$$

$$= (1-\tau_t^k)r_tK_t + (1-\tau_t^l)w_tL_t + (1-\delta)K_t + B_t + T_t \tag{19}$$

$$K_{t+1} = (1-\delta)K_t + X_t \tag{20}$$

K_0, B_0 given

where X_t is investment, K_t is the capital stock. The necessary first order conditions for optimality are given by:

$$\frac{(1-\tau_t^l)}{(1+\tau_t^c)} w_t U_c(C_t, 1-L_t) = U_l(C_t, 1-L_t) \tag{21}$$

$$q_{t,t+1} = \beta E_t \frac{U_c(C_{t+1}, 1-L_{t+1})}{U_c(C_t, 1-L_t)} \frac{(1+\tau_t^c)}{(1+\tau_{t+1}^c)} \tag{22}$$

$$\frac{U_c(C_t, 1-L_t)}{1+\tau_t^c} = \beta E_t \frac{U_c(C_{t+1}, 1-L_{t+1})}{1+\tau_{t+1}^c} \left[(1-\tau_{t+1}^k)r_{t+1} + (1-\delta)\right] \tag{23}$$

2.5 Equilibrium

A symmetric equilibrium for this economy is a collection of sequences for prices (w_t, r_t, q_t, p_t), quantities ($C_t, X_t, K_t, L_t, Y_t, k_t, l_t, y_t, Z_t$), government policies ($\tau_t^c, \tau_t^l, \tau_t^k, B_t, G_t, T_t, S_t$), and measures of intermediate goods producing firms N_t such that

- Given prices and government policies the quantities solve the households' problem and the final goods and intermediate goods producing firms problem.
- Government policies satisfy the government budget constraint

$$\tau_t^c C_t + \tau_t^l w_t L_t + \tau_t^k r_t K_t + q_{t,t+1}B_{t+1} + T_t = B_t + G_t + S_t \tag{24}$$

- Goods and factors market clear

$$C_t + X_t + G_t = Y_t \tag{25}$$

$$\int l_t(i)di = L_t \tag{26}$$

$$\int k_t(i)di = K_t \tag{27}$$

- Profits of firms are 0 in every period (Equation 14 holds)
- Transversality conditions hold

3 Calibration and Model Solution

3.1 Preference and Technology Parameters

In order to choose the parameters of the model we will follow the procedure outlined by Cooley and Prescott (1995), by picking the parameters consistent with the long run features of the Japanese economy or with micro-studies. We pick the following period utility

$$U(C, L) = \log(C) + \mu \frac{(1 - L)^{1-\sigma}}{1 - \sigma} \tag{28}$$

This functional form, as shown by King, Plosser and Rebelo (1988), yields a stationary series for hours per worker even in presence of long run growth. The parameter σ determines the intertemporal elasticity of substitution of labor and is set so that the model generates a volatility of labor input similar to the one observed in the data. The parameter μ is chosen so that in a steady state equilibrium L is equal to the average number of hours worked.

Juster and Stafford (1991) show that on average the US workers spend 1/3 of their discretionary time working. On the other hand Japanese labor statistics reported in Bosh and al. (1993) show that the average Japanese worker work 10% more hours than the average US worker: therefore we set μ to reproduce $L = 1.1 * (1/3) = .37$.

In order to calibrate the parameter β the first order condition for the bond (equation 22) is used under the assumption that consumption tax is constant over time[3]. Taking logs of the first order condition and using the functional form for the utility function specified in 28 we obtain that in steady state

$$\frac{1}{\beta} = \frac{1}{\bar{q}} \tag{29}$$

where $\frac{1}{\bar{q}}$ is the average real interest rate that is computed using the nominal government bond yield (from IMF International Financial Statistics) minus the realized rate of inflation (based on GDP Deflator) for the period 1960.1-1999.1. This procedure yields a value for the average real rate of 2.5% per year and hence a quarterly $\beta = .994$.Although the calibration of the discount factor is done comparing the (constant) steady state interest rate of the model with the long term (constant) average of the interest rate in the data, in the stochastic equilibrium of the model the real interest rate is not constant and moves in response to fiscal and productivity shocks.

To determine the value of θ observe that equation (12) implies that in a steady state equilibrium $\frac{1}{\theta} = \frac{p}{\Gamma_1}$ so that θ is the ratio between marginal cost and price , that is the inverse of the mark-up. Morrison (1992) provides estimates for mark-ups in the Japan manufacturing sector for the period 1960-1981 and finds an average mark-up of 26% over marginal cost that implies $\theta = .8$. In a steady state equilibrium N is normalized to 1 and thus $p = 1$ and $y = Y$.

[3] Evidence on consumption tax rates presented by Mendoza et al. (1994) shows that they move very little over time.

Using this and the zero profit condition (14) we find that $\phi = \frac{(1-\theta)}{\theta}Y$, that is fixed costs are 25% of steady state output. Since there is some uncertainty on the measure of markups and this parameter is important since it determines the size of the increasing returns we will conduct some sensitivity analysis.

To select the parameter α that in the model is the share of income going to capital we notice that cost minimization by the firm and the fact that $N = 1$ imply that in steady state

$$(1-\alpha) = \frac{wL}{\theta Y} \tag{30}$$

wL it is measured as the total of wage and salaries (reported in OECD National Income Accounts) and Y is GDP; this implies an average value for $\alpha = .58$.

In order to calibrate the depreciation rate δ we use the quarterly series of the total depreciation of the capital stock (δK_t). Using that measure, the data on gross capital formation (X_t) and an initial value for the capital stock K_0 (From OECD Flows and Stocks of Fixed Capital, 1997) a quarterly series for the capital stock can be reconstructed using (20). Once the series is obtained an estimate of δ is given by the average of the ratio between the total depreciation of the capital stock and the capital stock itself. This procedure yields a value of $\delta = .025$ per quarter.

