Chapter 7

Fiscal and Monetary Theories of the Price Level

How do monetary and fiscal policies affect price level determination? We have left this question in the background up to now. It is time to tackle it. We consider a simple economy with MIU, exogenous output and possibility for the government to finance its expenditures through either seigniorage, taxation or issuance of nominal debt.

7.1 A basic model

7.1.1 Households

The household sector is conventional. Households choose $\{C_t, M_t, B_t\}$:

$$\max_{c_t, M_t/P_t} E_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{c_t^{1-\sigma}}{1-\sigma} + \frac{m_t^{1-\eta}}{1-\eta} \right]$$
$$\text{s.t. } c_t + \frac{M_t}{P_t} + \frac{B_t}{P_t} + T_t = I_{t-1} \frac{B_{t-1}}{P_t} + Y + \frac{M_{t-1}}{P_t}$$

where now T_t denotes taxes (minus transfers) that the government raises from households.

The government is issuing a nominal bond B_t costing 1\$ and paying in $t+1$ a nominal interest rate of I_t\$.

In equilibrium since only households consume it will be the case that consumption will equal exogenous output Y minus government expenditure G. If Y and G are fixed, the marginal utilities of consumption today and tomorrow will be equal, therefore the household optimality conditions will be:

$$1 = \beta I_t \frac{P_t}{P_{t+1}} \tag{1}$$
$$Y^{-\sigma} = \left(\frac{M_t}{P_t}\right)^{-\eta} + \beta Y^{-\sigma} \frac{P_t}{P_{t+1}}$$

Combining the two equations above yields the usual money demand equation:

$$\frac{M_t}{P_t} = Y^{\frac{\sigma}{\eta}} \left(\frac{I_t - 1}{I_t}\right)^{-\frac{1}{\eta}} \tag{2}$$

7.1.2 Government

We begin with the government flow of funds. This flow of funds can be written as:

$$T_t + \frac{M_t}{P_t} + \frac{B_t}{P_t} = G + I_{t-1}\frac{B_{t-1}}{P_t} + \frac{M_{t-1}}{P_t} \tag{3}$$

7.1.3 Equilibrium

Goods market clearing implies that in equilibrium, by Walras' law, we only need to consider either the household or the government flows of funds. We choose to pick the latter.

Remark 11 *We see immediately a problem. Equations 1 to 3 involve three equations in the 5 unknowns P I M B T. This implies that we cannot specify independent paths for money supply M, government debt B and primary surplus T if we want to study a unique equilibrium. Precisely, an equilibrium exists only for a restricted set of $\{M, B, T\}$ processes. This is the sense in which we must think of policy coordination.*

If the government chooses a time path for T_t and M_t (or B_t, anyways 2 out of the 3), then equations (1) to (3) give equilibrium values for P, B and I, provided that $\beta^t M_t/P_t$ and $\beta^t B_t/P_t$ approach zero as time reaches infinity. Notice that goods market clearing already implies $B^g + B^h = 0$, $M^s = M^d$ and $Y = c + G - T$.

7.2 Price level determination without government debt ($B = 0$)

The case without government debt corresponds to what one would call a monetarist regime. Consider first the case in which there is no government debt at all, $B = 0$. In this case equations (1) to (3) simplify further since we can close the model simply by specifying a path for either T_t or M_t. The important lesson we learn is that in any case inflation is always and everywhere a monetary phenomenon.

1. MONEY SUPPLY RULE

Typically, we assume an exogenous stochastic process for money supply. In this case, the linearized versions of (1) to (3) will be:

$$\frac{M_t - M_{t-1}}{P_t} + T_t = 0$$

the log-linear equilibrium will be[1]

$$\begin{aligned} m_t - m_{t-1} &= \theta_t - \pi_t && \text{(a)} \\ I_t &= \pi_{t+1} && \text{(b)} \\ m_t &= -\frac{\eta^{-1}}{I-1} I_t && \text{(c)} \end{aligned}$$

do we have a unique determinate REE? The answer is yes. Consider perfect foresight, $\theta = 0$. Solve this system for π_t to obtain

$$\pi_t\left(1 + \frac{I-1}{\eta}\right) = \pi_{t+1}$$

If $\left|1 + \frac{I-1}{\eta}\right| > 1$, the price level is determinate.

