Taxation-Based Stabilization Policy

Bernhard Herz[a] Werner Roeger[b*] Lukas Vogel[a]

Preliminary version

May 2004

1. Introduction

As countries enter currency unions or fixed exchange rate regimes they loose their monetary independence. The costs and benefits of giving away monetary policy have been comprehensively discussed in the context of European Monetary Union. Asymmetric shocks and potential differences in the monetary policy transmission increase the importance of and the requirements for national fiscal policy as a tool for macroeconomic stabilization in the Euro area. This stabilization role conflicts with serious provisos against fiscal policy activism, however. Political economy incentives can substantially impair the anti-cyclical use of fiscal policy. Additionally, the potential deficit bias puts the long-run sustainability of government budgets at risk. Hence there seems to be a need for implementable fiscal policy rules.

In the context of this discussion, the paper investigates the potential for rule-based fiscal stabilization policy in a monetary union. The analysis uses a small dynamic optimising agent specification that is a standard tool in monetary policy research. We build on the models of Clarida et al. (2001), Galí and Monacelli (2002) and McCallum and Nelson (1997), and restrict attention to the small open economy case. We modify the aggregate demand equation to examine the stabilizing potential of fiscal policy and focus on the revenue side of the budget. Specifically, we explore the stabilizing potential of variable tax rates. Thus, the analysis treats fiscal policy as an endogenous variable and not as an exogenous shock as in the conventional analysis of (monetary) stabilization policy.

[a] VWL 1, Economics Department, University of Bayreuth, Germany (corresponding author: lukas.vogel@uni-bayreuth.de, Tel.: +49-921-55.29.14)
[b] European Commission, DG ECFIN

[*] The views expressed in this paper are those of the authors only.

While monetary policy has several advantages as a stabilization tool, e.g. the short decision lags and the reversibility of interest rate decisions (Taylor 2001), there are also certain limitations. In particular, monetary policy cannot react to asymmetric shocks in a monetary union. Against this background, the paper adapts the discussion of monetary policy to the question of taxation-based stabilization. To this aim, we replace the interest rate rule by a tax rule. The basic idea is that time-varying tax rates can be an adequate tool for stabilizing, anti-cyclical fiscal policy. The focus of this paper is on taxing consumption. Looking at taxation instead of time-varying expenditure can be justified by efficiency arguments. Mountford and Uhlig (2002) argue that, in the U.S., deficit-financed tax reductions have been superior to deficit- or tax-financed expenditure increases as a macroeconomic stabilization tool. Wijkander and Roeger (2002) furthermore suggest that variations in the VAT have a relatively strong effect on aggregate demand.

In contrast to much of the literature on macroeconomic stabilization, we do not restrict the role of fiscal policy to the operating of automatic stabilizers. The motivation is twofold. Firstly, automatic stabilizers dampen macroeconomic shocks only partially (Calmfors 2003), so that discretionary action may add to the stabilizing potential. Secondly, although automatic stabilizers certainly succeed in smoothen cyclical fluctuations, they may face a trade-off between allocation efficiency and macroeconomic stabilization. Their stabilizing potential is higher the more progressive the tax system and the more generous the transfer payments to the unemployed (Buti and Van den Noord 2003).

The analysis presumes that fiscal policy in the form of time-varying taxation has a priori no disadvantage with regard to the decision lag and the reversibility of decisions, i.e., we assume that the variable tax component can be adjusted at a similar speed as interest rates in monetary policy. Considering the present fiscal constitution of EMU member states this assumption is obviously too restrictive. Therefore, the discussion about fiscal stabilization policy also has to include institutional reforms. The proposals range from improved transparency and rules for national governments to the idea of delegating fiscal stabilization policy to an independent agency (Calmfors 2003, Wyplosz 2001).

The following section presents variable taxation in a dynamic model of optimising households. Section three then discusses the impact of inflation in the model. In section four, we calibrate the model equations and simulate impulse responses. Section five summarizes the main findings and concludes.

2. Model

This section incorporates fiscal policy in a dynamic model of inter-temporally utility maximizing households. Thereby, the focus is on time-varying taxation. This aspect of fiscal policy is made endogenous. The aim is to investigate its potential for macroeconomic stabilization in the absence of monetary policy. The discussion rests upon the model of Clarida et al. (2001) and Galí and Monacelli (2002). It simplifies the latter by restricting attention to countries within a monetary union. In such a setting, we do not have to consider nominal exchange rates and their impact on the terms of trade. On the other hand, we extend the small open-economy specification by including time-varying taxation as a policy tool. We consider a component τ of the VAT that may be adjusted according to the objective of output stabilization. In equilibrium, this component is equal to zero. The deviation of the tax rate τ from its steady state value thus simplifies to $\hat{\tau}_t = \tau_t - \bar{\tau} = \tau_t$. As we consider distortionary taxation, the proposition of Ricardian equivalence does not hold.

This section proceeds by presenting the building blocks of the model. We first discuss household utility. Then we derive aggregate demand. As third element we introduce the inflation dynamics and, finally, discuss the fiscal policy rule.

2.1 Household utility

The model focuses on the behaviour of a representative agent or representative household. Household utility is given as the discounted stream of utility

$$(1) \qquad U = E_t \sum_{j=0}^{\infty} \beta^j U_{t+j} \,,$$

with β as the discount factor.

Household utility is a function of household consumption and leisure. The positive valuation of leisure implies that working negatively affects household utility. With overall utility being additive in the utility of consumption and the disutility of working we get

$$(2) \qquad U_t(C_t, N_t) = \frac{1}{1-\sigma} C_t^{1-\sigma} - \frac{1}{1+\phi} N_t^{1+\phi} \,,$$

where C is consumption, N is the time spent working, σ is the coefficient of relative risk aversion, or the inverse of the inter-temporal elasticity of substitution, and ϕ is the inverse of the elasticity of labour supply.

Households consume a basket of domestic and foreign goods and services. We assume that the partition of consumption in foreign and domestic commodities can be described by the following CES utility function (see Galí and Monacelli 2002)

$$(3) \qquad C_t = \left[(1-\alpha)^{\frac{1}{\eta}} C_{H,t}^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}} C_{F,t}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}},$$

with C_H and C_F as domestic and imported consumer goods, respectively, η as the elasticity of substitution between C_H and C_F, and α as the equilibrium share of imports in domestic household consumption.

The private sector's budget constraint is

$$(4) \qquad W_t N_t - T_t \geq (1+\tau_t) P_{H,t} C_{H,t} + (1+\tau_t) P_{F,t} C_{F,t} - P_t X_t + \frac{B_{t+1}}{1+i_t} - B_t .$$

Note that, in order to keep the argument simple, capital and investment in capital is omitted in the model. Since our focus is on the effects of taxing consumption, this simplification seems admissible at this stage. Whether, or under which conditions, investment may be affected in an indirect or second round effect via the real interest rate changes is an aspect for further investigation.

The elements in the above restriction are the nominal wage per unit of labour, W_t, the expenditure on domestic consumer goods, $(1+\tau_t) P_{H,t} C_{H,t}$, the spending on foreign consumer goods, $(1+\tau_t) P_{F,t} C_{F,t}$, the exports of domestically produced commodities, $P_t X_t$, and the investment in risk-free one-period bonds, $B_{t+1}/(1+i_t) - B_t$. The nominal interest rate is i_t. Because labour is the only factor of production, all income from production is paid as wages. The government collects lump-sum taxes T_t to finance public spending.

Consumption is taxed in the country of destination at the rate τ_t. Therefore, the overall spending of domestic households on consumer goods is $(1+\tau_t) P_{H,t} C_{H,t} + (1+\tau_t) P_{F,t} C_{F,t}$. The term $(1+\tau_t) P_{F,t} C_{F,t} - P_t X_t$, on the other hand, can be considered as the private sector net imports.

