Chapter 11

Market-Clearing Models of the Business Cycle
Goal of This Chapter

• In this chapter, we study three models of business cycle, which were each developed as explicit equilibrium (market-clearing) models with optimizing consumers and firms.
  – Friedman-Lucas money surprise model
  – RBC model
  – Keynesian coordination failure model
• Each model differs from the others in terms of what is important in causing business cycles and the role implied for government policy.

• Each model allows us to understand one or a few features of the economy and some aspects of the economy’s response to macroeconomic shocks.
Friedman-Lucas Money Surprise Model

• The theory was sketched out by M. Friedman in 1968, and formalized by Robert Lucas in 1972.

• It was the first attempt to construct a theory where changes in the level of the money supply could have real effects, with all markets clearing all the time.
• The key element of the theory is that workers have *imperfect information*.

• They observe current nominal wage $W$. But they do not know the current price level $P$. Hence they cannot observe current real wage $w=W/P$. 
• Suppose there are two shocks that may hit the economy. One is temporary change in TFP \( z \), another is a permanent increase in money supply \( M \).

• Workers cannot observe either \( z \) or \( M \) during current period. But they can make *inferences* about the chances of a particular shock based on the movement of the nominal wage \( W \).
Now recall the monetary model we have learned. When we have $M \uparrow$, $P \uparrow$ while $w$ unchanged. So $W = wP \uparrow$. On the other hand, when $z \uparrow$, causes $w \uparrow$, $P \downarrow$, probably $W = wP$ also increase.

Workers care about the real wage. Under perfect information, when $M \uparrow$, they will not change labor supply, hence $Y$ unchanged. But when $z \uparrow$, they know $w \uparrow$, hence will increase labor supply, $Y$ increases.
• Since they only have imperfect information about $w$, and they only infer the probability of the shocks. So when they observe $W$ goes up, they have to put positive guess that the underlying shock is $z$, therefore labor supply will increase.

• This shows government can use unanticipated increase in money supply to “cheat” (or “confuse”) imperfectly informed but rationally expecting (as clever as economists!) agents to work harder.
Figure 11.1 The Effects of an Unanticipated Increase in the Money Supply in the Money Surprise Model
• Now money is not neutral.
\[ M \uparrow \Rightarrow Y \uparrow, r \downarrow, w \downarrow, N \uparrow, \frac{M}{P} \uparrow \]
(P \uparrow < M \uparrow)

• But this kind of “cheating” is bad because under the perfect information, market clearing equilibrium is PO. The deviation from this first best is sub-optimal.
• Market participants receive the wrong messages by misinterpreting the pure nominal increase in nominal wage as an increase in the real wage.

• But aftermath public will learn lesson and update their prior. *Money surprise only works in short-run.*
Policy Implication

- Make the money supply as predictable as possible.
- **Friedman Rule**: constant money growth rate.
Critique of the Money Surprise Model

• The model prediction is inconsistent with the data in terms of $w$, $P$ and $Y/N$. (Recall business cycle facts: $w$ is pro-cyclical, $P$ is counter-cyclical)

• Information on aggregate price level and the money supply is widely available.
Table 11.1  Data Versus Predictions of the Money Surprise Model with Monetary Shocks

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The Real Business Cycle Model

- It was introduced by Finn Kydland and Edward Prescott in 1982.
- Motivated by the observation of the close comovement b/w $z$ and $Y$, they asked the question whether or not a standard model of economic growth subjected to random productivity shocks could replicate, *qualitatively* and *quantitatively*, observed business cycles.
Figure 11.2 Solow Residuals and GDP
Since the change in TFP is persistent, let’s combine the increases in $z$ and $z’$.

Equilibrium Effects

$Y \uparrow$, $r \downarrow$, $w \uparrow$, $N \uparrow$, $C \uparrow$, $I \uparrow$, $Y/N \uparrow$, $P \downarrow$

All are consistent with the data. (Except that of money supply)
Figure 11.3 Effects of a Persistent Increase in Total Factor Productivity in the Real Business Cycle Model
Figure 11.4 Average Labor Productivity with Total Factor Productivity Shocks
# Table 11.2 Data Versus Predictions of the Real Business Cycle Model with Productivity Shocks

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RBC and the Behavior of the Money Supply

• RBC can also explain two key business regularities of money supply
  – The nominal money supply is procyclical.
  – The nominal money supply tends to lead real GDP.
Rugularity 1: Endogenous Money
In practice, the money supply is not determined exogenously by the monetary authority but responds to conditions in the economy. It can explain the procyclicality of money in two ways.
• If money supply measure is M1 or M2, it includes the bank deposits. $z \uparrow \Rightarrow Y \uparrow$, bank deposits $\uparrow \Rightarrow M \uparrow$

• Or suppose that central bank wishes to stabilize the price level. $z \uparrow \Rightarrow$ money demand $\uparrow$ (because $Y \uparrow$ and $r \downarrow$), $P \downarrow \Rightarrow$ in order to stabilize $P$, Fed needs to increase $M$
Figure 11.5  Procyclical Money Supply in the Real Business Cycle Model with Endogenous Money
• Regularity (2): statistical causality
• The banking sector tends to lead other sectors of the economy.
• It takes time to let $M$ affects the price level. So the monetary authority may take action before the occurrence of the shocks.
Policy Implication of RBC Model

• In the basic RBC model, there is no role for government stabilization policy!
  – Neutrality of money implies attempts to smooth out business cycles through monetary policy have no effect
  – All markets clear, there are no inefficiencies to correct (recall the First Welfare Theorem)

• Business Cycles are simply optimal responses to fluctuations in TFP.
• But in practice, there is a role for government arising from the need to correct market failures and distortions.

