

Real Business Cycles
Notes on Plosser and Mankiw

I. Introduction

- A. Plosser argues that the dynamics of an “ideal system” should be analyzed before one resorts to market failures to explain business cycles.
- B. The set-up of the RBC models follows from neoclassical growth theory in spirit. It is argued that technical change may be responsible for cycles as well as trends in macro variables.

II. Model Set-up

- A. Assume 1 representative infinitely-lived agent (Crusoe).
- B. The individual’s utility is a function of consumption and leisure over the infinite horizon.
- C. Each agent uses capital and labor to produce output via a CRS production function.
- D. The production function is subject to random shocks (assumed initially to be known in advance, however).
- E. The individual’s problem is to choose consumption and leisure plans to maximize lifetime utility (subject to constraints relating investment to capital accumulation in each period).

III. The Problem: Maximize L choosing C_t, N_t, K_{t+1}, I_t :

$$L = \sum_{t=0}^{\infty} \mathbf{b}^t [u(C_t, 1 - N_t)] + \sum_{t=0}^{\infty} \mathbf{b}^t \mathbf{I}_t [\Theta_t F(K_t, N_t) - C_t - K_{t+1} + (1 - \mathbf{d}) K_t]$$

- A. First order conditions are:

$$u_1(C_t, 1 - N_t) - \mathbf{I}_t = 0$$

$$u_2(C_t, 1 - N_t) - \mathbf{I}_t \Theta_t F_2(K_t, N_t) = 0$$

$$\mathbf{b} \mathbf{I}_{t+1} [\Theta_{t+1} F_1(K_{t+1}, N_{t+1}) + (1 - \mathbf{d})] - \mathbf{I}_t = 0$$

$$\Theta_t F(K_t, N_t) + (1 - \mathbf{d}) K_t - K_{t+1} - C_t = 0$$

- B. Given an initial condition and a series of productivity shocks, we use the equations above to solve for time paths for C , N , K , and I .
- C. Implicit competitive prices are given by:

$$w_t = \Theta_t F_2(K_t, N_t)$$

and

$$(1+r) = \frac{I_t}{I_{t+1}b}$$

1. The RHS of the latter expression is a ratio of Lagrange multipliers, and corresponds to a ratio of marginal utilities (MRS between consumption amounts in successive periods).

IV. An intuitive discussion of the RBC Model

A. Temporary positive productivity shock

1. Other things unchanged, output will be higher in this period. Crusoe *could* consume more in just this period leaving all other choices unchanged (but he will not).
2. Crusoe prefers to spread the consumption gain out somewhat by saving (investing). Plentiful output today, relative tomorrow leads to a low implicit interest rate today.
3. On the “supply” side, Crusoe sees that this is a good time to work, because productivity (real wage) is high. So labor input will be high in this period.
4. There will also be small (because the shock is assumed to be temporary) wealth effects. This causes a small increase in consumption, and small reductions in work effort. The latter effect is not likely to offset the intertemporal substitution effect which is motivating more work effort today.
5. Summary: High output is associated with a lower interest rate, higher investment, higher consumption, higher real wage and higher work effort. There is some persistence in the output movement because of the effort to spread out consumption over time. Employment effects might also persist because consumption spreading leads to a higher capital stock which increase the marginal product of labor and leads to more work effort over multiple periods.

B. Permanent positive shock

1. Because the shock is permanent, there is no immediate intertemporal substitution effect. Work is more productive now (real wage higher) in all periods. There may be a substitution effect away from leisure toward work in all periods however.

2. Wealth effects are now greater because the shock is permanent. This leads to lower work effort (i.e., more leisure is demanded).
3. The productivity shock does make investment more attractive. We begin to head for a new steady state with both more output and more capital. In the current period, there will be some increase in the implicit interest rate because of the increase in investment demand. The movement to a new steady state may be prolonged, hence the effect of the shock are persistent.
4. This higher interest rate will induce more work effort in the current period.
5. Summary: Output up, consumption up, real wage up, work effort ambiguous but likely up initially, investment up, interest rate up. Note that compared to the previous example, the interest rate is behaving differently here.

C. Temporary Foreign War (Increase in non-productive government spending).

1. In this period output is scarce. Because shock is temporary, individuals will wish to maintain consumption, which drives up the implicit interest rate.
2. Wealth effect is small, because shock is temporary. Small negative wealth effect will induce higher work effort and more total output.
3. Summary: An increase in government spending raises the interest rate, output, and work effort.
 - a) Results appear somewhat like IS-LM model results, but the reasoning is different. More work is not induced by spending and multiplier effects, but by the need to work harder to “replace” wasted output.

V. Policy Implications

- A. In this model, all fluctuations are optimal responses to exogenous shocks. There can be no policy options aimed at stabilization that could possibly increase welfare.

VI. Empirical Evidence

- A. “Testing” has proceeded by
1. Plugging in plausible parameters in the model for production, utility function.
 2. Using Solow residuals as “shocks.”
 3. Solve the model for paths of key variables.

4. Inspecting the resulting series for output, work effort, interest rate, real wage, etc. These become the model's "business cycle facts."
5. Compare the model "facts" to actual business cycle patterns.

B. Test Results

1. Output, consumption, investment paths track actual values very closely.
2. Actual hours worked are more volatile than predicted (but actual hours are not quality adjusted).

C. What about money?

1. RBC proponents argue that reverse causality could explain the money output correlation.

VII. Mankiw's critique

- A. Large economy-wide shocks are implausible.
- B. Solow residuals are not likely to be good indicators of technology shocks on a period by period basis (e.g. labor hoarding may be an alternative explanation for low productivity in a recession).
- C. Is technological regress really likely as a cause of recessions?
- D. Policy implications are dangerous.
- E. Labor supply elasticities are not large enough to explain the wide variations in labor input that are observed.
- F. The model implies unemployment is voluntary; counter to the observation that many unemployed were involuntarily laid off.
- G. Evidence (like Romer-Romer) shows that monetary policy has real effects.
- H. RBC analysts cannot explain procyclical prices.