The representative agents maximize utility as given in (1) to (3) under the budget constraint (4). For household consumption, the resulting first order conditions are

$$(5) \qquad C_t^{-\sigma} = \lambda_t (1+\tau_t) P_t$$

(6) $$C_{t+1}^{-\sigma} = \lambda_{t+1}(1+\tau_{t+1})P_{t+1}$$

Maximizing utility from consumption according to (3) and (4), the shares of domestic and of imported commodities in C_t equal

(7) $$C_{H,t} = (1-\alpha)\left(\frac{P_{H,t}}{P_t}\right)^{-\eta} C_t \qquad\qquad C_{F,t} = \alpha\left(\frac{P_{F,t}}{P_t}\right)^{-\eta} C_t\,,$$

and the resulting price level is

(8) $$P_t = \left([1-\alpha]P_{H,t}{}^{1-\eta} + \alpha P_{F,t}{}^{1-\eta}\right)^{\frac{1}{1-\eta}}.$$

The first order condition for labour supply is

(9) $$N_t{}^{\phi} = \lambda_t W_t\,,$$

and for saving in one-period bonds

(10) $$\lambda_t = \beta(1+i_t)\lambda_{t+1}\,.$$

Plugging (5) and (6) into (10), one obtains the equation for the inter-temporal trade-off between saving and consumption

(11) $$1 = \beta(1+i_t)E_t\left\{\left[\frac{C_{t+1}}{C_t}\right]^{-\sigma}\frac{(1+\tau_t)P_t}{(1+\tau_{t+1})P_{t+1}}\right\}.$$

With $\hat{x}_t = \ln X_t - \ln \overline{X}$ as the percentage deviation of variable X_t from its steady state $\overline{X}$, $\ln(1+x) \approx x$ for x close to zero, and $\beta = (1-\bar{r})^{-1}$, we obtain the standard log-linear approximation of the Euler equation (11) around the steady state, extended by the inclusion of the variable consumption tax

(12) $$\hat{c}_t = E_t\hat{c}_{t+1} - \frac{1}{\sigma}(i_t + \tau_t - E_t\tau_{t+1} - E_t\pi_{t+1} - \bar{r})\,.$$

The trade-off between consumption and leisure determines labour supply according to (5) and (9) as

(13) $$\frac{N_t{}^{\phi}}{C_t^{-\sigma}} = \frac{W_t}{(1+\tau_t)P_t}\,,$$

which states that labour supply is a function of the real wage. The higher the consumer tax rate, the lower the real wage. In logarithmic form, with smaller case letters as the variables' logarithms, the equation becomes

(14) $w_t - \tau_t - p_t = \phi n_t + \sigma c_t$.

2.2 Aggregate demand

Let us now define aggregate demand for domestically produced goods and services as

(15) $Y_t = C_{H,t} + C^*_{H,t} + G_t$.

Its log-linear approximation around the steady state is

(16) $\hat{y}_t = \frac{C}{Y}([1-\alpha]\hat{c}_{H,t} + \alpha\hat{c}^*_{H,t}) + \frac{G}{Y}\hat{g}_t$,

where C/Y is the steady-state share of consumer goods in total demand, which combines $(1-\alpha)(C/Y)$, the share of domestic households, and $\alpha(C/Y)$, the share of exports in overall demand. A star indicates the variables of the foreign country, or, more accurately, for the aggregate of foreign countries. Finally, G is government consumption of domestically produced commodities. It is financed by the lump-sum tax T and considered exogenous. For simplicity, we further assume that government spending prevails at its equilibrium level, so that $\hat{g} = 0$.

Similarly, the log-linear approximation of domestic household consumption, $C_t = C_{H,t} + C_{F,t}$, around the steady state is

(17) $\hat{c}_t = (1-\alpha)\hat{c}_{H,t} + \alpha\hat{c}_{F,t}$.

The analogous expression for foreign household consumption is

(18) $\hat{c}^*_t = (1-\gamma)\hat{c}^*_{F,t} + \gamma\hat{c}^*_{H,t}$,

with γ as the share of domestic country exports in foreign household consumption. Because we assume the domestic country to be small compared to the aggregate of remaining EMU countries, the share γ in overall foreign household consumption is negligible.

Inserting (17) in (16), assuming $\hat{g} = 0$, and re-arranging the terms, one obtains

(19) $\hat{y}_t = \frac{C}{Y}([1-\alpha]\hat{c}_t + \alpha\hat{c}^*_t + \alpha[\hat{c}^*_{H,t} - \hat{c}^*_t] - \alpha[\hat{c}_{F,t} - \hat{c}_t])$.

The log-linearisation of (7) around the steady state yields $\hat{c}_{F,t} - \hat{c}_t = -\eta(\hat{p}_{F,t} - \hat{p}_t)$. Analogously, and under the law of one price, one obtains $\hat{c}^*_{H,t} - \hat{c}^*_t = -\eta(\hat{p}_{H,t} - \hat{p}^*_t)$ as the approximation of foreign demand for domestic goods.

With the log-linear approximations of (7) and the log-linear approximation of the price level (8) around the steady state,

$$\hat{p}_t = (1-\alpha)\hat{p}_{H,t} + \alpha\hat{p}_{F,t}, \tag{20}$$

we can rewrite equation (19) as

$$\hat{y}_t = \frac{C}{Y}([1-\alpha]\hat{c}_t + \alpha\hat{c}^*_t - \eta\alpha[2-\alpha][\hat{p}_{F,t} - \hat{p}_{H,t}]). \tag{21}$$

At this stage, we make two important assumptions. As already mentioned above, and analogously to Clarida et al. (2001) and Galí and Monacelli (2002), we consider the case of a small country. The latter is supposed not to affect the price level in the aggregate of foreign countries, so that $P^*_t = P_F$, nor does it affect the Euro area output gap and the decision parameters of the union-wide monetary authority in a sensible way. Secondly, we assume that production in the aggregate of foreign countries, the rest EMU, is at its equilibrium level. Either do national shocks average out, or monetary policy can rather quickly restore the steady state. The equilibrium assumption implies $\hat{c}^*_t = 0$ and $\tau^*_t = 0$.

We are now able to derive our inter-temporal equation for the deviation of aggregate demand from the steady-state level. To this end, we plug equation (12) in (21), with $\hat{c}^*_t = 0$, and then replace $E\hat{c}_{t+1}$ by the expression for $E_t\hat{y}_{t+1}$ according to (21). After simplifying the expression, this procedure gives

$$\hat{y}_t = E_t\hat{y}_{t+1} - \frac{C}{Y}\frac{1-\alpha}{\sigma}(i_t + \tau_t - E_t\tau_{t+1} - E_t\pi_{t+1} - \bar{r}) + \frac{C}{Y}\eta\alpha(2-\alpha)(E_t\pi_{F,t+1} - E_t\pi_{H,t+1}). \tag{22}$$

Under the above assumption that $E_t\pi_{F,t+1} = 0$, i.e. the average EMU follows the steady state path, and given equation (20) the expression reduces to

$$\hat{y}_t = E_t\hat{y}_{t+1} - \frac{C}{Y}\frac{1-\alpha}{\sigma}(i_t + \tau_t - E_t\tau_{t+1} - [1-\alpha]E_t\pi_{H,t+1} - \bar{r}) - \frac{C}{Y}\eta\alpha(2-\alpha)E_t\pi_{H,t+1}. \tag{23}$$

Following the approach in Clarida et al. (2001) and Galí and Monacelli (2002), we have so far considered the path of aggregate demand. We have not yet taken into account that taxing consumer goods creates a wedge between aggregate spending and effective aggregate demand. This distinction shall be discussed in the following.

Private households are, in the first place, constrained in their overall expenditure. Equation (4) states that overall private consumption expenditure in t cannot exceed the wage earned plus the dissaving minus the lump-sum taxes paid over this period. Therefore, the household problem of inter-temporal optimisation in equation (12) is, in the first place, above the inter-temporal allocation of consumption expenditure. In this context, the Euler equation gives an optimum for the ratio of present to future consumption. It does, however, not specify the absolute levels of present and future demand.

From equation (15) we have the level of effective demand for domestic products as $Y_t = C_{H,t} + C^*_{H,t} + G_t$. Overall spending on domestically produced commodities, the element fixed by the budget constraint, on the other hand is

(24) $$Z_t = (1+\tau_t)C_{H,t} + C^*_{H,t} + G_t$$

The wedge between overall spending and aggregate demand is thus $Z_t - Y_t = \tau_t C_{H,t}$. As above, we assume the aggregate of foreign economies to operate on the equilibrium path. This implies that $\tau_t^* = 0$ and avoids complications from tax-driven fluctuations in export demand.