3.2 Total Factor Productivity

In order to compute total factor productivity we used the traditional Solow decomposition modified in order to capture the returns from specialization. Using the market clearing conditions together with the first order conditions from the firms, aggregate output of the final good can be written as

$$Y_t = Z_t K_t^{\frac{\alpha}{\theta}} L_t^{\frac{1-\alpha}{\theta}} \tag{31}$$

and thus for given values of α and θ we can compute the log of total factor productivity Z_t as

$$\log(Z_t) = \log(Y_t) - \frac{\alpha}{\theta}\log(K_t) - \frac{1-\alpha}{\theta}\log(L_t) \tag{32}$$

Using the constructed series for capital stock for K_t, the series of total employment (from OECD Main Economic Indicators) for L_t and the series of Real GDP for Y_t we obtain a series for Z_t. Since the series is not stationary we take out a deterministic trend (in order to exclude deterministic technological progress) from Z_t and then estimate the following relation for the period 1970.1 – 1999.1

$$\log(Z_t) = \zeta \log(Z_{t-1}) + \varepsilon^z \tag{33}$$

$$\varepsilon_t^z \rightsquigarrow N(0, \sigma^2_{\varepsilon^z})$$

where ζ is a parameter determining the persistence of the process. We find that ζ=.945 and that the standard deviation of ε^z is equal to 0.9%.

3.3 Government Policies

Fiscal policy here is not modeled as the outcome of an explicit decision but rather as an exogenously given process measured using data on actual policy. We use the theory only to impose two simple restrictions on the nature of policies: the government budget constraint (equation 16) and the transversality condition on government debt (in order to rule out explosive paths for debt).

We will assume tax rates on capital and labor income and on consumption are constant. We set the tax rate on labor income $\tau^l = .2$ and the tax rate on consumption $\tau^c = .05$. Both these numbers are the average of the series of tax rates measured by Mendoza at al. (1994) for Japan in the period 1980-

1992. We set the tax rate on capital income so that in the deterministic steady state government revenues are equal to government expenditures. This implies $\tau^k = .25$. Transfers and subsidies S_t are assumed to be deterministic and growing at a constant rate and such that on average they are about 11% that is the average share of transfers[4] over GDP in Japan in the last 20 years reported by Fiorito (1997). The growth path pf public spending $\bar{G}_t$ is set to match an average ratio of public expenditure to GDP equal to .19, that is the average for Japan in the period 1970-1998. In order to estimate the process for public spending notice that equation (15) can be rewritten as

$$\log(\frac{G_t}{\bar{G}_t}) = \gamma \log(\frac{G_{t-1}}{\bar{G}_{t-1}}) + \chi E(\log(\frac{Y_t}{\bar{Y}_t})|\Omega_t) + \varepsilon_t^g \tag{34}$$

$$\varepsilon_t^g \rightsquigarrow N(0, \sigma^2_{\varepsilon^g})$$

The variable $\log(\frac{G_t}{\bar{G}_t})$ is measured as percentage deviations of total public spending (consumption plus investment) from its trend and the variable $\log(\frac{Y_t}{\bar{Y}_t})$ is measured as the percentage deviations from trend for GDP. Equation (34) can be estimated on Japanese data for the period $1974.3 - 1998.4$. In order to estimate the equation we follow a Generalized Method of Moments (GMM) procedure similar to the one outlined by Clarida, Gali and Gertler (1996) to estimate monetary policy rules. First we denote by ξ_t the forecast error on output, that is

$$\xi_t = \log(\frac{Y_t}{\bar{Y}_t}) - E(\log(\frac{Y_t}{\bar{Y}_t})|\Omega_t) \tag{35}$$

As usual the forecast error it is assumed to be uncorrelated with variables in the information set Ω_t. Equation (35) can be substituted in equation (34) so to obtain

$$\log(\frac{G_t}{\bar{G}_t}) = \gamma \log(\frac{G_{t-1}}{\bar{G}_{t-1}}) + \chi \left(\log(\frac{Y_t}{\bar{Y}}) - \xi_t\right) + \varepsilon_t^g \tag{36}$$

[4] Tranfers include social security payments.

that can be rewritten as

$$\log(\frac{G_t}{\bar{G}_t}) = \gamma \log(\frac{G_{t-1}}{\bar{G}_{t-1}}) + \chi \log(\frac{Y_t}{\bar{Y}}) + \eta_t \tag{37}$$

$$\eta_t = \varepsilon_t^g - \chi \xi_t$$

Because of the assumption on ξ_t and on ε_t^g the error term η_t is not correlated with variables in the information set $u_t \in \Omega_t$ and therefore we can use the orthogonality conditions

$$E(u_t \eta_t) = 0 \tag{38}$$

where

$$u_t \in \Omega_t$$

$$\eta_t = \log(\frac{G_t}{\bar{G}_t}) - \gamma \log(\frac{G_{t-1}}{\bar{G}_{t-1}}) - \chi \log(\frac{Y_t}{\bar{Y}})$$

to estimate the parameters γ and χ using GMM. In general Ω_t will contain lagged variables and current variables that help forecast output and that are uncorrelated with the forecast errors v_t and with the policy errors ε_t^g. We therefore include two lagged values of output, two lagged values of private investment, two lagged values of employment and the current quarter forecast for the TANKAN[5] diffusion index of business conditions (all enterprises). Estimates for γ, χ and σ_η are reported in the following table

[5] The series has been obtained from the Bank of Japan web site at http://www.boj.or.jp/en/siryo/siryo_f.htm. The series is only available starting from the first quarter of 1974.