2. INTEREST RATE RULE A-LA TAYLOR

In this case money supply becomes endogenous. Assume central bank adjust money supply so as to ensure that

$$I_t = \alpha\pi_t \tag{a}$$

[1] From $\frac{M_t}{P_t} = Y^{\frac{\sigma}{\eta}}\left(\frac{I_t-1}{I_t}\right)^{-\frac{1}{\eta}}$
$\ln m_t = -\frac{1}{\eta}\ln\left(1 - \frac{1}{I_t}\right)$
$\widehat{m_t} = -\frac{1}{\eta}\frac{\beta}{1-\beta}\widehat{I}_t$, using $\beta = I^{-1}$

combine this with the Fisher equation

$$I_t = \pi_{t+1} \tag{b}$$

(c) is irrelevant since it dictates only endogenous money supply. Solve for π_t to obtain

$$\alpha\pi_t = \pi_{t+1}$$

hence we have a unique REE only if $|\alpha| > 1$.

3. INTEREST RATE PEG

This case is trivial. This is like 2 but with $\alpha = 0$. In this case we have only an equation in which the price level appears as an expectational error

$$P_t = P_{t+1}$$

hence any expectation of the price level will be self-fulfilling. The price level only appears in the form on an expected rate of change, therefore it is indeterminate. Intuitively, if all agents expect prices to be permanently higher, current prices will be higher as well. The central bank will increase money supply so as to leave the interest rate unchanged, so the real variables will be determinate, but the nominal variable P_t will not. Intuitively, the price level is indeterminate if central bank does not care about nominal variables.

4. PRICE LEVEL TARGETING

Rewrite the two equations

$$\begin{aligned} I_t &= \alpha P_t \\ I_t &= P_t + P_{t+1} \end{aligned}$$

determinacy obtains iff $\alpha > 0$

5. ADDING NOMINAL RIGIDITIES

Nominal rigidities solve the problem of nominal indeterminacy since under nominal rigidities yesterday's price level provides the economy with a nominal anchor. For instance, in our model with nominal rigidities:

$$P_t = \theta P_{t-1} + (1-\theta) P_t^*$$

however there is in this models the possibility of real indeterminacy, as argued by Clarida, Gali and Gertler.

7.3 Price level determination with government debt

We return now to the basic setup which includes equations 1 to 3 (and 5 endogenous variables, I, P, T, B, M) unless we make some assumptions), and ask how monetary and fiscal policies affect price level determination. Remember that in order to close the model we need to specify stochastic processes for two variables out of M, B and T.

Before we delve into how we specify these processes, it is important to realise that prices will in general no longer be determined only by monetary conditions. In fact, to a first approximation, one can say that:

$$\begin{aligned} P_t &= M_t \left(\frac{I_t - 1}{I_t} \right)^{\frac{1}{\eta}} Y^{-\frac{\sigma}{\eta}} \\ P_t &= \frac{I_{t-1} B_{t-1} - B_t + M_{t-1} - M_t}{T_t - G} \end{aligned}$$

the first equation is a velocity-type equation. The second equation is a valuation equation: if we forward that equation, an equivalent way of rewriting it is:

$$\frac{1}{\text{price level}} = \frac{\text{expected value of future primary surpluses}}{\text{nominal government debt}}$$

this is the counterpant to formulas in finance where:

$$\text{stock price} = \frac{\text{expected value of future dividends}}{\text{number of shares}}$$

7.3.1 The "fiscal" theory of price level

Proponents of the fiscal theory of the price level stress that even in a world where the level of nominal money balances shrinks to zero (thus rendering the money demand equation unsuitable to calculate the price level), the level of government liabilities allows us to pin down an equilibrium price level that depends on the government asset position and on the present value of expected future surpluses.

This happens because government debt B acts as money here (it is just a pledge to the bearer to pay back IB at the next date); given the real surplus that the government manages to get in the next period T, the price level will be P such that $PT = IB - B$, that is:

$$P = \frac{(I-1)B}{T-G} = \frac{1-\beta}{\beta} \frac{B}{T-G}$$

The rest is controversies.

7.3.2 Some unpleasant monetarist arithmetic

Sargent and Wallace (1981) present a model economy that satisfies the monetarist assumptions that the monetary base is closely connected to the price level and that the monetary authority can raise seignorage through money creation. They show that under certain conditions the monetary authority's ability to control inflation is limited. They major condition responsible for this result is the exogeneity of the process for the government's deficit. Given this exogeneity, tight money today leads to higher inflation in the future and may even lead to higher inflation today.

