

- 1) According to Christina Romer, the pre and post-war business cycles are similar in terms of volatility [though the recent period may be different]. Also, the length of recessions are similar in both periods. However, expansions are longer in the post-war era compared to the pre-war era. Also, there is less spread between severe recessions and mild recessions in the post-war era relative to the pre-war era.
- 2) In the 1970s the monetary authorities operated under the assumption of a stable and exploitable Phillips Curve (inflation/unemployment or inflation/output tradeoff). In fact the Phillips Curve can shift over time and is not stable and the long-run Phillips Curve is vertical. The other main lesson of the period is that inflation is in fact a monetary phenomenon. Thus the monetary authorities through their management of monetary policy are responsible for inflation, both as a cause and a cure.
- 3) The left-hand side (LHS) of the equation is the optimal desired capital stock of the firm.
 - a) The first term on the right-hand side (RHS) reflects the state of future demand. Higher demand leads to output sold at a higher price and so firms would have a higher level of desired capital.

The second term on the RHS is the effect of taxes, interest rates, and depreciation. Raising the profit tax reduces the profitability of investment and leads to lower desired capital stock. A higher interest rate raises the opportunity cost of capital and hence leads to a lower desired stock of capital. Greater depreciation leaves less capital leftover after production and hence less that can be sold (or a higher cost to maintain a level of production) and so also reduces the desired stock of capital.

The third term on the RHS is the expected capital gain/loss. An expected rise in the investment tax credit tomorrow relative to today, lowers the expected capital gain today and hence lowers the desired level of the capital stock.
 - b) The solution assumes that firms are profit-maximizers that set marginal cost equal to expected marginal benefit. The solution also assumes that markets clear, i.e., markets are in equilibrium.

3) c) In Hall and Jorgenson's analysis they treat the investment tax credit as permanent once it has been put in place. Lucas states that a more likely scenario is that an investment tax credit will be transitory (put in effect for a period of time and then eventually removed). Given that firms forecast the behavior of policy rationally, they would react optimally in each of these situations. Lucas finds that the effect of an investment tax credit on the firm's desired stock of capital is approximately 7 times as large with his set of assumptions relative to Hall and Jorgenson's assumptions. This makes sense because under Lucas's assumptions firm's forecast that the policy is temporary and so there is a greater incentive to respond to the tax credit today relative to if they forecast that the policy is permanent as in Hall and Jorgenson.

4) In our model both Bob and Jerry are "lifetime utility maximizers". The only way that Bob would be consuming more than Jerry today given that they have the same lifetime income streams is if

$\beta_{Bob} < \beta_{Jerry}$ which implies that $\rho_{Bob} > \rho_{Jerry}$ since $\beta = 1/(1+\rho)$. In words, Bob discounts future utility at a higher internal discount rate than Jerry. As such, Bob prefers to consume more today than Jerry.

5) a) Since optimal consumption given the solution to the Ramsey problem is

$$c_t^* = \frac{1}{1 + \tau^*}$$

and the present discounted value of government expenditure is 1, then the governments budget constraint is simply

$$\left(\frac{1}{1 + \tau^*}\right)\tau^* \sum_{t=0}^{\infty} \left(\frac{1}{1 + r}\right)^t = 1$$

Using the fact that we have a geometric series this gives us

$$\left(\frac{\tau^*}{1 + \tau^*}\right)\left(\frac{1 + r}{r}\right) = 1$$

which implies that $\tau^* = r$.

- 5) b) We know from the solution to a) that in period 0, the government issues debt

$$G_0 - T_0 = 1 - \frac{r}{1+r} = \frac{1}{1+r}$$

We also know the government's flow budget constraint

$$G_t + (1+r)B_{t-1}^g = T_t + B_t^g$$

From period 1 and on we know this is

$$B_t^g = -\frac{r}{1+r} + (1+r)B_{t-1}^g = -\frac{r}{1+r} + (1+r)\frac{1}{1+r} = \frac{1}{1+r} \quad \text{for all } t \geq 1$$

Basically after the first period core deficit, the government runs core surpluses that pay the interest cost on the debt.

So we can see that

$$\lim_{t \rightarrow \infty} \left(\frac{1}{1+r}\right)^t B_t^g = \lim_{t \rightarrow \infty} \left(\frac{1}{1+r}\right)^t \left(\frac{1}{1+r}\right) = \lim_{t \rightarrow \infty} \left(\frac{1}{1+r}\right)^{t+1} = 0$$

and the transversality condition is satisfied.