Table 1. Parameters of the process for Japanese public spending

Description	Symbol	Value	Standard Error
Persistence	γ	.85	(.12)
Elasticity to Output	χ	$-.40$	(.11)
Standard Deviation	σ_η	.02	$-$

The sample for the regression is 1974.1- 1999.1

Notice that both γ, χ are highly significant and the elasticity of government spending to current (expected) output is quite large in magnitude, meaning that, in response to an expected 1% drop in GDP, public spending on average has gone up by 0.4%. Finally a process for lump sum taxation T_t is needed. Rewriting the government budget constraint as

$$B_{t+1} = \frac{1}{q_{t,t+1}} B_t + \frac{1}{q_{t,t+1}} \left[G_t + S_t - T_t - \tau_t^c C_t - \tau_t^l w_t L_t - \tau_t^k r_t K_t \right] \qquad (39)$$

it is apparent that in absence of a specific restriction on T_t the process for B_t will be non stationary when $q_{t,t+1}$ is less than one (positive interest rate) and thus B_t will violate the transversality condition. In order to avoid this problem we specify the following process for lump sum taxes

$$T_t = (1 - q_{t,t+1} + v(B_t))\, B_t \qquad (40)$$

where the function $v(.)$ has the following properties

$$v(\bar{B}) = 0 \qquad v'(.) > 0$$

where $\bar{B}$ is the steady state debt level. This specification implies that any level of $\bar{B}$ is consistent with the government budget constraint and that the time series for government debt will be mean reverting to that level. We will set $\bar{B}$ so to replicate an average debt to GDP ratio of .5 that is the ratio observed in Japan for the period $1970-1999$ (from various issues of the OECD Economic Outlook) Also in light of the recent ample and persistent expansion of Japanese government debt we set v' equal to a constant so that the degree of mean reversion of the time series for debt implied by the model is similar to one observed in the data.

3.4 Model Solution

Unfortunately the model presented does not admit analytical solutions and numerical methods are needed in order to analyze the equilibria of the model. Once the parameters values are chosen, the equations characterizing the equilibria are linearized around the deterministic steady state and a numerical solution is found by solving the resulting system of linear difference equations.

4 Results

Figure 2 below shows the predictions of the model for the deviations of output from its trend in the last 20 years together with the time series for the data.

FIGURE 2 APPROXIMATELY HERE

Notice that the innovations to productivity and to public spending (ε_z and η) measured from the data are used as inputs of the model. Although there are episodes in which output predicted by the model is different from the one realized in the data, in general the model predicts quite well the major recessions and booms that Japan has gone through in the last 20 years. As an additional check a table with the main business cycle statistics is reported and one can observe that volatilities and correlations of the main macroeconomic aggregates predicted by the model are not very far from those measured in the data.

Table 2. Business Cycles Statistics [6]

	Standard Deviations				
	Absolute	Relative to GDP			
	GDP	Consumption	Investment	Employment	Gov. Spending
Data	1.34	.77	2.54	0.34	1.86
Model	2.03	.65	2.86	0.47	1.39
	Correlations with GDP				
Data	1.00	.73	.91	.50	-.19
Model	1.00	.95	.97	.88	-.21

Finally figure 3 shows the path for government debt (as a fraction of GDP) in the model and in the data. It is important to notice that even by holding tax rates and transfers constant the model is able to reproduce the rapid growth

[6] Statistics for the the data are computed on quarterly series the period 1980.1 1999.1. The statistics for the model are computed on series of the same length as the data. The innnovations for the exogenous stochastic processes in the model are measured in the data. All series are in logs and HP filtered.

of Japanese public debt in the last few years, showing that large part of the increase in debt is really due to the increase in spending.

FIGURE 3 APPROXIMATELY HERE

5 Policy Experiments

The results shown in the previous section show that the model used captures the basic features of the Japanese business cycles together with the evolution of fiscal variables. It is therefore reasonable to use the same model to ask the following question: could the Japanese fiscal authorities speed up the recovery of Japan from the last recession by following a more vigorous countercyclical fiscal policy. And if so what would be the effect of such a policy on the public debt ?

In particular we will consider an alternative path for fiscal policy from the second quarter of 1997 to the first quarter of 1999, that is the period in which Japanese output has steadily declined. The alternative policy includes a 5% increase in government spending respect to the government spending measured in the data. Figure 4 shows the actual ratio of public spending to GDP in Japan in the last two years together with the path for the same ratio under the alternative policy specification. Under the alternative policy the level of government spending would have reached 30% of GDP by the first quarter of 1999.

FIGURE 4 APPROXIMATELY HERE

Figures 5 and 6 show the effect of such a policy. The continuous lines are the paths for output growth and debt to output ratio predicted by the model with using the fiscal policy measured in the data while the dashed lines are the predicted paths under the alternative policy. Fiscal policy would have not been very effective in stabilizing output achieving only an increase in the growth rate of .25% in the first three quarters, but it would have increased the debt to output ratio by more than 10%.

FIGURES 5 AND 6 APPROXIMATELY HERE

In order to understand why this model predicts such a limited impact of fiscal policy on output it is instructive to plot the model impulse responses to a 1% increase in government spending. A government spending shock increases the future tax burden of consumers and hence is a negative wealth shock. As a consequence both consumption and leisure fall thereby increasing labor input. The increase in labor input tend to increase investment for two reasons: the first is that capital and labor are complements in production and the second is the increase in total factor productivity caused by the increasing returns. On the other hand the negative wealth effect induces agents to save less and thus to restore equilibrium in the asset market real interest rate has to raise: this effects reduce investment. Which one of the effect dominates is a quantitative issue and it depends on the parameter of the model. From the impulse responses appear that for our parameterization the interest rate effect is dominant and a decline in investment is observed in response to an increase in public spending. This strong crowding out effect on investment is one important reason why effects of fiscal policy on output are small in magnitude.

FIGURE 7 APPROXIMATELY HERE

It is worth noticing that recent work by Blanchard and Perotti (1999) has shown that small multipliers of government spending and large investment crowding out are consistent with empirical evidence in the United States. It also important to notice that the expansionary effects predicted by the model are somehow magnified by the fact that we are considering a closed economy. If one had explicitly modeled the foreign sector, the effects of fiscal expansion on domestic output would be even smaller. The intuitive reason is that in an open economy the effects of domestic fiscal shocks on factor prices are smaller since part of the shock is absorbed by the foreign sector and thus factor and output responses are smaller. In the extreme case of a small open economy, in which the real interest rate is not affected by domestic conditions, an increase in government spending would not affect the capital-output ratio so it would not affect wages, labor supply and domestic output and the additional spending would only increase the current account deficit.