SW describe a model in which r (the real interest rate) is constant and greater than g, the growth rate of the economy. This might happen under, say, an OLG structure.

What is the effect of open market operations? Assume a fall in money supply growth. This should lead permanently to higher debt, and therefore to higher debt service in steady state. Higher debt over GDP might stabilize at a permanently higher level, if $r = g$, or it might be bound to explode if $r > g$ unless the higher deficit will force money supply eventually to increase, leading to higher inflation.

In the short run, however, interest rates rise (since expected inflation rises) and this leads to a fall in m_t. This implies that $\frac{M}{P}$ must fall. We know that M drops, but if η is large, P might need to drop in the short run.

Altogether, an open market operation might drive price level down temporarily, and inflation permanently higher in the long run.

7.4 Active and passive policies

Leeper (1992): best model in order to understand at least the basis of all controversies that have surrounded the fiscal theory of the price level.

See also Woodford's book, Chapter 4.4 (Fiscal requirements for price stability)

Remark 12 *The government flow of funds requires that shocks to the real value of government debt either are financed by future taxes or by inflation (that is, money creation). Having said that, we can dichotomize policies into* (1) *those where future taxes back entirely debt (passive fiscal policies and active monetary policies);* (2) *those where money creation entirely backs debt, like in Sargent and Wallace example above (passive monetary policies and active fiscal policies)*

To the basic setup made by equations (1) to (3), he adds the following rules for monetary and fiscal policy:

$$\begin{aligned} \widehat{I}_t &= \alpha\widehat{\pi}_t + \widehat{e}_t && \text{(LL1)} \\ \widehat{T}_t &= \gamma\widehat{b}_{t-1} + \tau_t && \text{(LL2)} \end{aligned}$$

Let us look at the log-linear equilibrium. Log-linearizing (2) we get the usual Fischer equation

$$\widehat{\pi}_{t+1} = \widehat{I}_t \tag{LL3}$$

From money demand (3)

$$\widehat{m}_t = -\frac{\eta^{-1}}{I-1}\widehat{I}_t \tag{LL4}$$

From mkt clearing (4)

$$(I-1)\,\widehat{T}_t + \frac{M}{B}\left(\widehat{m}_t - \widehat{m}_{t-1} + \widehat{\pi}_t\right) + \widehat{b}_t = I\left(\widehat{I}_{t-1} + \widehat{b}_{t-1} - \widehat{\pi}_t\right) \tag{LL5}$$

Use $(LL3)$ and $(LL2)$ the fact that money demand is endogenous and replace T_t.

$$\pi_{t+1} = \alpha\pi_t + e_t \tag{a}$$

Multiply by P/B log-linearized (4)

$$\frac{PT}{B}\left(\gamma\widehat{b}_{t-1} + \tau_t\right) + \frac{M}{B}\left(\widehat{m}_t - \widehat{m}_{t-1} + \widehat{\pi}_t\right) + \widehat{b}_t = I\left(\widehat{I}_{t-1} + \widehat{b}_{t-1} - \widehat{\pi}_t\right)$$

drop $\widehat{m}_t$ using $(LL4)$, define $M/B = \mu$, use steady state for PT/B and drop I_t using Taylor rule to obtain:

$$I\,(I-1)\left(\gamma\widehat{b}_{t-1} + \tau_t\right) - \frac{\eta^{-1}\mu}{I-1}\left(\alpha\left(\widehat{\pi}_t - \widehat{\pi}_{t-1}\right) + \widehat{e}_t - \widehat{e}_{t-1}\right) + \mu\widehat{\pi}_t + \widehat{b}_t = I\left(\alpha\widehat{\pi}_{t-1} + \widehat{e}_{t-1} + \widehat{b}_{t-1} - \widehat{\pi}_t\right) \tag{b}$$