What households can actually smooth independently is the inter-temporal allocation of consumption expenditure, i.e. of $C_t^\tau = (1+\tau_t)C_t$. We may thus rewrite equation (12) as the inter-temporal allocation of consumer spending as

(25) $$\hat{c}_t^\tau = E_t \hat{c}_{t+1}^\tau - \frac{1}{\sigma}(i_t + \tau_t - E_t \tau_{t+1} - E_t \pi_{t+1} - \bar{r}),$$

with $\hat{c}_t^\tau = \hat{c}_t + \tau_t$. The log-linear approximation of (24) around the steady state yields

(26) $$\hat{z}_t = \frac{C}{Y}([1-\alpha]\hat{c}_{H,t}^\tau + \alpha \hat{c}_{H,t}^*) + \frac{G}{Y}\hat{g}_t,$$

because $Z = Y$ holds in the steady state. For the difference between the overall demand and the overall expenditure deviation from the steady state it follows

(27) $$\hat{y}_t = \hat{z}_t - \frac{C}{Y}(1-\alpha)\tau_t.$$

Analogously to (23) we can write the optimising equation for aggregate expenditure on domestically produced commodities as

(28) $\hat{z}_t = E_t \hat{z}_{t+1} - \frac{C}{Y}\frac{1-\alpha}{\sigma}(i_t + \tau_t - E_t\tau_{t+1} - [1-\alpha]E_t\pi_{H,t+1} - \bar{r}) - \frac{C}{Y}\eta\alpha(2-\alpha)E_t\pi_{H,t+1} + \varepsilon_{z,t}$,

where we have added $\varepsilon_{z,t}$ as a demand shock. Finally, we thus obtain the deviation of aggregate demand from its equilibrium level as

$$\hat{y}_t = E_t \hat{z}_{t+1} - \frac{C}{Y}\frac{1-\alpha}{\sigma}(i_t + [1+\sigma]\tau_t - E_t\tau_{t+1} - [1-\alpha]E_t\pi_{H,t+1} - \bar{r}) - \frac{C}{Y}\eta\alpha(2-\alpha)E_t\pi_{H,t+1} + \varepsilon_{z,t}.$$

2.3 Aggregate supply and inflation dynamics

In the absence of monetary or fiscal policy intervention, the model dynamics is entirely driven by the interaction of inflation and the output gap in reaction to exogenous shocks. The impact of inflation on the output gap has been derived in the above sections. This section sketches out the effect of aggregate demand on inflation.

We suppose that fluctuations in aggregate supply are, in the short run, determined by fluctuations in aggregate demand. Any quantity demanded can be supplied. However, we do not assume that they are supplied at constant costs. Instead, marginal costs are supposed to vary with fluctuations in the level of production. The deviations of output from its steady state are thus associated with price level changes or inflation. As we are concerned with the output gap of the domestic economy, we focus on the price level for domestically produced commodities.

According to standard practice, firms are considered as setting their prices in a forward-looking manner and as charging a fixed price mark-up. Under the assumption of staggered price setting, the New Keynesian Phillips curve (see e.g. Clarida et al. 1999, Galí and Monacelli 2003, Galí 2003) results as

(29) $\pi_{H,t} = \beta E_t \pi_{H,t+1} + \lambda \hat{mc}_t$.

The point now is to relate the log-deviations of domestic real marginal costs from their equilibrium level to the domestic output gap. To this aim, the logarithm of real marginal costs can be expressed as

(30) $mc_t = w_t - p_{H,t} - a_t$,

where a_t is the parameter of labour productivity. Inserting the labour supply equation (14), one can rewrite the expression as

$$mc_t = \sigma c_t + \phi n_t + (p_t - p_{H,t}) + \tau_t - a_t.$$

Above we assumed, that output is determined by aggregate demand, in the short run. As labour is the only factor of production, the production function is $Y_t = A_t N_t$. In logarithmic terms this gives $y_t = a_t + n_t$, so that

$$(31) \qquad mc_t = \sigma c_t + \phi y_t + (p_t - p_{H,t}) + \tau_t - (1+\phi)a_t .$$

From the fact that the steady-state consumption equation (11) holds for domestic and foreign households, and assuming an integrated bond market, Galí and Monacelli (2002, 6) derive

$$c_t = c_t^* + \left(\frac{1-\alpha}{\sigma}\right)(p_{F,t} - p_{H,t})$$

as log-relationship between domestic and foreign consumption. Together with equation (7) for $C_{H,t}$ and $C_{H,t}^*$, they furthermore obtain (see Galí and Monacelli 2002, 9f.)

$$(p_{F,t} - p_{H,t}) = \frac{\sigma}{1+\alpha(2-\alpha)(\sigma\eta-1)}(y_t - y_t^*) .$$

Using $p_t - p_{H,t} = \alpha(p_{F,t} - p_{H,t})$ from (20), replacing c_t and $p_{F,t} - p_{H,t}$ in (31) by the two above expressions, and assuming that the aggregate of foreign countries operates at the steady-state level, with $\hat{c}_t^* = 0$ and $\hat{y}_t^* = 0$, the deviation of marginal costs from steady state are equal to

$$(32) \qquad \hat{m}c_t = \left(\frac{\sigma}{1+\alpha(2-\alpha)(\sigma\eta-1)} + \phi\right)\hat{y}_t + \tau_t - (1+\phi)\hat{a}_t ,$$

where $-\lambda(1+\phi)\hat{a}_t + u_t$ can be replaced by $\varepsilon_{\pi,t}$ to indicate a technology or cost shock. The component u_t is a cost-push shock that can be motivated, e.g., by adding a wage mark-up at the right-hand side of equation (14). Insertion of (32) and the cost shock in (29) finally gives the reaction of inflation to the output gap as

$$(33) \qquad \pi_{H,t} = \beta E_t \pi_{H,t+1} + \lambda\left(\frac{\sigma}{1+\alpha(2-\alpha)(\sigma\eta-1)} + \phi\right)\hat{y}_t + \lambda\tau_t + \varepsilon_{\pi,t} .$$

Although appealing as a theoretical benchmark, equation (33) has been contested on empirical grounds. The reason is the observed persistence of inflation rates (see Galí et al. 2001). There seems to be an important autoregressive component in price level changes. This inflation inertia is captured by the so-called hybrid Phillips curve, which is

$$\pi_{H,t} = \rho\beta E_t \pi_{H,t+1} + (1-\rho)\beta\pi_{H,t-1} + \lambda\hat{m}c_t ,$$

with $0 < \rho < 1$. Replacing the marginal cost component as above, we then obtain inflation in the price level of domestic goods as

$$\pi_{H,t} = \rho\beta E_t \pi_{H,t+1} + (1-\rho)\pi_{H,t-1} + \lambda\left(\frac{\sigma}{1+\alpha(2-\alpha)(\sigma\eta-1)} + \phi\right)\hat{y}_t + \lambda\tau_t + \varepsilon_{\pi,t}\,. \quad (34)$$

2.4 Fiscal policy

As a final component, we add the fiscal policy rule. The notion of fiscal rules appears in different connotations in the literature. Often it explicitly refers to legally enshrined limitations on fiscal policy discretion. Here, we refer to fiscal rules as a reaction function for the policy maker, analogously to rules in monetary policy. The fiscal policy rule is thus meant to guide the action of the fiscal authority.

The policy variable to be adjusted is a mark-up on the consumer tax. So, which are the arguments to guide the policy choice? With output and employment stabilization as an obvious goal, one should include the output gap. The variable tax component should be lowered in response to negative and raised in reaction to positive deviations of production from its potential level. The argument seems also justified on empirical grounds. Bohn (1998), for the U.S, and Ballabriga and Martinez-Mongay (2002), for the EU members, find evidence for an anti-cyclical reaction of fiscal deficits. Galí and Perotti (2003) conclude that the objective of output stabilization has gained importance in the EU countries' fiscal policies since 1992. Thereby, the anti-cyclical reaction comes not only from the automatic stabilizers, but it also extents to discretionary policy action.

A second point is whether the policy rule should also contain an inflation-stabilization objective. The principal objection is that the ECB policy target pins down the long-run national inflation rate. An additional national inflation target would only be a target for relative price level developments in the euro area. Fiscal policy should therefore content itself to output stabilization (Calmfors 2003). Additionally, a numerical target for the inflation level would deprive the government of its degree of freedom, as its action would then also depend on the central bank's target level and on the realisation of the latter.

One argument in favour of a national inflation target is that the welfare costs from inflation accrue irrespective to whether other countries are affected in a similar way or not. A second one relates to the real interest rate effect (e.g. Bofinger 2003). In our model, the nominal interest rate is exogenous. The real interest rate thus varies with expected changes in the price level. National inflation differentials then imply country differences in the real interest rate. In the above aggregate demand equation, lower real rates induce households to shift consumption from the future to the present. The result is an increasing output gap, which by itself positively affects current inflation. In the open economy this effect is at least partially compensated. Increasing expected inflation here leads to a decline in net exports, which negatively affects aggregate demand. However, for a certain combination of parameters the export effect seems too week to counter the real interest rate effect of inflation (see section 3).

In order not to preclude the relevance of the latter arguments, we specify the tax rule as

$$(35) \qquad \tau_t = \mu \hat{y}_t + \kappa \pi_{H,t} + \varepsilon_{\tau,t} ,$$

with $\mu > 0$, $\kappa \geq 0$, and with $\varepsilon_{\tau,t}$ as non-systematic variation in the tax component. The policy rule is fairly simple. Under temporary and randomly distributed shocks, it is also compatible with the sustainability of public finances. If government revenue is equal to government expenditure in equilibrium, the revenue from taxation will fall short of expenditures in recessions and exceed government spending in booms. The steady-state level of the variable tax component is zero, as is the average amount of extra VAT paid over the business cycle.

