

Recent Developments in Business Cycle Theory

Toshihiko Mukoyama

Concordia University and University of Virginia

- Most of the current research (on business cycles, and on macroeconomics overall) is based on (so-called) DSGE framework. That is,
 - **D**ynamic . . . Consider an economy over time.
 - **S**tochastic . . . Consider uncertainty.
 - **G**eneral **E**quilibrium . . . Consider all the markets, based on microeconomic theory.

Dynamic

- Most of the interesting macroeconomic phenomena take place over time.
 - Business cycles
 - Economic growth
 - Inflation
 - Saving
 - Investment

Stochastic

- Uncertainty is a part of the definition of business cycles.
 - How is the business cycle different from the seasonal cycle?
 - Why do people worry about business cycles, but not seasonal cycles?
- A little bit of historical reason, too (later).

General Equilibrium

- When considering a macroeconomy, it is necessary to consider all the markets at the same time (all the markets are interrelated).
- Based on microeconomic theory
 - Analyze the individual behavior (consumers, firms, etc.) carefully
 - Analyze the determination of prices and quantities in the market.
 - Advantage:
 - * Provide a “deeper” theory.
 - * Clear welfare criterion. (Utility function!)

Methodology

- Emphasis on **quantitative** aspect of the model.
 - An increase in government spending increases GDP.
 - 1% increase in government spending increases GDP by 3%.
- Use of computers.
 - Solving (and simulating) the model.
 - * Models are complex.
 - * Quantitative predictions.
 - Estimating/testing the model.
- Emphasis on comparing the model to the data. In particular, **microeconomic** (individual level) data in recent studies.

A bit more formally, what is “the business cycle”?

The business cycle is a recurrent deviation of the macroeconomy from a trend in which **variables move together**.

“Stylized facts” about U.S. business cycles: (Cooley and Prescott (1995))

· · · What should a successful theory explain?

1. The magnitude of fluctuations in output and aggregate hours work are nearly equal.
2. Employment fluctuates much more than average weekly hours. (Not true in Europe.)
3. Consumption of nondurables and services are smooth.
4. Investment in both producers’ and consumers’ durables fluctuate much more than output.

(I skipped the other six.)

History

- Pre-1930s: No macroeconomics. Economics= microeconomics.

But, many people recognized that there are business cycles, and there were a lot of theories. (Haberler, *Prosperity and Depression*, 1937.) Measurement by Mitchell, Kuznets, etc. (NBER is established in 1920.)

An important contribution (from the current viewpoint): Frisch, “Propagation Problems and Impulse Problems in Dynamic Economics,” 1933.

- Impulse: Exogenous shocks that causes business cycles. (Uncertainty is essential.)
- Propagation: How the economy reacts to the shocks.

- 1930s: Two events.
 - Great Depression.
 - Keynes, *General Theory* is published.

Macroeconomics is born. (Also, governments started collecting macroeconomic data more actively.)

- In Keynesian Economics, recessions can be avoided by government policies.
- Business cycle theories disappeared.

Macroeconomists in 1960s did not think of their efforts as directed toward finding an “explanation of business cycles.” Earlier economists who had thought of their research in this way were viewed as simply out of date, as Romanovs of the Keynesian Revolution. We thought of this problem as being, in a general way, solved, and our research was focused on refining the various pieces, or sectors, of an overall theory whose main outlines were fairly widely agreed upon. (Lucas, *Studies in Business-Cycle Theory*, p.2)

- 1970s:
 - It became clear that Keynesian framework (IS-LM, Phillips curve) has not solved all the problems in reality. (Stagflation.)
 - Methodological revolution—“Rational expectations”. It became possible to analyze dynamic models with uncertainty.

- One of the important papers: Lucas, “Economic Policy Evaluation: A Critique” (1976)—often called “Lucas Critique”.
 - To evaluate an economic policy, one has to understand what is **policy invariant** (“deep parameters”) → We need a deep theory!
 - The reason is that economic agents are **intelligent** → they change their behavior once the “rule of the game” changes.
 - For example, the fact that the Keynesian consumption function fits the historical data does not mean that it won’t change when a policy is implemented.
 - In modern economics, **tastes** and **technology** are regarded as “deep parameters” (“fundamentals”). Macroeconomists build models starting from these two fundamentals. (Not consumption function, for example.)

Lucas, “Methods and Problems in Business Cycle Theory” (1980) summarizes the agenda for modern macroeconomists:

Our task as I see it ... is to write a FORTRAN program that will accept specific economic policy rules as “input” and will generate as “output” statistics describing the operating characteristics of time series we care about, which are predicted to result from these policies. For example, one would like to know what average rate of unemployment would have prevailed since World War II in the United States had M1 grown at 4 percent per year during this period, other policies being as they were.