6 Sensitivity Analysis

This section analyzes the robustness of the results to changing the degree of increasing returns. In a model with greater increasing returns to scale government spending might have a bigger effect on output. The initial increase in labor input would translate in a greater increase in productivity and this might magnify the effect on output. As an upper bound for the measure of increasing returns we will consider a value of $\theta = .6$ (that implies a mark-up of 67%). Figure 8 plots the impulse responses to a government spending shock for the same model considered in the previous section where the parameter θ is now set equal to .6. In this case the effect of increase in total factor productivity due to the increase in labor input is quantitatively stronger and sufficient to induce an increase in investment. But even in this case the output multiplier of government spending remains quantitatively small. Figure 9 shows the path for output under the alternative fiscal policy considered in the previous section. Although now, due to the presence of stronger increasing returns, the effect on output are somehow bigger (the alternative policy achieves a maximum increase in output growth of about 1%) they are still not big enough to stabilize Japanese output during the last recession.

FIGURES 8 AND 9 APPROXIMATELY HERE

7 Conclusions

This paper uses a dynamic general equilibrium model calibrated to the Japanese economy to measure the effectiveness of fiscal stabilization in the recent Japanese slowdown. Even though from a qualitative standpoint fiscal expansions have positive effects on output it is shown that from a quantitative point of view these effects are small. A consequence of this is that expansionary fiscal policy significantly increases the government debt output ratio. The model suggests that the recent decline in output is explained by a sharp and prolonged decline in productivity and that, in an economy already characterized by a high level of government debt, public demand policies do not seem to be a very effective tool that Japanese policy makers can use to stabilize output. The spirit of this result is similar to the one obtained by Krueger and Prescott (1998) that analyze the desirability of a cut in taxes for Japan.

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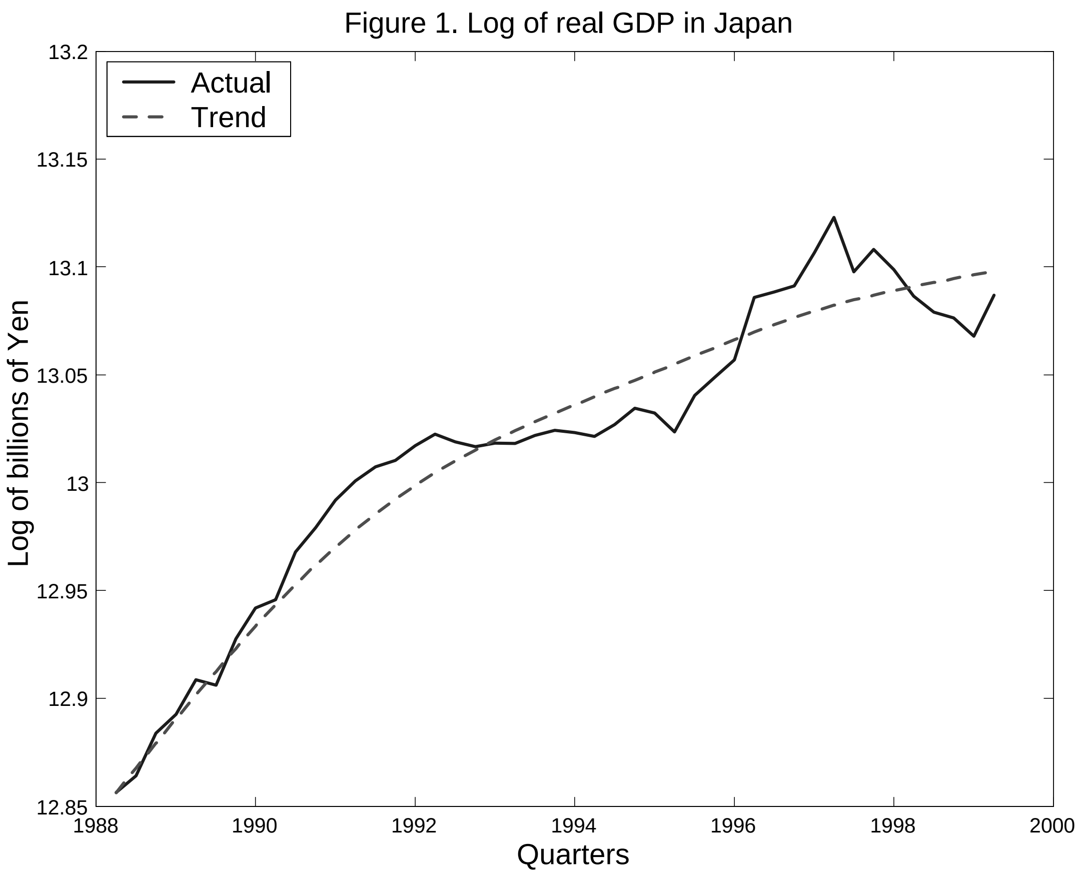
Figure 1. Log of real GDP in Japan
Actual
Trend
13.2
13.15
13.1
13.05
13
12.95
12.9
12.85
Log of billions of Yen
1988
1990
1992
1994
1996
1998
2000
Quarters

Fig. 1.