Beside this compatibility, the solvency requirement may also suggest to consider the overall level of debt relative to GDP as a third element in the tax rule (35). A high level of debt should then lead to tax increases in order to collect additional revenue. However, debt stabilisation can also be achieved by adapting other sources of government income. An option is to adjust lump-sum taxes, as in Perez and Hiebert (2002), instead of charging the variable VAT component with a double objective.

Finally, research on monetary policy has proposed some modifications on reaction function such as equation (35). These extensions include interest rate or tax smoothing, the use of lagged or of expected values for the output gap and inflation, and the replacement of the output gap by GDP growth (see Schmitt-Grohe and Uribe 2003). Such modifications may be considered such modifications in subsequent work. To keep the focus on our key question, they are however excluded for the time being.

3. The impact of inflation: expansionary or contracting?

We have already mentioned in section 2.4 that the qualitative impact of expected inflation on the output path depends on the model calibration. To see this, consider the effect of inflation in the unregulated system, i.e. in a situation without policy reaction. An expected increase in the price level lowers the real interest rate, which has an expansionary effect. But above-average national inflation rates do, on the one hand, also reduce net exports. Whether the latter can neutralize the expansionary impact of the real interest rate effect depends on the degree of economic openness, on the inter-temporal elasticity of substitution and on the elasticity of substitution between domestic and foreign commodities. The output-gap equation (23) illustrates the argument. Without the tax variable, it can be re-formulated as

$$\hat{y}_t = E_t \hat{y}_{t+1} + E_t \pi_{H,t+1} \frac{C}{Y}\left(\frac{(1-\alpha)^2}{\sigma} - \eta\alpha[2-\alpha]\right) - \frac{C}{Y}\frac{1-\alpha}{\sigma}(i_t - \bar{r}) .$$

For inflation to have a contracting impact on the output gap, price level increases should dampen aggregate demand. The latter requires the term in brackets to become negative. This is equivalent to

$$\eta\alpha(2-\alpha) > \frac{(1-\alpha)^2}{\sigma} \quad ,$$

which gives

$$\alpha^2 - 2\alpha + \frac{1}{1+\eta\sigma} > 0 .$$

As $0 < \alpha < 1$, the relevant solution is

$$\alpha > 1 - \left(\frac{\eta\sigma}{1+\eta\sigma}\right)^{\frac{1}{2}} .$$

For common parameter choices, $\eta = 0.5$ and $\sigma = 1$, this implies $\alpha > 0.42$. Thus, for a steady-state degree of economic openness smaller 0.42, the expansionary real interest rate effect prevails, whereas in a more open country the dampening impact on net exports dominates the dynamics.

4. Simulation results

The following section presents initial results from model simulations with the tax rule (35) in the context of the above model, consisting of equations (27), (28) and (33). In order to simulate impulse responses, the equations have to be calibrated. Table 1 contains the parameter values assigned. For the smaller EMU countries, the overall share of consumption in GDP and the ratio of exports to GDP are both about 0.55 (European Commission 2003).[1]

Together with the above demand specification, which assumes that only consumption goods are traded, it follows that $\alpha(G/Y)$ is roughly 0.30, and $(1-\alpha)(G/Y)$ is about 0.25. Common choices for σ are 1 (Clarida et al. 2000) or 2. The elasticity of substitution between exports and imports, η, is the weighted average for the EMU countries in Fagan et al. (2001). For the impact of marginal cost fluctuations on inflation and for inflation persistence, we follow the Euro area estimates of Galí et al. (2001). The nominal interest rate is set exogenously at $i_t = \bar{r}$.

C/Y	α	σ	η	β	λ	ρ	ϕ	μ	κ
0.55	0.55	1.00	0.50	0.99	0.09	0.70	1.00	0.10; 1.0; 2.0	0.00

Table 1: Model calibration

As indicated above, this section limits itself to impulse responses from the purely forward-looking model, i.e. to a model without inflation or output-gap persistence. We present results from two different simulation scenarios. The first one considers impulse responses to a persistent unit demand shock, with an AR (1) coefficient in the shock of 0.95. The second simulation looks at the system's behaviour after a persistent unit supply shock, with an AR (1) coefficient of 0.95. The simulations are deterministic ones. We investigate the path towards the steady state after the economy has been hit by the unit shock in period one. The paths of the variables are given in percentage-point deviations from their respective equilibrium or flexible-price levels. Each period corresponds to a quarter of a year.

We are interested in investigating the stabilizing potential of the consumer-tax rule. To this aim, and as a first step, we consider the policy implications and the system dynamics under different sensitivities of the policy instrument to the output gap. More precisely, given the rule $\tau_t = \mu\hat{y}_t + \kappa\pi_{H,t} + \varepsilon_{\tau,t}$, we compare the impulse responses for $\kappa = 0$ and $\mu = 0.1; 1.0; 2.0$. Equations (27) and (28) together with the policy rule suggest that the stabilization becomes more difficult the higher the persistence of shocks. The reason is that for the consumption tax to bring about shifts in the inter-temporal allocation of consumption expenditure what matters

[1] These are non-weighted average values for Austria, Belgium, Greece, Finland, Ireland, the Netherlands and Portugal.

is the difference between the actual and the expected future tax rate. Focusing on the situation of high shock persistence, the simulation thus considers something like a worst-case scenario for the discussed stabilization tool.

Although discussing monetary policy at the country level is counterfactual in the context of a monetary union or a fixed exchange rate regime, we finally look at the stabilizing potential of monetary policy following an equivalent monetary policy rule. As the transmission of monetary policy differs from the one of distortionary taxation in our model, this comparison is a very informal one. It only aims at giving some qualitative indications as to whether there are marked differences between the stabilizing potential of fiscal and monetary policy under the above economic structure. Additionally, the annex contains the impulse responses for the unregulated system. They show that the implementation of the fiscal rule makes a difference compared to the unregulated system, at least if the sensitivity of taxation to the output gap in the former is sufficiently high.

Given our model calibration, the system has three eigenvalues larger than one in modulus for three forward-looking variables in all of the below simulations. The conditions for the stability of the system and the uniqueness of the equilibrium in the neighbourhood of the steady state are thus met (see Blanchard and Kahn 1980, Juillard 1999).

Figure 1 plots the reaction, under different sensitivities of taxation to the output gap, to a persistent unit aggregate demand shock in period one. It shows that increasing consumer taxation in response to the shock can actually reduce the deviation of output from its steady-state level. It affects the size of the output gap. The time that it takes to return to equilibrium is not shortened, however. The impact on inflation is only marginal. The reason is that there are two opposite effects at work. Raising the tax rate dampens the output gap and thus reduces inflationary pressure. But, on the other hand, the tax also reduces nominal wages and therefore enters the Phillips curve (33) in a direct way. The main difference between fiscal and monetary policy is thus that the consumer tax affects aggregate demand and labour supply, whereas the latter is limited to the effect on aggregate demand.

*** Figure 1 ***

The reaction to the unit demand shock under a monetary policy rule, where the sensitivity of the nominal interest rate to the output gap is taken as in the above taxation rule, is reported in figure 2. The pictures reveal a somewhat stronger dampening effect on the output gap. Contrary to the tax rule, the increase in the interest rate also leads to a pronounced decline in inflation. Finally, the implied variation of the policy instrument, the deviation of the nominal from the equilibrium real interest rate, is lower than in the fiscal policy case. A potential advantage of the variable VAT component however is that it does not face a zero lower-bound constraint.

*** Figure 2 ***

The next two figures display the impulse responses to the persistent unit aggregate supply or cost-push shock. In this event, monetary policy faces a trade-off between output stabilization and inflation. For fiscal policy this trade-off is less pronounced, however. One the one hand side, lowering the consumer tax helps to narrow the output gap, whereas the resulting increase in inflation, one the other hand, is rather small. Again, the reason is that the tax has two opposite effects on price level changes. It enters the Phillips curve indirectly, via the output gap, as well as directly, because it reduces the real wage.

*** Figure 3 ***

For monetary policy the output-inflation trade-off is obvious. Lowering interest rates, on the one hand, narrows the output gap. The effect is stronger than in then fiscal policy case. But, on the other hand, the increase in inflation following the cost-push shock becomes more pronounced under an output-oriented policy rule. As for the demand shock above, the variation in the policy instrument is stronger under the fiscal rule. Note, however, that with an output sensitivity of monetary policy as high as in our example the zero lower-bound constraint may be binding.