We want to characterize the determinacy properties of the equilibrium: to this purpose, we only consider the perfect foresight equilibrium: the system made up by (a) and (b) can be written as:

$$\begin{aligned} \left(-\frac{\eta^{-1}\mu\alpha}{I-1} + I + \mu\right)\widehat{\pi}_t + \widehat{b}_t &= \left(\alpha\left(I - \frac{\eta^{-1}\mu}{I-1}\right)\right)\widehat{\pi}_{t-1} + \left(I - \gamma\,(I-1)\right)\widehat{b}_{t-1} && \text{(b')} \\ \pi_t &= \alpha\pi_{t-1} && \text{(a')} \end{aligned}$$

which in matrix form looks like

$$\begin{bmatrix} 1 & -\frac{\eta^{-1}\mu\alpha}{I-1}+I+\mu \\ 0 & 1 \end{bmatrix}\begin{bmatrix} b_t \\ \pi_t \end{bmatrix}=\begin{bmatrix} I-\gamma\left(I-1\right) & \alpha\left(I-\frac{\eta^{-1}\mu}{I-1}\right) \\ 0 & \alpha \end{bmatrix}\begin{bmatrix} b_{t-1} \\ \pi_{t-1} \end{bmatrix}$$

The system is recursive, and eigenvalues are the two elements on the main diagonal. For a saddle path equilibrium to exists, the eigenvalues must lie on either side of the unit circle, which can happen only if both α and γ exceed or fall short of one in absolute value.

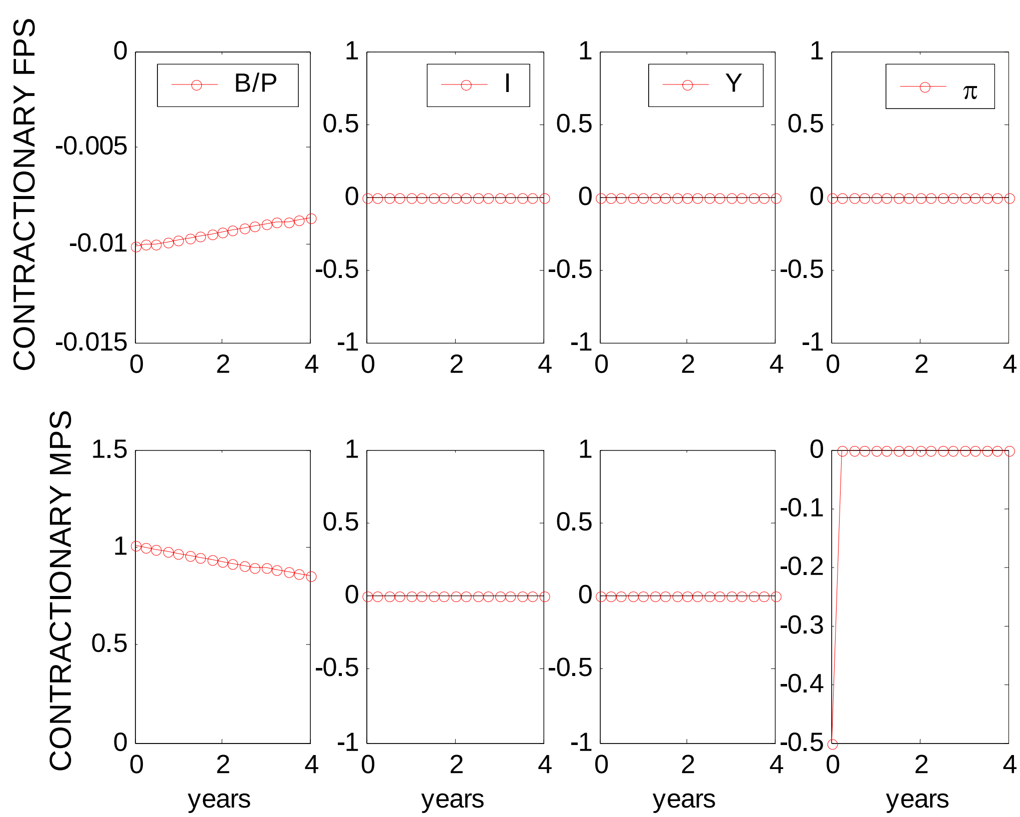
$$\begin{aligned} \mu_1 &= \alpha \\ \mu_2 &= I-\gamma\left(I-1\right)=\beta^{-1}-\gamma\left(\beta^{-1}-1\right) \end{aligned}$$

Equilibrium can be characterised in terms of different policies.