• Government should act as a “referee” instead of a “player”.
Critique of RBC Model

- There is a measurement error in using Solow residual to measure TFP.
- During a boom, machines and workers are fully utilized.
- But in a recession, sometimes machines are sitting idle, the workforce tends to be underutilized. This phenomenon is called "labor hoarding".
So the drop in output during a recession might simply be due to the quantity of inputs in production drops, with no change in TFP.
A Numerical Example

- Production function

\[ Y = zK^{0.36}N^{0.64} \]

- Suppose initially we have \( z=1, \ K=100, \ N=50. \) So \( Y=64.2. \)

- During the recession, the utilization of capital is 95\%, that of labor is 90\%. \( Z \) as same as before. \( K=95, \ N=45. \) Now \( Y=58.9. \)
• If we mistakenly used the measured $K$, measured $N$ to calculate the Solow residual, we get

$$z = \frac{58.9}{(100)^{0.36} (50)^{0.64}} = 0.918$$
Shocks and the Post-1970 Recessions


- 1974-75. Conventional wisdom: negative shock to TFP caused by a sharp increase in the relative price of energy. $z \downarrow \Rightarrow Y \downarrow$, $r \uparrow$, $M \downarrow$ (consistent with endogenous money theory)
• 1981-82: “Volcker Recession”. Tightening in monetary policy to reduce the inflation caused the recession. There is also a real shock on the second oil crisis.

• 1990-91: There was a spike in the relative price of energy. Increases in money supply likely prevented the recession from being more severe.

• 2001: IT bust and terrorist attack

• 2008: Oil Shock and Subprime Crisis
Figure 11.6 Percentage Deviations From Trend in Money Supply and GDP
Figure 11.7 Real and Nominal Interest Rates
Figure 11.8  Relative Price of Energy
A Keynesian Coordination Failure Model

• Difficulty in coordinating actions among private sector workers and producers

• Existence of Strategic complementarities: one person’s willingness to engage in some activity increases with the number of other people engaged in that activity.

• Example: party-going. Exist two possible equilibria. Everybody goes and nobody goes.
• Extend this example to the whole economy. There are possible multiple equilibria for the aggregate economy. Output-employment is (high, high) or (low, low).

• Business cycles might be simply fluctuations between these high (good) and low (bad) equilibria, driven by the waves of optimism and pessimism.
Model

• Strategic complementarities among firms imply that there can be increasing returns to scale at the aggregate level.

• Hence we have increasing marginal product of labor.
Figure 11.9 A Production Function with Increasing Returns to Scale
Figure 11.10 Aggregate Labor Demand with Sufficient Increasing Returns to Scale
• In order to have an equilibrium, the aggregate labor demand curve must have a greater slope than the labor supply curve. (Why?)

• This implies a downward sloping output supply curve.
• Both downward sloping output supply and demand curve determine the existence of multiple equilibria.
• Good equilibrium: higher $Y$, higher $N$, higher $w$, lower $r$, lower $P$.
• Bad equilibrium: lower $Y$, lower $N$, lower $w$, higher $r$, higher $P$. 
Figure 11.11 The Labor Market in the Coordination Failure Model
Figure 11.12 The Output Supply Curve in the Coordination Failure Model
Figure 11.13  Multiple Equilibria in the Coordination Failure Model
• When the economy will hit the good equilibrium?
• Answer: Everyone is optimistic.
• When the economy will hit the bad equilibrium?
• Answer: Everyone is pessimistic.
• Business cycles could result if consumers and firms are alternately optimistic and pessimistic. (Keynes referred this to “animal spirits”)

• In the coordination failure model, it is possible that extraneous events that are completely unrelated to economic fundamentals can “cause” business cycles. Economists call such extraneous events “sunspots”.

• Observe sunspot $\Rightarrow$ a sign of optimism
  $\Rightarrow$ everybody wants to invest, supplies more labor, … $\Rightarrow$ good equilibrium.

• Vise versa.
Model Prediction

• As well as the RBC model: “Good” equilibrium (boom) has $Y \uparrow$, $r \downarrow$, $w \uparrow$, $N \uparrow$, $C \uparrow$, $I \uparrow$, $Y/N \uparrow$, $P \downarrow$

• Can also accommodate the procyclicality of the money supply.
  – Money can be a sunspot variable that produces self-fulfilling optimism or pessimism.
  – $M \uparrow$ viewed as a “good” sign, people are optimistic, economy in “good” equilibrium. Vice versa.
Table 11.3  Data Versus Predictions of the Coordination Failure Model

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Figure 11.14 Average Labor Productivity in the Keynesian Coordination Failure Model
Figure 11.15 Procyclical Money Supply in the Coordination Failure Model
Policy Implication

• The government policies that promote optimism would be beneficial.
  – Encouraging statements by public officials could bump the economy from the bad equilibrium to the good one.

• Policy could also be designed to smooth business cycles or to eliminate them altogether.
• Example: \( G \downarrow \Rightarrow T \downarrow \Rightarrow \) lifetime wealth \( \uparrow \)
  \( \Rightarrow \) labor supply \( \downarrow \Rightarrow \) output supply curve shifts to right (recall it is downward sloping); on the other hand, \( G \downarrow \Rightarrow \) output demand curve \( \downarrow \)
  eliminate multiple equilibria

• Caveat: public might take the gov policy as sunspot, multiple equilibria might not be eliminated completely
Figure 11.16 Stabilizing Fiscal Policy in the Coordination Failure Model
Critique of the Coordination Failure Model

• The evidence about the existence of sufficient increasing returns to scale in aggregate production is weak.
• The underlying shocks that cause business cycles are expectations, and expectations are essentially unobservable.