*** Figure 4 ***

A time varying component in consumer taxation may, in sum, contribute to smooth fluctuations in output that are driven by persistent demand or cost shocks. The narrowing of the output gap that can be achieved is somewhat smaller than for a monetary policy that operates with an equivalent output sensitivity of interest rate choices. The variation of the tax component thus needs to be stronger to achieve a similar degree of output stabilization. Inflation, on the other hand, is almost insensitive to temporary changes in the VAT. Given an aggregate demand shock, fiscal policy therefore fails to achieve the same amount of output and inflation stabilization as monetary policy. In the event of a cost-push shock, on the other hand, the fiscal rule is less exposed to the trade-off between output and inflation stabilization.

5. Conclusions

The present paper investigated the potential of fiscal policy for macroeconomic stabilization. To this aim, we modified the small open-economy specification of Clarida et al. (2001), and Galí and Monacelli (1999) in order to include a time-varying tax rate on consumption. This adjustable tax rate has then been taken as the fiscal policy tool.

We calibrated the model with what seem to be plausible parameter values for small euro area countries. The simulation exercise then compared impulse responses for fiscal rules with different sensitivities to the output gap. To this aim, we have focused on the situations of persistent aggregate demand and aggregate supply shocks. Impulse responses for monetary policy under an interest rate rule with equivalent output sensitivity were presented in order to make some informal comparison between the stabilizing potential of consumer tax and interest rate variations.

The preliminary results suggest that time-varying consumer taxation may contribute to smooth macroeconomic fluctuations. Nevertheless, the stabilizing potential of monetary policy with respect to output and inflation seems to outperform fiscal policy rule in the event of persistent aggregate demand shocks. With adverse supply shocks, our fiscal policy rule however experiences less of a trade-off between output and inflation. In both scenarios, variations in the fiscal policy tool need to be stronger to bring about an equivalent degree of output stabilization than monetary policy.

From the perspective of stabilizing macroeconomic fluctuations, the variable VAT component may thus be considered as an imperfect substitute for the loss of monetary policy at the national level. At this stage the result is only of tentative nature, however. The weaknesses and potential merits of taxation-based stabilization shall be investigated further in subsequent work. To this aim, a quantitative, loss-function based evaluation should be added. Furthermore, one should consider the case of large open economies in a monetary union, e.g. along the lines of Beetsma and Jensen (2002, 2004). In addition, the analysis could also be extended to direct taxation.

References:

Ballabriga, Fernando, Carlos Martinez-Mongay (2003): Has EMU shifted policy?, Economic Papers 166, European Commission

Beetsma, Roel, and Henrik Jensen (2002): Monetary and fiscal policy interactions in a micro-founded model of a monetary union, ECB working paper 166

Beetsma, Roel, and Henrik Jensen (2004): “Mark-up fluctuations and fiscal policy stabilization in a monetary union”, Journal of Macroeconomics 66, 357-376

Blanchard, Olivier, and Charles Kahn (1980): “The Solution of Linear Difference Models under Rational Expectations”, Econometrica 48, 1305-1311

Bofinger, Peter (2003): “The Stability and Growth Pact Neglects the Policy Mix between Fiscal and Monetary Policy”, Intereconomics 38 (1), 4-7

Bohn, Henning (1998): “The Behavior of U.S. Public Debt and Deficits”, Quarterly Journal of Economics 113 (3), 950-963

Buti, Marco, and Paul Van den Noord (2003): What is the impact of tax and welfare reforms on fiscal stabilizers? A simple model and an application to EMU, European Economy 187

Calmfors, Lars (2003): "Fiscal policy to stabilize the domestic economy in the EMU: What can we learn from monetary policy?", CESifo Economic Studies 49 (3), 319-353

Clarida, Richard, Jordi Galí, and Mark Gertler (1999): “The science of monetary policy: A New Keynesian perspective”, Journal of Economic Literature 37 (4), 1661-1707

Clarida, Richard, Jordi Galí, and Mark Gertler (2001): "Optimal monetary policy in open vs. closed economies: An integrated approach", American Economic Review 91 (2), 248-252

Clarida, Richard, Jordi Galí, and Mark Gertler (2000): "Monetary policy rules and macroeconomic stability: Evidence and some theory", Quarterly Journal of Economics 105 (1), 147-180

European Commission (2003): European Economy - Statistical Annex, Bruxelles

Fagan, Gabriel, Jerome Henry, and Ricardo Mestre (2001): An area-wide model for the euro area, ECB working paper 42

Galí, Jordi (2003): “New Perspectives on Monetary Policy, Inflation, and the Business Cycle”, in: Mathias Dewatripont, Lars Hansen, and Stephen Turnovsky (eds.): Advances in Economics and Econometrics, Vol. 3, Cambridge: Cambridge University Press, 151-197

Galí, Jordi, and Roberto Perotti (2003): "Fiscal policy and monetary integration in Europe", Economic Policy 37 (3), 535-572

Galí, Jordi, and Tommaso Monacelli (2002): Monetary policy and exchange rate volatility in a small open economy, NBER working paper 8905

Galí, Jordi, Mark Gertler, and David Lopez-Salido (2001): "European inflation dynamics", European Economic Review 45, 1237-1270

Juillard, Michel (1999): “The Dynamic Analysis of Forward-Looking Models”, in: Andrew Hughes Hallett and Peter McAdam (eds.): Analyses in Macroeconomic Modelling, Boston: Kluwer, 207-224

McCallum, Bennett, and Edward Nelson (1997): An optimizing IS-LM specification for monetary policy and business cycle analysis, NBER working paper 5875

Mountford, Andrew, and Harald Uhlig (2002): What are the effects of fiscal policy shocks?, CEPR discussion paper 3338

Perez, Javier, and Paul Hiebert (2002): Identifying endogenous fiscal policy rules for macroeconomic models, ECB working paper 156

Schmitt-Grohe, Stephanie, and Martín Uribe (2003): Optimal simple and implementable monetary and fiscal rules, mimeo

Taylor, John (2001): "Reassessing discretionary fiscal policy", Journal of Economic Perspectives 14 (3), 21-36

Taylor, John (1993): "Discretion versus policy rules in practice”, Carnegie-Rochester Conference Series on Public Policy 39, 195-214

Wijkander, Hans, and Werner Roeger (2002): "Fiscal policy in EMU: The stabilization aspect", in: Marco Buti, Juergen von Hagen, and Carlos Martinez-Mongay: The Behaviour of Fiscal Authorities, Basingstoke, 149-166

Wyplosz, Charles (2001): Fiscal policy: Institutions and rules, mimeo

Annex:

Impulse responses in the unregulated system

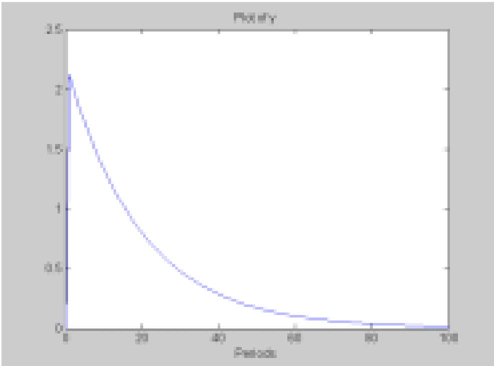
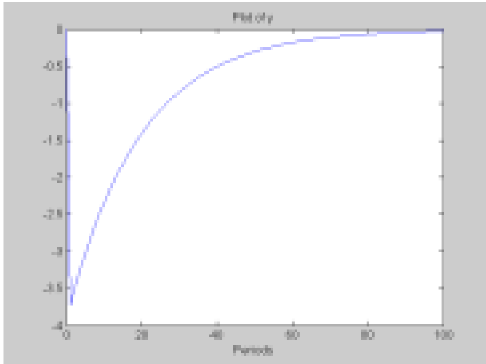
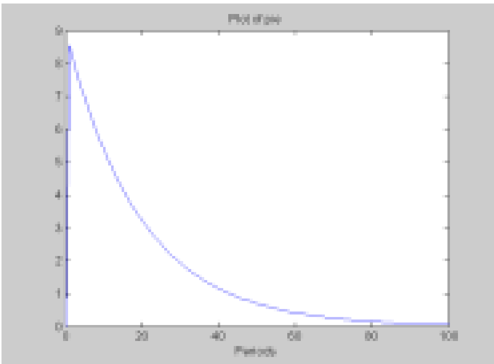
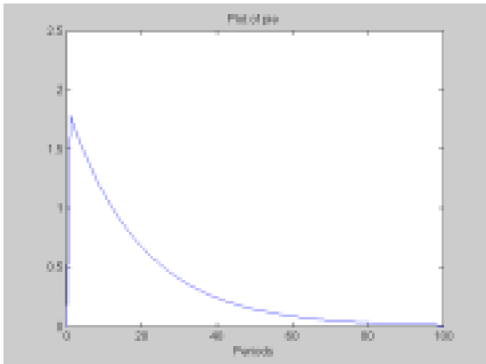
<table>
<tr><th></th><th>Unit AD shock, AR (1) = 0.95</th><th>Unit AS shock, AR (1) = 0.95</th></tr>
<tr><td>$\hat{y}$</td><td></td><td></td></tr>
<tr><td>π_H</td><td></td><td></td></tr>
</table>