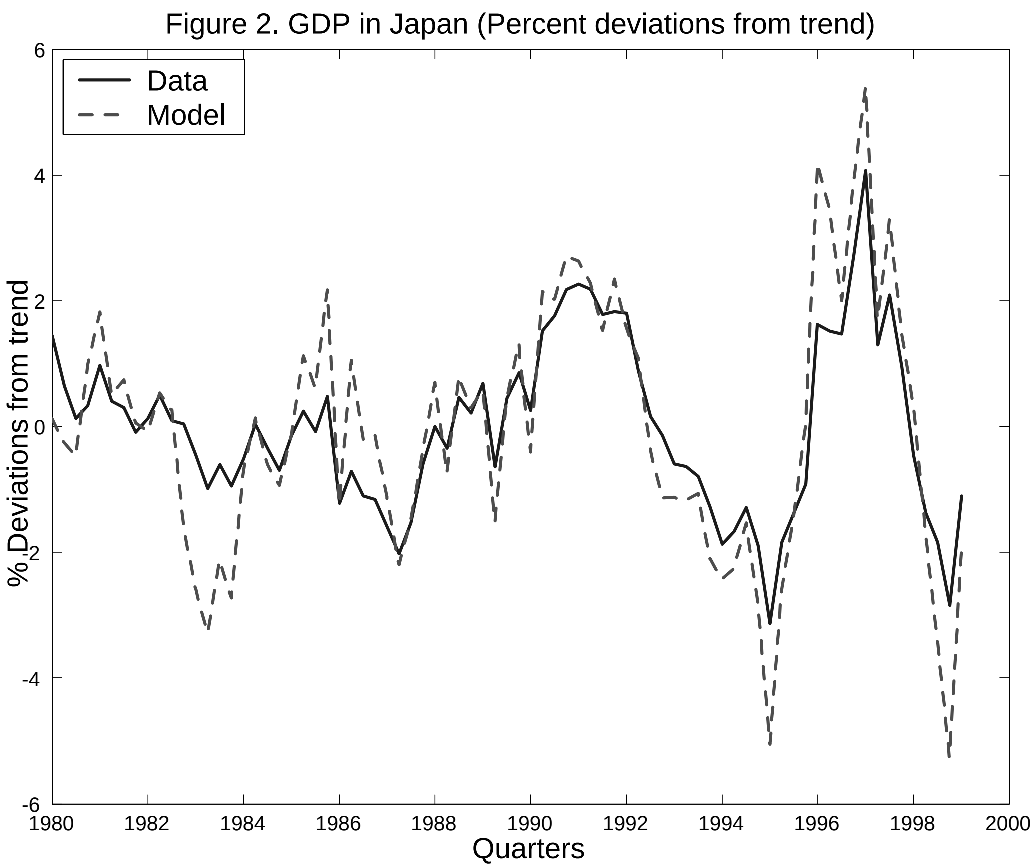
Figure 2. GDP in Japan (Percent deviations from trend)
Data
Model
% Deviations from trend
Quarters
6
4
2
0
-2
-4
-6
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000

Fig. 2.

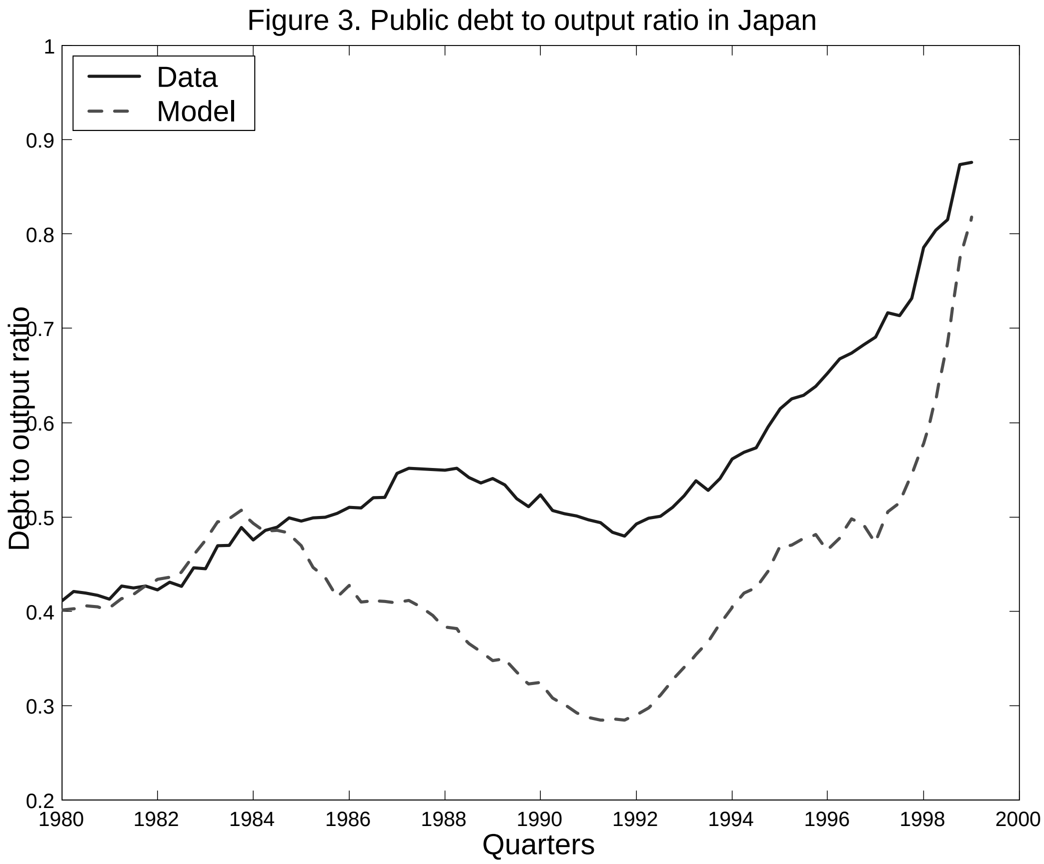
Figure 3. Public debt to output ratio in Japan
Data
Model
Debt to output ratio
Quarters
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000

Fig. 3.