- *Active monetary* $\alpha > 1$ *and Passive Fiscal* $\gamma > 1$. There is a unique REE in which inflation is only a monetary phenomenon. Inflation and nominal interest rate fluctuations depend entirely on the parameters of the policy rule, the discount factor, and the monetary policy shock. In this case (b) is stable difference equation that can be solved backward for b, whereas (a) can be solved forward to obtain, if $e_t = \rho_e e_{t-1} + \varepsilon_t$

  $$\pi_t = \frac{1}{\alpha}\pi_{t+1} + \frac{1}{\alpha}e_t = \frac{1}{\alpha}\frac{1}{1-\rho_e\alpha^{-1}}e_t$$

  Figure 1 considers this case: (1) in the top row: a transitory increase in taxes causes a persistent fall in real government debt, which keeps the present value of taxes constant.[2] (2) Bottom row: a transitory decrease in money supply (positive e_t) causes inflation to fall, and real debt to rise.



1: Active monetary and passive fiscal

[2] With $\gamma > 1$ real debt slowly returns to baseline following a fiscal shock, given the that taxes are "high".

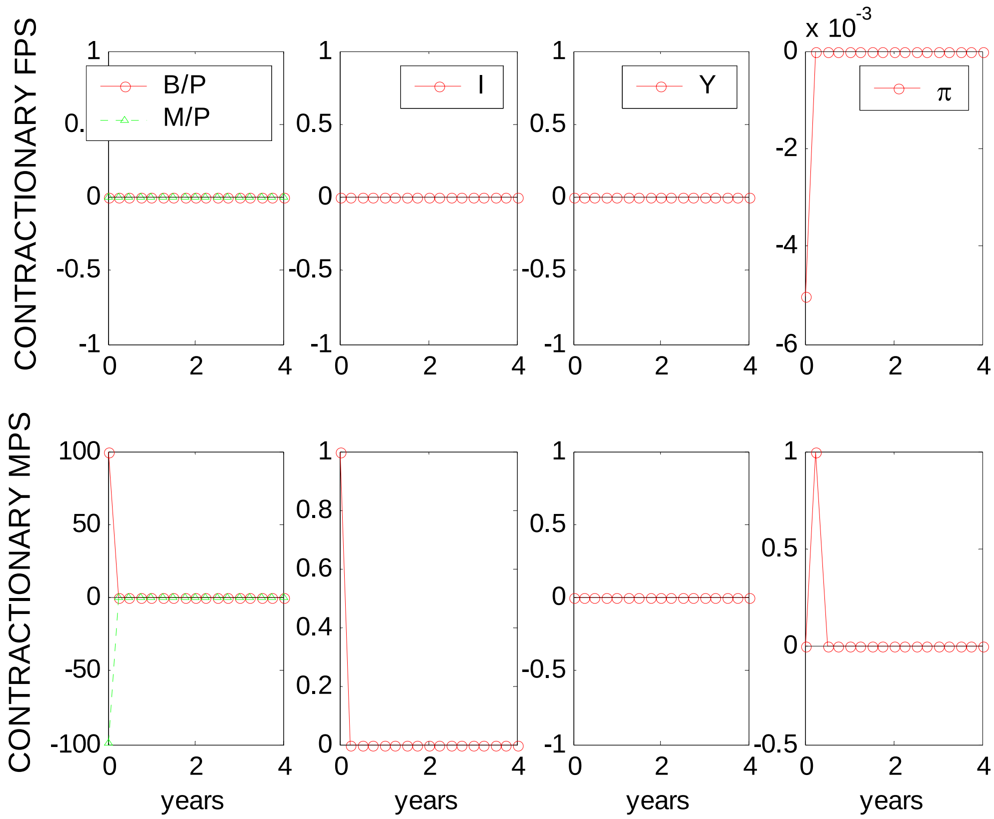
- *Passive Monetary* $\alpha < 1$ *and Active Fiscal* $\gamma < 1$. Here inflation is a monetary and Fiscal phenomenon (FTPL).

