Real Business Cycle Theory

Graduate Macroeconomics I
ECON 309 – Cunningham
From New Classicals to RBC

- The **New Classical Economics (NCE)** challenged Keynesian theory, and stimulated the development of New Keynesian (NK) and Real Business Cycle (RBC) Theory.

- **NK theory** accepts the REH, but emphasizes the importance of imperfect competition, costly or impeded price adjustments, and externalities. It argues that nominal shocks are the predominant cause of business cycles.

- **RBC theory** accepts the REH, but views cycles arising in frictionless, perfectly competitive economies with complete markets. It argues that cycles arise through the reactions of optimizing agents to real disturbances, such as random changes in technology or productivity.
Stadler, 1994 (JEL) writes:

“...such models are capable of mimicking the most important empirical regularities displayed by business cycles.”
Major Contributions

- RBC theory makes the contribution of demonstrating that fluctuations in economic activity are consonant with competitive general equilibrium environments in which all agents are rational optimizers.
- RBC Theory makes (exogenous) stochastic fluctuations in factor productivity the predominant cause of fluctuations in business activity.
- Coordination failures, price stickiness, waves of optimism or pessimism, or monetary or fiscal policy are not needed to explain business cycles.
Stylized Facts about Business Cycles

1. Cycles vary a lot in amplitude and duration.
2. Output movements in many sectors display a high degree of coherence.
3. Investment and durable goods production is much more volatile than output.
4. Nondurable goods consumption is less volatile than output.
5. Velocity of money is countercyclical in most countries.
6. The relationship of monetary aggregates and output is highly variable.
7. Long-term interest rates are less volatile than short-term interest rates.
8. Short-term interest rates are almost always positively correlated with output.
9. Long-term interest rates have a negative or zero correlation with output.
10. Prices levels are procyclical.
11. Employment is as variable as output, and positively correlated.
12. Productivity is less volatile than output.
Real Business Cycle (RBC) Models

- Like New Classical Economics, the RBC theorists agree that:
  - Agents optimize
  - Markets clear
- Therefore, the business cycle is an equilibrium phenomenon, and is optimal!
Features of RBC Models

1. Adopt a representative agent model, focusing on a representative household and firm, agents homogeneous, so that there are no aggregation problems.
2. Firms and households optimize explicit objective functions, subject to resource and technology constraints.
3. The cycle is driven by an exogenous shock to productivity.
4. The impact of productivity is amplified by intertemporal substitution of leisure. The increase in productivity raises the opportunity cost of leisure, causing employment to increase.
5. All agents have rational expectations.
6. All markets continually clear.
7. There are complete markets.
8. There are no informational asymmetries.
Positive Technology Shock

\[ Y = F(N, K) \]

Diagram showing the relationship between price (P), labor (N), and output (Y) with two LRAS curves, \( LRAS_1 \) and \( LRAS_2 \), indicating a shift in the short-run aggregate supply due to a positive technology shock.
Why shocks have persistent effects

- Agents seek to smooth consumption over time. This implies that the increase in output will result in an increase in investment, and therefore the capital stock. (weak)
- Agents also intertemporal substitute labor supply toward periods when real wages are higher, and away from periods when real wages have fallen. (stronger)
- Lags in investment (time-to-build) can result in current shocks affecting future investment and therefore future output. (stronger)
- Firms answer increased demand first by drawing on inventories. Once inventories are depleted, then the firms respond with production changes. If the firms face rising marginal costs, they will replenish inventories slowly, causing output changes to persist. (weak)
A Simple RBC Model

(1) $U_t = \text{Max } E_t \left[ \sum_{j=0}^{\infty} \beta^j u(c_{t+j}l_{t+j}) \right], \ 0 < \beta < 1$

(2) $y_t = z_t f(k_t, n_t), \ z_t \sim \text{iid}(0, \sigma_z^2), \ f \text{ is CRS}$

(3) $k_{t+1} = (1 - \delta)k_t + i_t$

(4) $y_t = c_t + i_t$

(5) $n_t + l_t = 1$
Solution (1)

First Order Conditions

(5) \( u_1(c_t, l_t) - \lambda_t = 0 \)

(6) \( u_2(c_t, l_t) - \lambda_t z_t f_2(k_t, n_t) = 0 \)

(7) \( -\lambda_t + E_t \beta \lambda_{t+1} [z_t f_1(k_t, n_t) - (1 - \delta)] = 0 \)

(8) \( c_t + k_{t+1} = z_t f(k_t, n_t) + (1 - \delta) k_t \)

Assume \( \delta = 1 \), log-linear utility, and Cobb-Douglas production. Solve for \( z_t, c_t \), and \( k_{t+1} \).
Solution (2)

The utility function forces income and substitution effects of a wage change cancel each other.

(1) So employment is constant.

(2) \[ c_t = \left[ 1 - (1 - \alpha)\beta \right] z_t n_t^\alpha k_t^{1-\alpha} \]

(3) \[ k_{t+1} = (1 - \alpha)\beta n_t^\alpha k_t^{1-\alpha} \]

where \[ z_t f(\bullet) = z_t n_t^\alpha k_t^{1-\alpha} \]

Note that shocks affect consumption, but also the capital stock, so have long-term effects.
Money, Credit, RBC
King and Plosser, 1984

- Banking firms supply financial (transactions) services.
- A positive shock to productivity will also stimulate demand for transactions, and therefore transactions services.
- So the volume of such services will vary with output.
- Inside money is created.
- Money is endogenously created in response to real sector activity.
- Y causes M.
If all the important shocks are productivity shocks, then worker hours and productivity should move together.

Thus productivity should be highly positively correlated with output and hours. In the real world, the correlation is negative (if at all).
Five Major Criticisms

1. There is no evidence of the large, economy-wide disturbances that drive these models.
2. These models have not been subjected to rigorous econometric testing. In fact, there appears to be no way objective way to test how well these models explain business cycles.
3. The models do not account for the periodicity of cycles. They do not match reality at all because they offer only weak explanations for the propagation of the effects through time.
4. RBC models do not account for recessions since this would require economy-wide negative productivity shocks.
5. The use of the representative agent model makes it impossible to examine welfare, distributional, or aggregative problems.
General Arguments against RBC

- The explanation of business cycles does not work. (Problem of persistence)
- Technology shocks are typically limited to individual industries, and do not have such economy-wide effects.
- The assumed (voluntary) response by the labor force to changes in the real wage. The real-world labor supply curve is very steep. (Work is a necessity.)
An Econometric Problem

- RBC Models almost universally use the Hodrick-Prescott (HP) filter to decompose series into growth and business cycle components.

- Two Problems:
  - It removes some time series information that is usually associated with business cycles. (King and Rebelo, 1993)
  - The filter can impart spurious patterns into the data. (You can generate random data with a random number generator, apply the HP filter, and cycles emerge. Oops!)