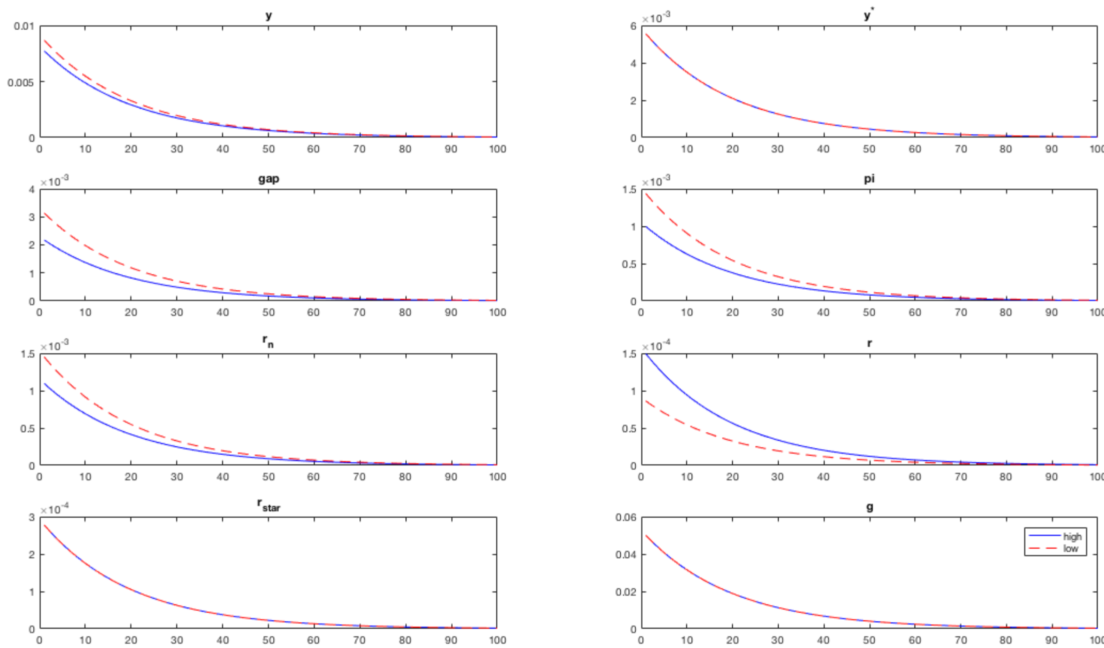
# Computational Part

## Fiscal shocks

Figure 1 shows the evolution of the economy after a fiscal shock of the same magnitude (5%) under two parametrizations: $\phi_\pi = 1.1$ (high) and $\phi_\pi = 1.01$ (low). As pointed out in the previous point of the problem set (handwritten on paper) when there is a fiscal shock we can see from the equations of $\hat{r}^*_{t+1}$ and $\hat{y}^*_t$ that the increase in $\hat{g}_t$ directly increases the output under flexible prices and the natural interest rate (the coefficient is positive under our parametrization, as explained in the previous point). Note that as the fiscal shock follows an AR(1) process, the difference between today's spending and tomorrow's is positive, therefore the second term on the RHS of the IS equation is positive and drives up $\hat{y}_t$. Note that output goes up more than natural output because the coefficient of the shock is higher. This drives up the output gap. As output gap positively enters into the AS equation, inflation goes up too. Then the central bank responds by raising the nominal interest rate $\hat{r}^n_t$, which in turn raises directly $\hat{r}_{t+1}$ being the latter the difference between the nominal rate and expected inflation. As $\hat{r}_{t+1}$ goes up, the positive effect of the fiscal shock is attenuated by the last term in IS. This in turn lowers inflation and, as people know that this effect will prevail in the long run to drive the system again to the steady state expected inflation goes down too, helping the cooling down of the economy through its relation with nominal and real interest rate and monetary policy. As the fiscal shock attenuates following its natural AR decaying process and the expansive effect is cooled down through the mechanism described above, all the variables return to the steady state. Finally, note the difference between the two parametrizations of $\phi$: when $\phi$ is high, the response of the central bank through nominal rates when inflation goes up at the beginning is stronger (i.e. $\widehat{r}^n_t$ increases more) the real interest rate increases more and this immediately compensate the expansionary effect of the spending shock as it cools down output, output gap, inflation. $\hat{r}^*_{t+1}$ and $\hat{y}^*_t$ are not affected by that as $\phi$ does not enter their equations. The difference between these two parametrizations is clearly visible from the pictures, as the IRF when $\phi$ is high is below the response when $\phi$ is low for output, output gap, inflation and nominal rate and is above for the real interest rate.