  In this class we also have exogenous taxes $\gamma = 0$ + interest rate (or money supply) peg, $\alpha = 0$. When $\alpha = 0$ and $\gamma = 0$, the solutions for π_t and b_t are:

$$\pi_t = -\frac{1-\beta}{1+\beta\mu}\tau_t - \frac{\mu}{\mu+\beta^{-1}}\left(\beta\left(1+\frac{\eta^{-1}}{\beta^{-1}-1}\right) - \frac{\eta^{-1}}{\beta^{-1}-1}\right)e_t + e_{t-1}$$

$$b_t = \beta m\left(1+\frac{\eta^{-1}}{\beta^{-1}-1}\right)e_t$$

notice that government debt influences the response of inflation to both monetary and fiscal changes. (1) A tax increase (positive τ) lowers inflation, with an elasticity which is greater the smaller $\mu = m/b$. This happens because the monetary authority can now print less money, thus demonetizing the tax cut (top Figure 2). Tax changes do not affect real debt. (2) Interest rate increases (bottom Figure 2) represent a pure asset exchange: a rise in I induces substitution from M into B. Initially, $M + B$ is constant, hence prices do not change. In the next period, the higher real debt must be financed through inflation (since fiscal policy is active), therefore inflation rises with one period lag.



2: Passive monetary and active fiscal

- *Active monetary* $\alpha > 1$ *and Active Fiscal* $\gamma \leq 1$. Public debt will explode over time.

- *Passive Monetary* $\alpha < 1$ *and Passive Fiscal* $\gamma > 1$. Sunspots. Indeterminacy of Equilibria. Each autority acts passively, and there is more than just one interest rate process that is consistent with equilibrium conditions. Notice that this mirrors the indeterminacy results that we obtained in section "Price level determination with government debt".

7.4.1 Evaluation

The standard monetarist recipe for price stability is to make sure that the central bank has a commitment to price stability.

The FTPL argues that this is not a sufficient condition, but price stability also requires an appropriate fiscal policy, which is not *implied* by a strong central bank. The FTPL would therefore imply that central banks must also convince fiscal authorities to behave in an appropriate way. In sum, the difference between the fiscal and monetarist approach boils down to the views on the government budget constraint.

- MONETARISTS: argue that policy must be set in a way that RHS equals LHS, whatever the value of P is (RICARDIAN assumption).
- FTPL: argue that this is just a flow of funds. Whenever LHS or RHS change, the price level will adjust to restore the equality (NON RICARDIAN assumption)

Moving to real world, it seems that the non-ricardian assumption cannot describe always government behaviour in all circumstances. Governments often adjust fiscal variables when their real debts get large (e.g. Maastricht treaty, or US late 1980s: federal debt grew producing political support for raising taxes)

However, as proponents of the FTPL argue, this theory might provide a useful characterisation of actual policies in some contexts (e.g. high inflation in Brazil in late 1970s. In a sense, the FTPL might pose a rationale for the type of budget rules that constitutions or budget rules pose to governments.

Another alleged good point about the FTPL is that is allows to pin price level down even in a cashless economy (when M approaches a near zero level).

7.5 Accounting for price stickiness

It is easy to amend this model to account for price stickiness. What we need to do is the following. Add a Phillips curve (as you can imagine, we add output and we add one equation)

$$\widehat{\pi}_t = \widehat{\pi}_{t+1} + \kappa \widehat{Y}_t \tag{LL6}$$

"replace" the Fisher equation with the AD curve (consumption is no longer fixed now):

$$\widehat{I}_t - \widehat{\pi}_{t+1} = -\sigma^{-1} \left(\widehat{Y}_t - \widehat{Y}_{t+1} \right) \tag{LL3}$$

amend the money demand equation:

$$\widehat{m}_t = \frac{\eta^{-1}}{\sigma} \widehat{Y}_t - \frac{\eta^{-1}}{I-1} \widehat{I}_t \tag{LL4}$$

consider if you want a more general Taylor rule:

$$\widehat{I}_t = \alpha \widehat{\pi}_t + \alpha_y \widehat{Y}_t + \widehat{e}_t \tag{LL1}$$

Fiscal rule and budget constraint for the government remain the same. This setup is due to Woodford (1995), as you can see here taxes are lump-sum. The model nests Leeper if $\kappa = \infty$ and $a_y = 0$

Woodford finds that an "unexpected increase in the fiscal deficit, not offset by any future reduction in future primary deficits, stimulates aggregate demand, temporarily increasing both inflation and output". This happens because an increase in the present value of government deficit increases the present value of total consumption that the representative household can afford, if prices and interest rates do not change, and thus induces and increase in aggregate demand for goods.

Interesting result: a more aggressive monetary policy - i.e., higher ϕ_π and ϕ_y - implies that inflation rises by MORE following a fiscal shock. Try this by yourself with leeper.m

Woodford discusses under which conditions the Taylor principle continues to hold.