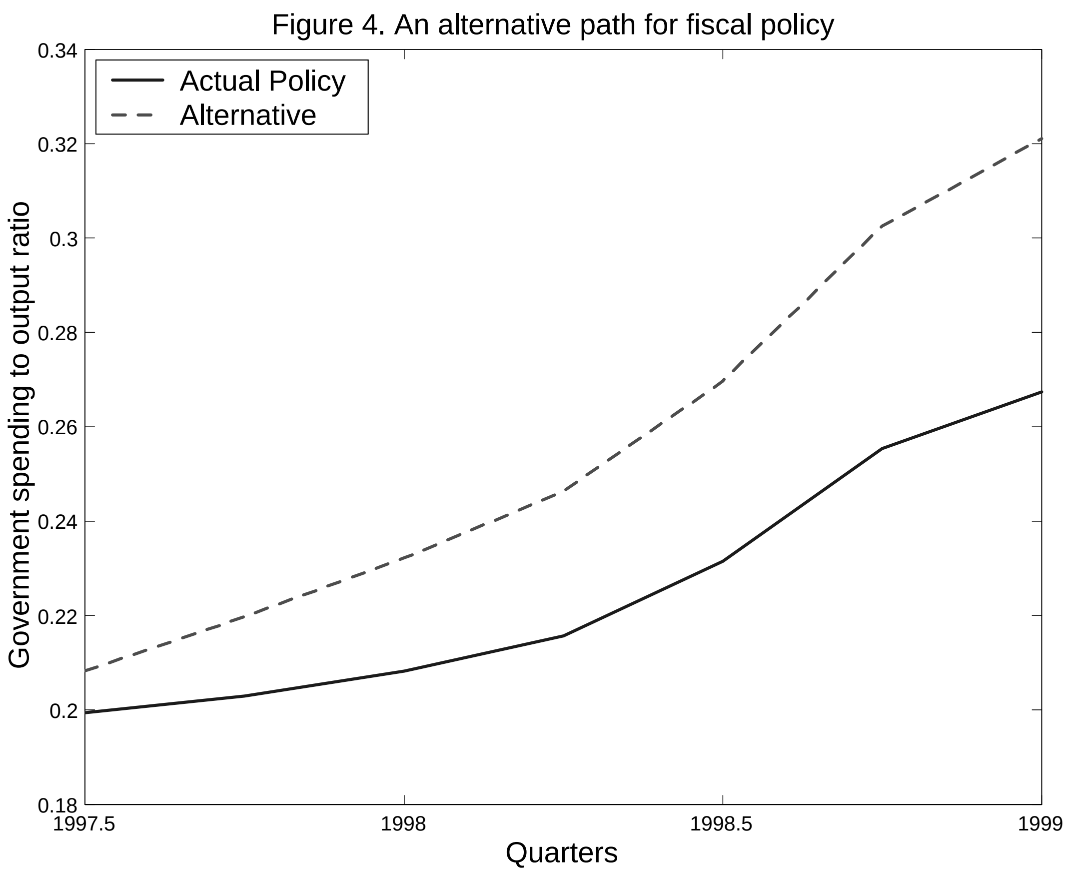
Figure 4. An alternative path for fiscal policy
Actual Policy
Alternative
Government spending to output ratio
0.34
0.32
0.3
0.28
0.26
0.24
0.22
0.2
0.18
1997.5
1998
1998.5
1999
Quarters

Fig. 4.

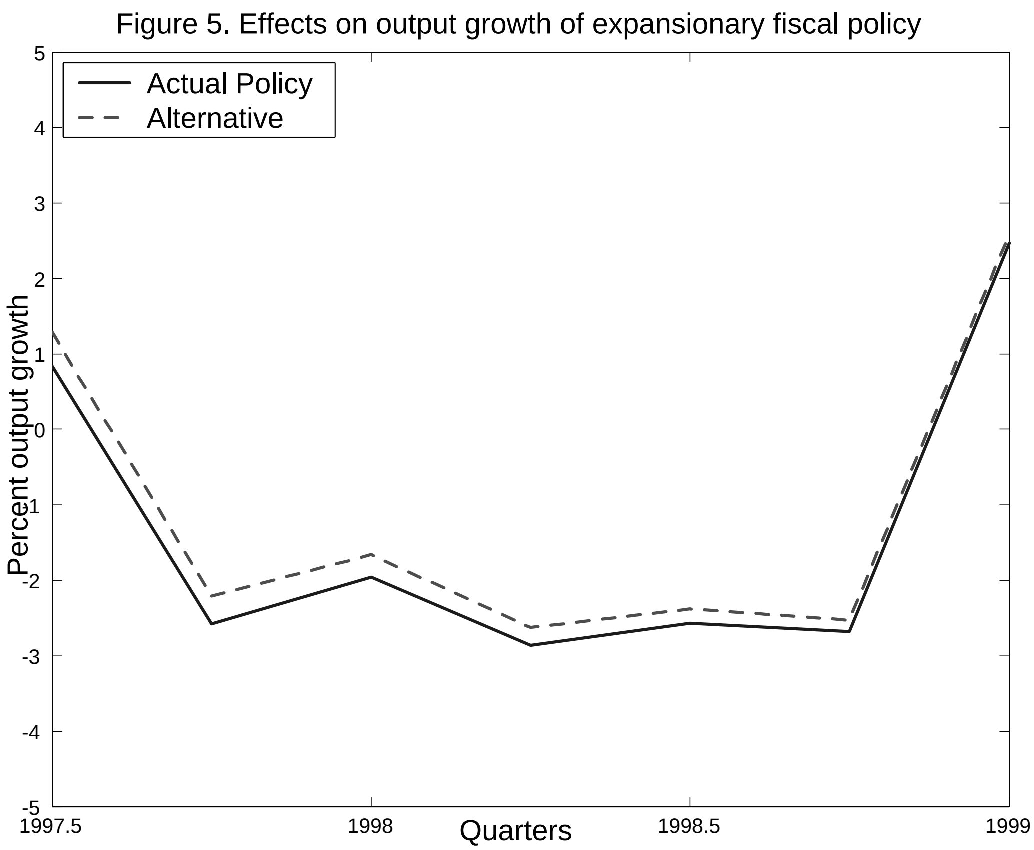
Figure 5. Effects on output growth of expansionary fiscal policy
Actual Policy
Alternative
Percent output growth
5
4
3
2
1
0
-1
-2
-3
-4
-5
1997.5
1998
1998.5
1999
Quarters

Fig. 5.