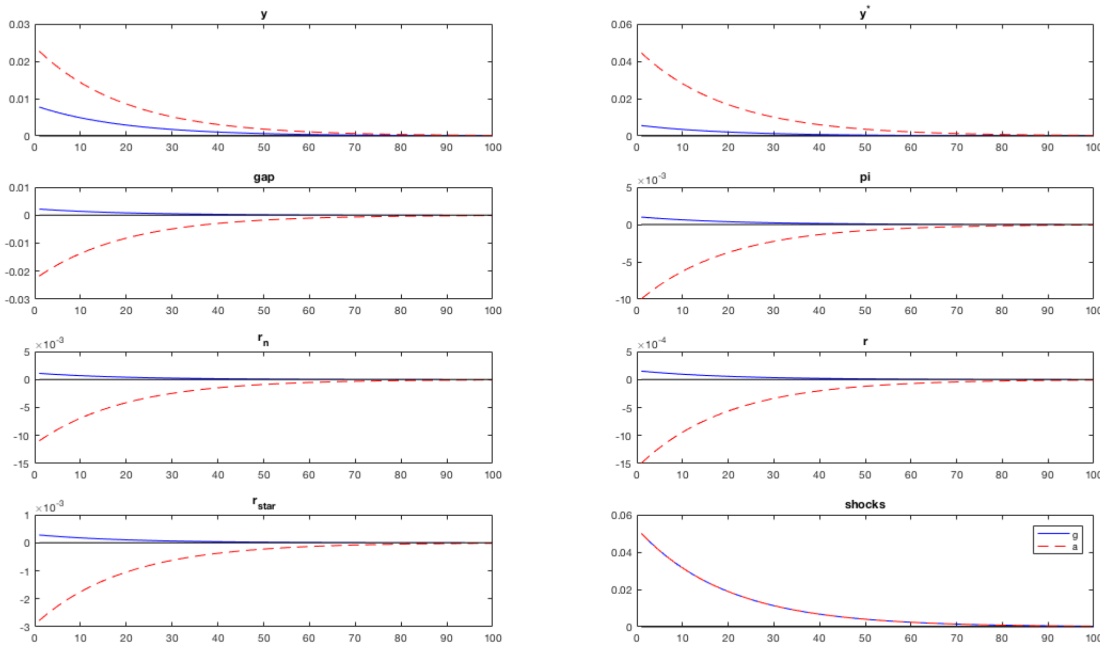
Figure 1: IRFs to Fiscal Shock $\varepsilon_{gt}$, with $\phi_\pi = 1.1$ (high) and $\phi_\pi = 1.01$ (low)




## Productivity shock

Figure 2 compares the effects of a productivity shock to the ones that follow an expansionary fiscal policy shock. The effects are quite different between the two cases: with the productivity shock output gap is negative, output and natural output increase more, inflation and all the interest rates go down. The mechanism that follows a productivity shock is the following: natural output increases as positively depends on the productivity shock. The natural rate of interest instead depends on the difference between productivity tomorrow and today: as the shock follows an AR process this difference is negative and therefore the rate goes down. We know that productivity positively affects $\hat{y}_t$ from the combination of equations 20, 21 and 18. However, the effect on output is lower than that on the natural output as its coefficient for productivity shock is lower because the mark up goes up and not all firms can immediately adjust the price hence real salaries go down, labor supply goes down and this decreases the positive effect on output. Hence output gap falls and inflation falls too. In turn the cental bank lowers the nominal rates and this induces the real rates to go down. As the economy proceeds, firms will try to readjust the prices and this will drive up inflation, so that the economy gradually returns to the steady state as higher real interest rate will depress the positive effect on output and the AR process of the shock will vanish. Note the main difference between productivity and fiscal shock: while the former is a "supply" shock as it has direct effect on firms' production function, mark-up and labor market, the latter is a "demand" shock that only operates through the resource constraint. As it is clear these two shocks have completely different consequences: while the economy boosts with a fiscal shock, because there are no market frictions that attenuate the positive effects of the increased government expenditures, with a productivity shock in this case we get a way less expansionary outcome because of the distortions in the supply side.

Figure 2: IRFs to a Productivity Shock $\varepsilon_{at}$, and Fiscal Shock $\varepsilon_{gt}$, with $\phi_\pi = 1.1$




## Dynare Code

```
var y y_star y_tilda pi rn r r_star g a;
varexo ea eg;
parameters share_g lambda kappa phi beta theta phi_pi rhoa rhog;
share_g = 0.2; phi = 1; beta = 0.99; theta = 0.9; phi_pi =1.1; %phi_pi=1.01
kappa = phi+(1-share_g)^(-1); lambda = (1-theta)*(1-beta*theta)/theta;
rhoa = 0.95; rhog = 0.95;
model;
y = y(+1)+share_g*(g-g(+1))-(1-share_g)*r(+1);
r = rn-pi(+1);
y_star = (1+phi)*(kappa)^(-1)*a + share_g*(1-share_g)^(-1)*(kappa)^(-1)*g;
r_star = (1-share_g)^(-1)*(kappa)^(-1)*(1+phi)*(a(+1)-a)-
-share_g*(1-share_g)^(-1)*(1-(1-share_g)^(-1)*(kappa)^(-1))*(g(+1)-g);
pi = lambda*kappa*y_tilda+beta*pi(+1);
y_tilda = y-y_star;
rn = phi_pi*pi;
a = rhoa*a(-1)+ea;
g = rhog*g(-1)+eg;
end;
initval;
y = 0;  y_star = 0;  y_tilda = 0;  pi = 0; rn = 0; r = 0; r_star = 0; end;
shocks;
var eg=0.05^2; %ea=0.05^2
```

```
end;
steady;
stoch_simul(irf=100,order=1);
```