Figure 1: Unit AD shock, AR (1) = 0.95, rule with output component only

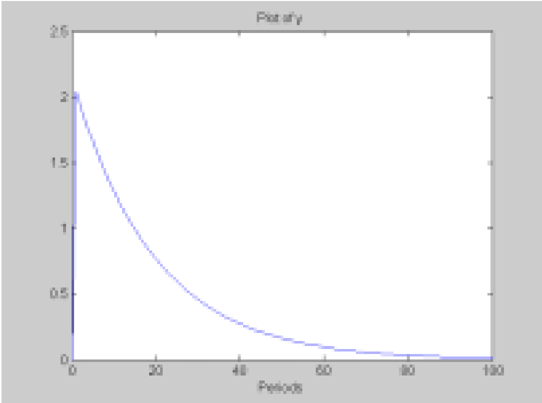
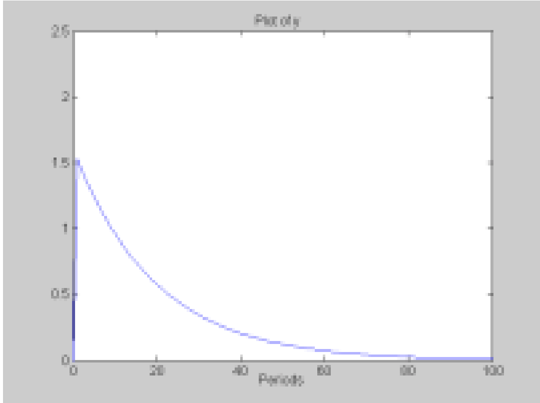
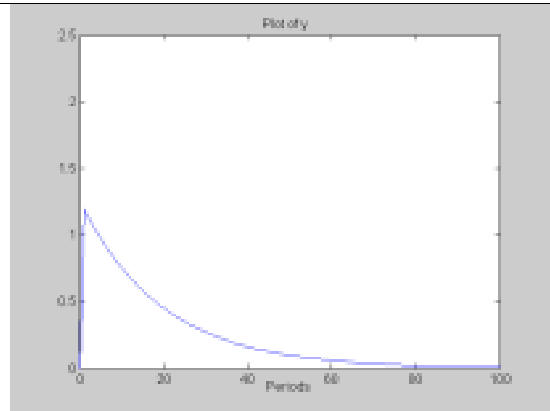
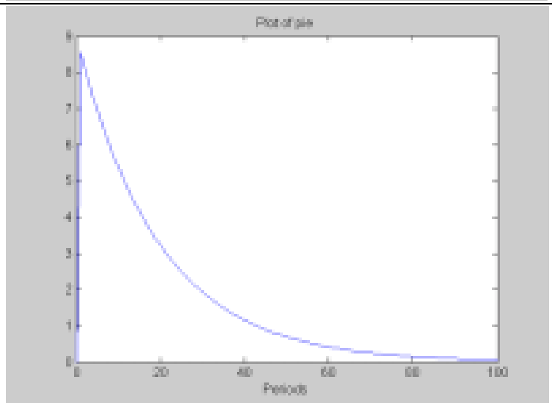
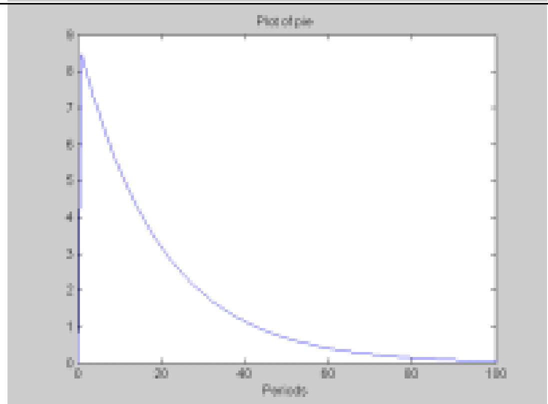
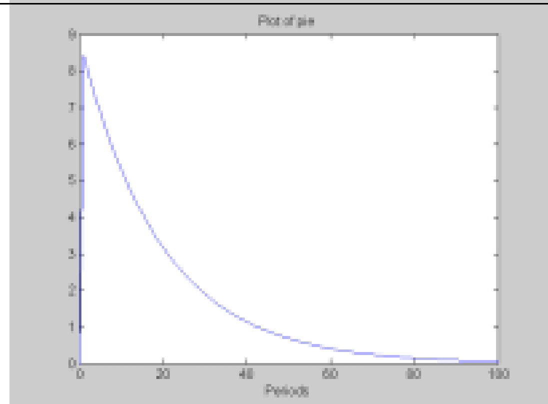
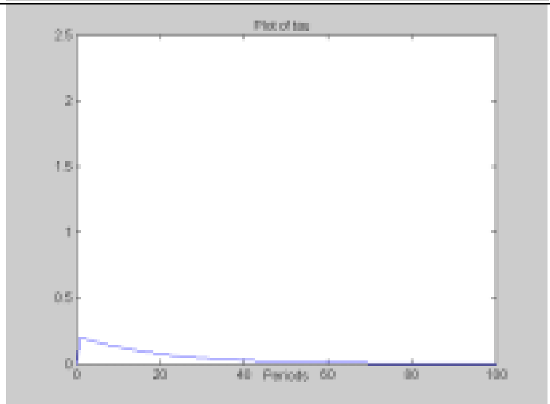
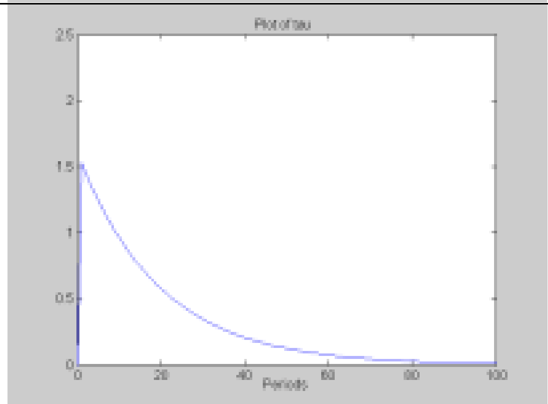
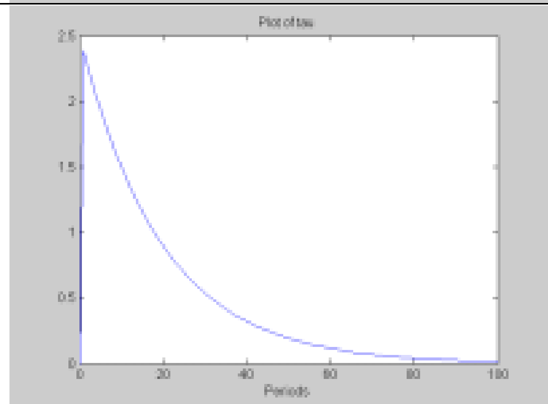
	0.1	1.0	2.0
$\hat{y}$			
π_H			
τ			

Figure 2: Unit AD shock, AR (1) = 0.95, interest rate rule with output component only