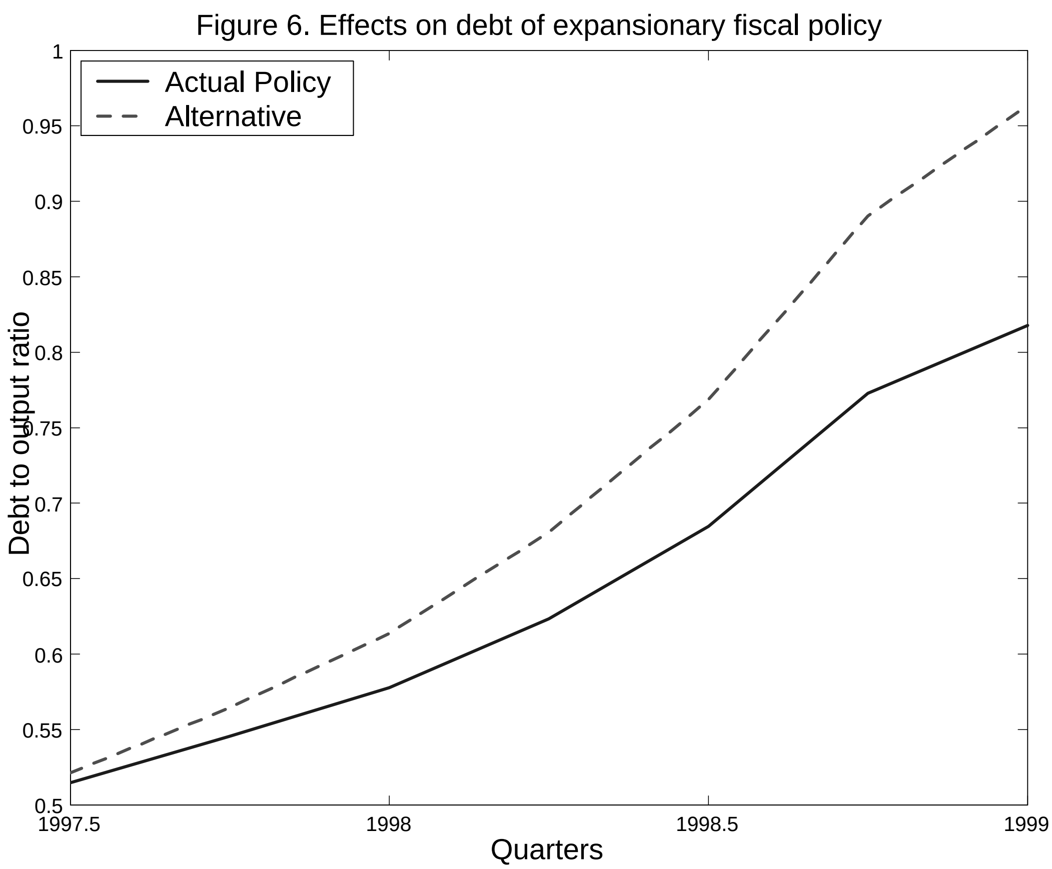
Figure 6. Effects on debt of expansionary fiscal policy
Actual Policy
Alternative
Debt to output ratio
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
1997.5
1998
1998.5
1999
Quarters

Fig. 6.

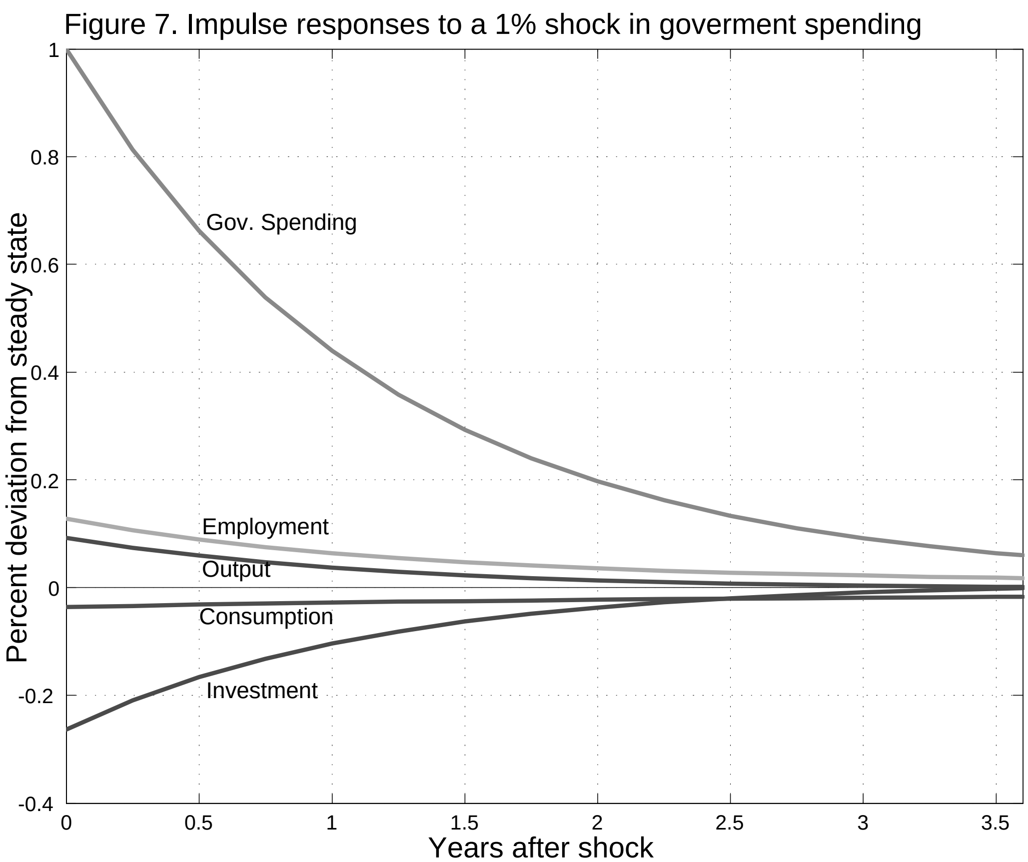
Figure 7. Impulse responses to a 1% shock in goverment spending
Percent deviation from steady state
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
Gov. Spending
Employment
Output
Consumption
Investment
0
0.5
1
1.5
2
2.5
3
3.5
Years after shock

Fig. 7.

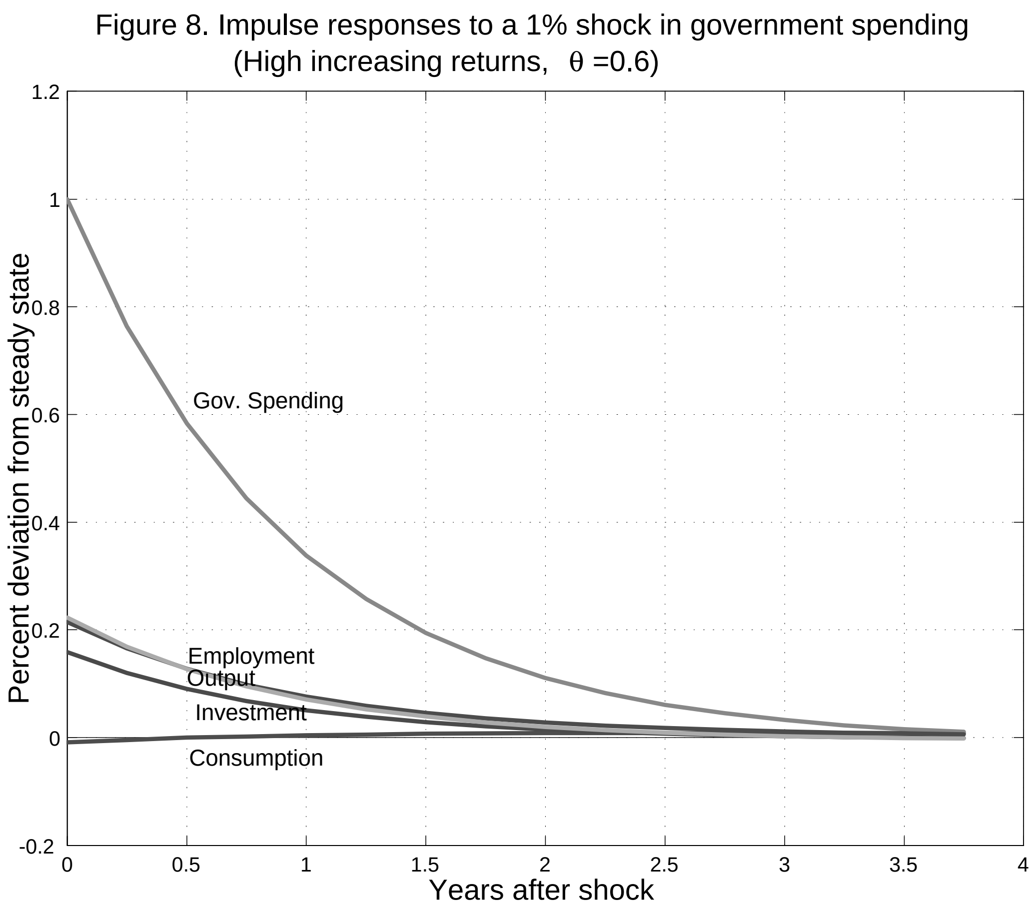
Figure 8. Impulse responses to a 1% shock in government spending
(High increasing returns, θ =0.6)
Percent deviation from steady state
Years after shock
Gov. Spending
Employment
Output
Investment
Consumption
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
0
0.5
1
1.5
2
2.5
3
3.5
4

Fig. 8.

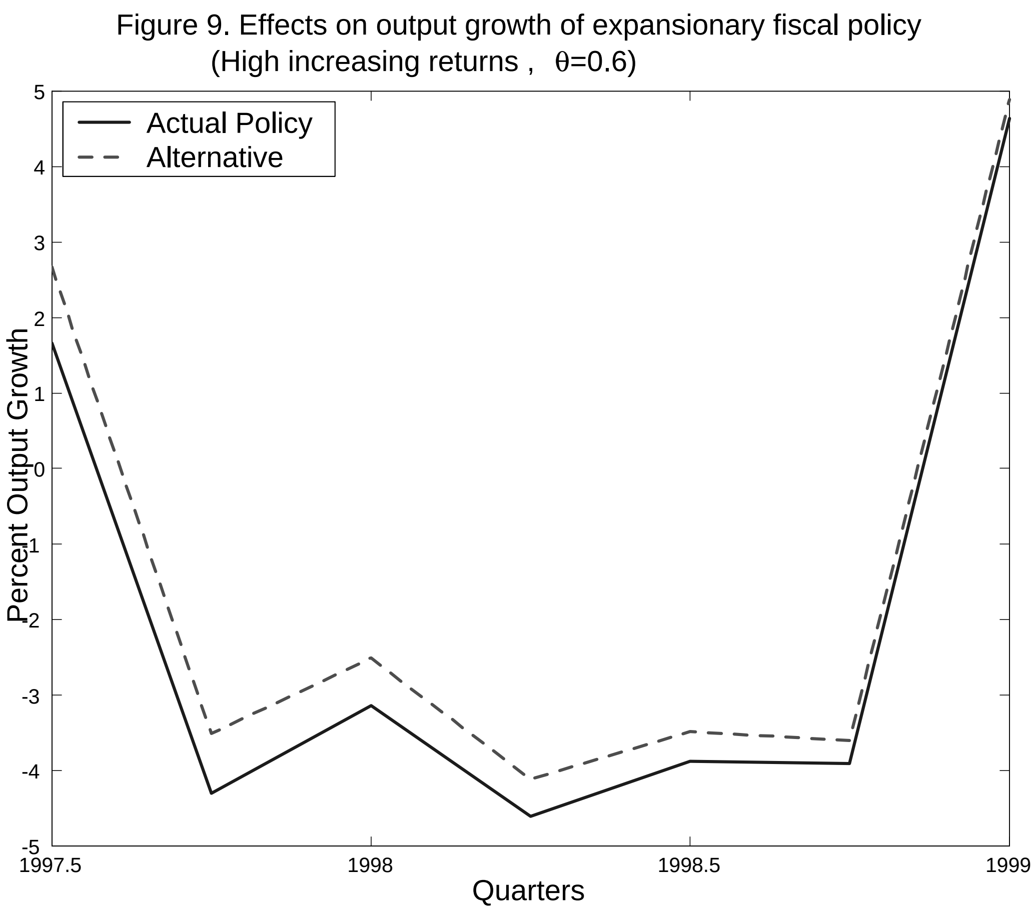
Figure 9. Effects on output growth of expansionary fiscal policy
(High increasing returns , θ=0.6)
Actual Policy
Alternative
Percent Output Growth
Quarters
5
4
3
2
1
0
-1
-2
-3
-4
-5
1997.5
1998
1998.5
1999

Fig. 9.