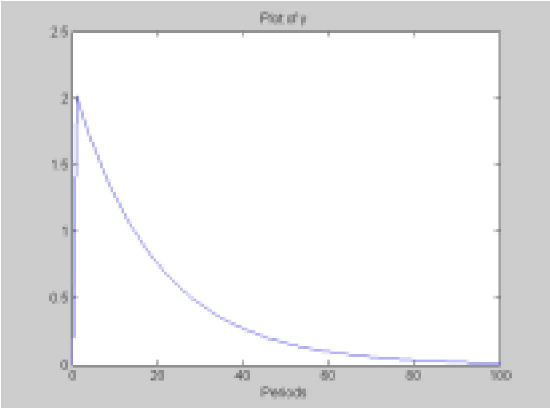
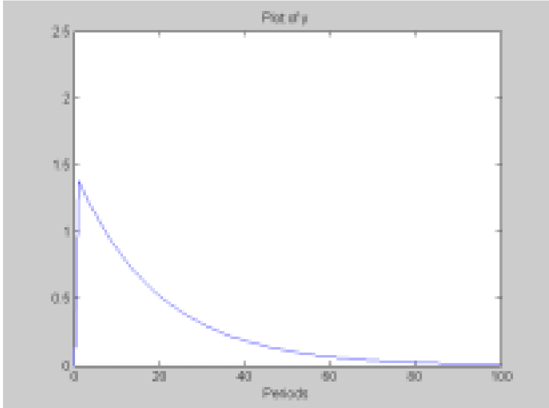
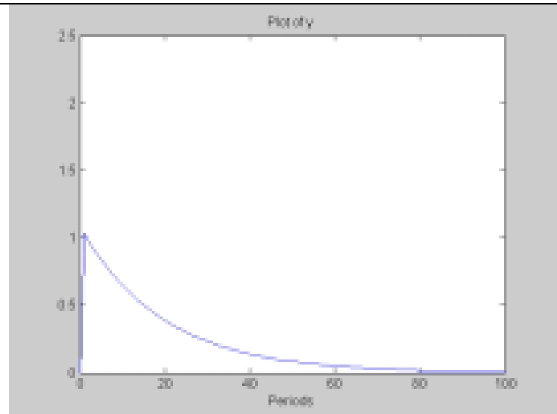
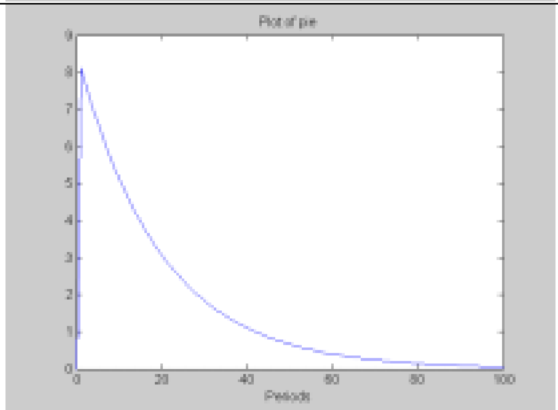
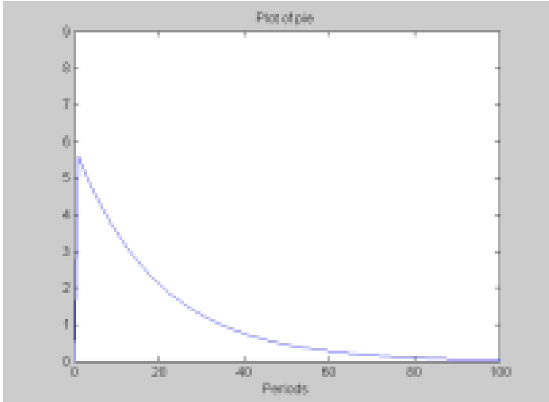
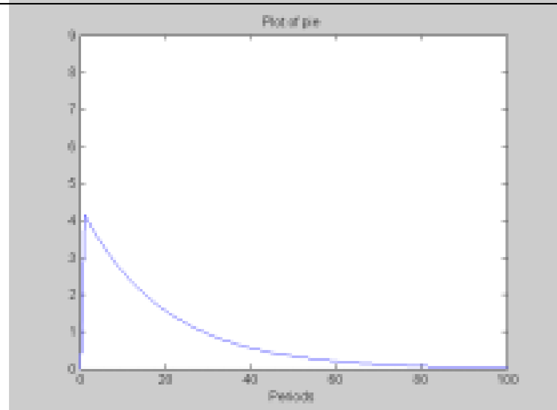
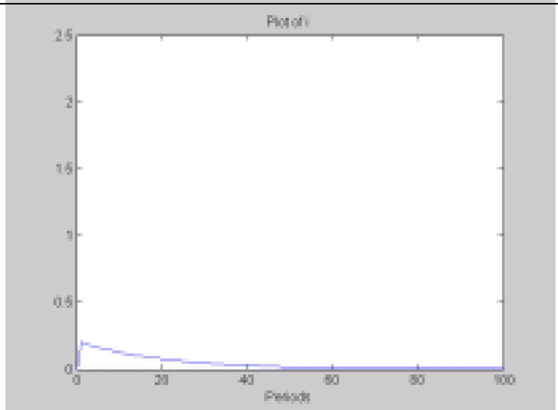
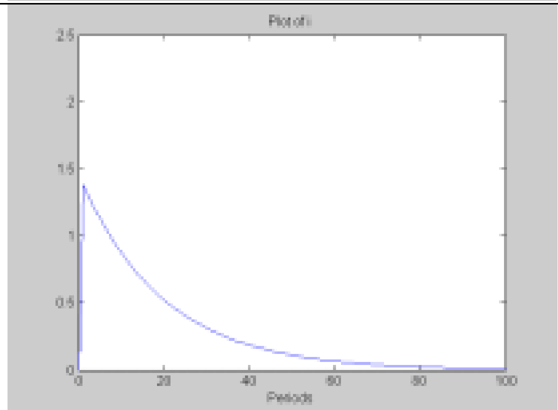
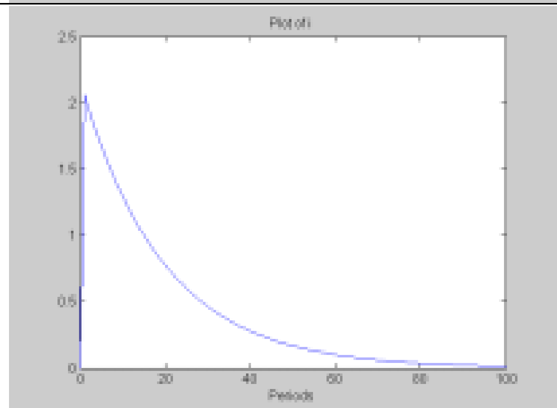
	0.1	1.0	2.0
$\hat{y}$			
π_H			
$i-\bar{r}$			

Figure 3: Unit AS shock, AR (1) = 0.95, rule with output component only

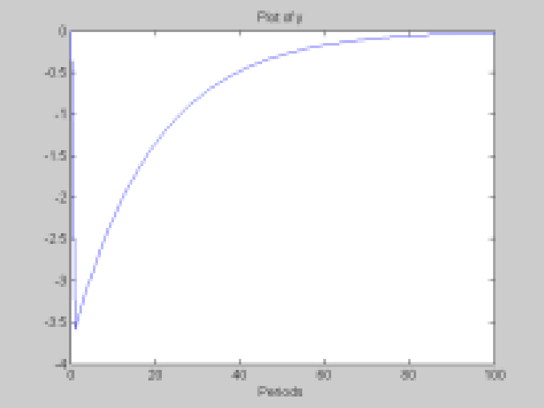
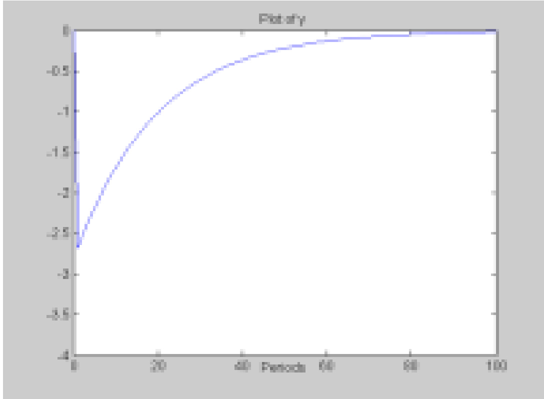
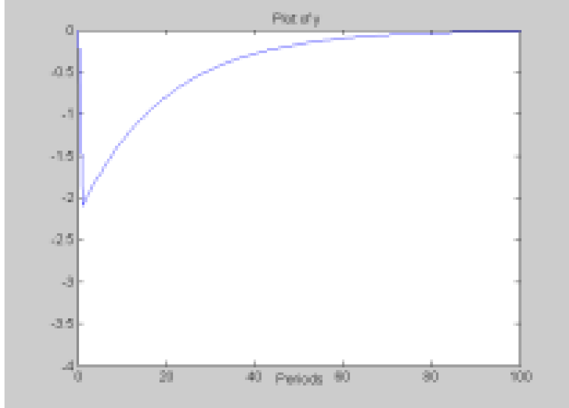
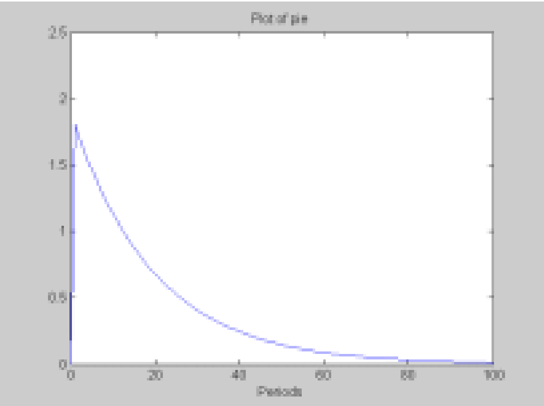
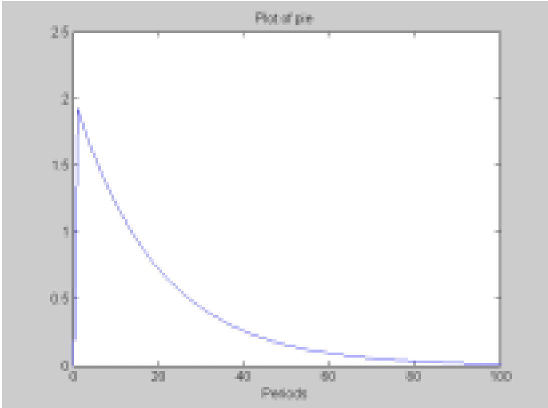
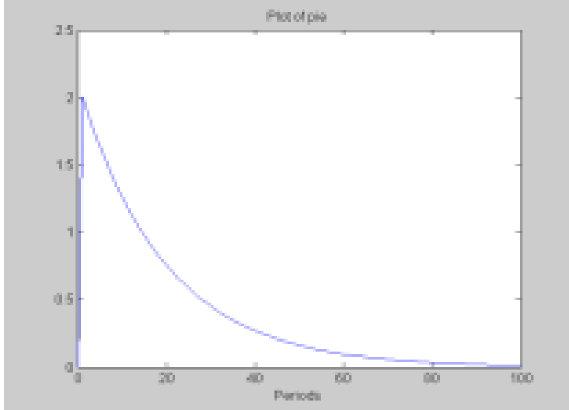
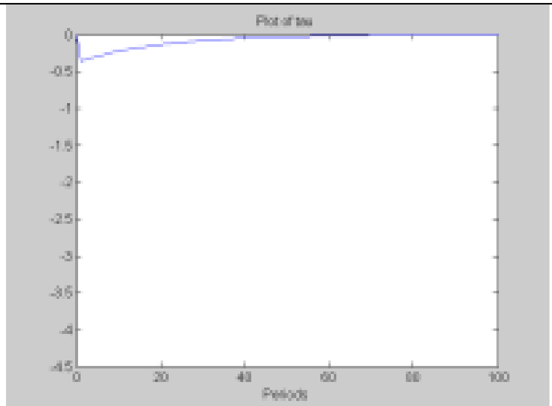
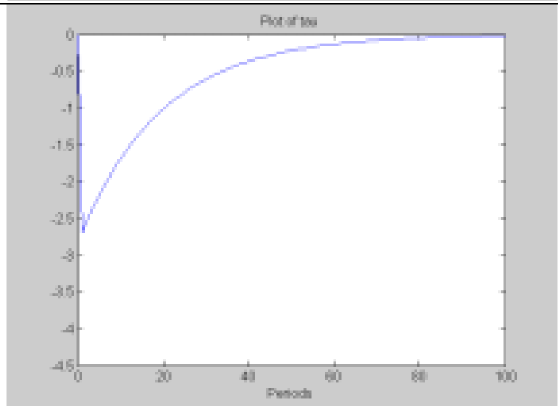
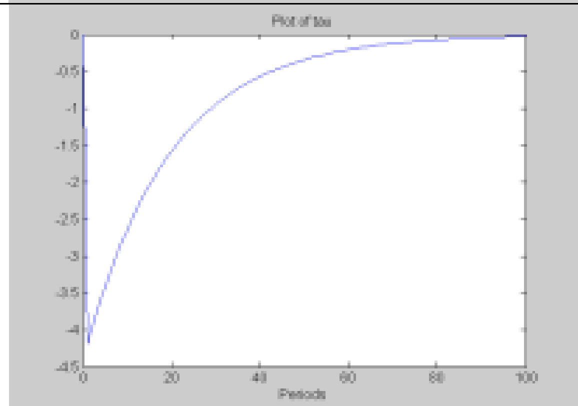
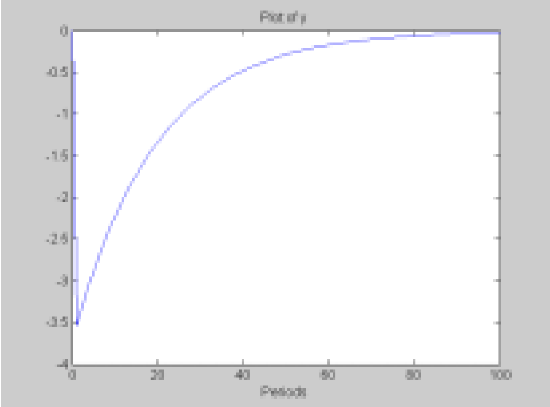
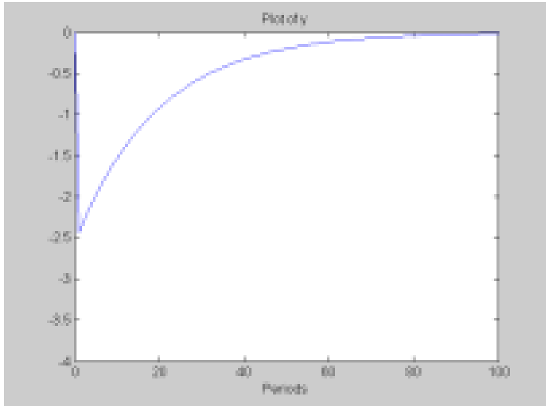
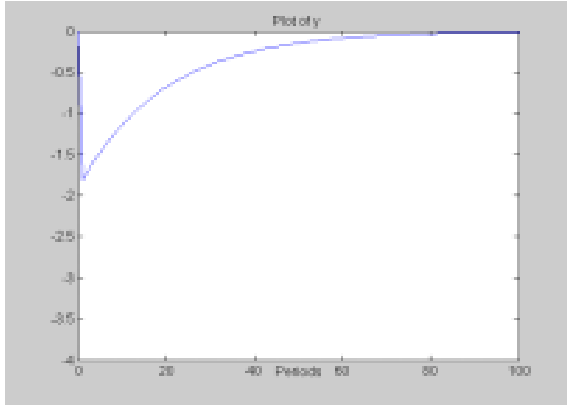
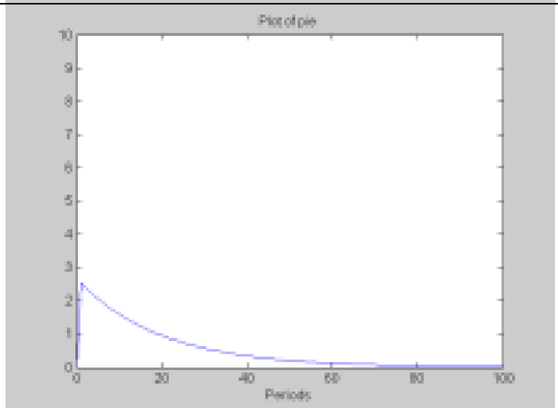
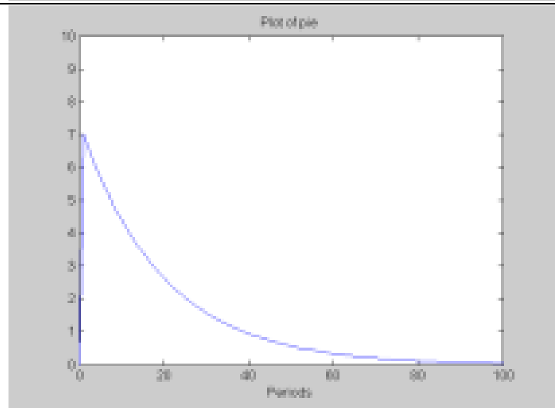
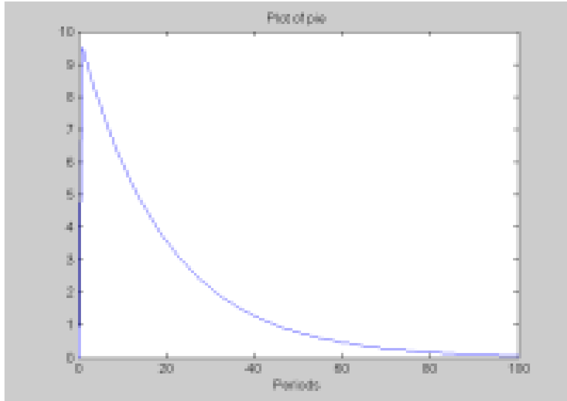
	0.1	1.0	2.0
$\hat{y}$			
π_H			
τ			

Figure 4: Unit AS shock, AR (1) = 0.95, interest rate rule with output component only

	0.1	1.0	2.0
$\hat{y}$			
π_H			
$i - \bar{r}$