In sum, he advocates the methodology of creating an artificial economy (or “laboratory”) in a computer and run policy experiments there. It means that we take the model very seriously.

- 1980s:
 - Development of time-series econometrics, in particular unit root analysis
 - Emphasis of “real” causes of business cycles (as opposed to “monetary” causes).
 - Kydland and Prescott, “Time to Build and Economic Fluctuations,” 1982.
 - * Implements the above Lucas agenda.
 - * Methodological revolution:
 - “Calibration”—compare the **quantitative** prediction of the model with data. Extensive use of computers in solving the model.
 - * Follow Frisch’s impulse-propagation tradition. Emphasize the technology shocks (new technology, regulation, oil price shocks).
 - * Start the “real business cycles” literature. (Particularly in the midwest.)
 - In the east coast, “new Keynesian economics” emerges—emphasize sticky prices.
 - Midwest/east coast (fresh water/salt water) economists hold different views. (They still do, to some extent.) But note that both theories are explicitly based on **microeconomic theory**.

Basic mechanism of the business cycle with technology shocks

- Aggregate production function

$$Y_t = A_t F(K_t, L_t).$$

- Real interest rate

$$r_t = A_t F_K(K_t, L_t)$$

- Wage

$$w_t = A_t F_L(K_t, L_t)$$

- Therefore, $A_t \downarrow \Rightarrow r_t \downarrow w_t \downarrow \Rightarrow$ less investment, less working hours.

- 1990s-2000s: Generalization of Kydland-Prescott methodology. (From RBC to DSGE.)
 - Kydland-Prescott methodology wins, with application to models with different features (including “new-Keynesian” types).
 - * Consider shocks other than technology shocks (fiscal policy shocks, taste shocks, monetary shocks, etc.).
 - * Detailed examination of the propagation mechanism.
 - * Monetary models with sticky prices. (“New Neoclassical Synthesis”)
 - * Incomplete asset markets, heterogeneous agents.
 - * Modelling labor market—search models.
 - * Comparison with time-series (VAR) evidences.

- It is worthwhile to emphasize that **Kydland-Prescott methodology, by itself, has nothing to do with**
 - * Representative agent (Robinson Crusoe)
 - * Infinitely-lived agents
 - * Perfectly competitive markets
 - * Monetary neutrality
 - * Optimality of business cycles
 - * “Real” shocks.

Some models that employ Kydland-Prescott methodology have these features, and some models don't.

In this sense, it was misleading that Kydland-Prescott methodology was initially (and by some, still) called “Real Business Cycles (RBC) Theory”.

- Current topics
 - More on comparison with data
 - * Labor market—why is labor market so volatile?
 - * Asset market—why don't people hold stocks?
 - * International economics—why don't people hold more international assets? Why aren't the consumption series more correlated across countries?
 - * Richer propagation mechanism.
 - * New methodologies to compare the model with data.
 - What are the sources of the shocks? (Endogenous business cycles? Should we depart from the Frisch framework?)
 - International comparison (applications)
 - * European unemployment problem
 - * Japan's stagnation (Hayashi-Prescott)
 - Application of Kydland-Prescott methodology to economic history
 - * Great depression
 - * Baby booms
 - Optimal policy

A Small Model

- Build a small model, just to give a flavor...
 - One household, two periods.
 - The household consumes only in period 2. (C).
 - The household chooses how much to work (between 0 and 1) in period one (L_1) and two (L_2). Working is painful.

Utility:

$$C - b_1 L_1 - b_2 L_2.$$

- Working in the first period yields $w_1 L_1$ amount of consumption goods, and working in the second period yields $w_2 L_2$. Goods can be stored (saved in the backyard).

Budget constraint:

$$w_1 L_1 + w_2 L_2 = C.$$

- Therefore, overall, the household chooses L_1 and L_2 to maximize

$$w_1L_1 + w_2L_2 - b_1L_1 - b_2L_2.$$

- Clearly, the optimal behavior is:

- * $L_1 = 1$ if $w_1 > b_1$ and $L_1 = 0$ if $w_1 < b_1$.

- * $L_2 = 1$ if $w_2 > b_2$ and $L_2 = 0$ if $w_2 < b_2$.

- Suppose that there is an economy that repeats these two periods over time.
(The first half of the year and the second half of the year).
 - GDP: $w_1 L_1 + w_2 L_2$.
 - Employment: $L_1 + L_2$.
- Suppose that initially $w_1 > b_1$ and $w_2 > b_2$. Then:
 - GDP: $w_1 + w_2$
 - Employment: 2
 - Utility: $w_1 + w_2 - b_1 - b_2$.

Technology shock

- Suppose that suddenly there is a negative technology shock in the first half of the year: $w_1 < b_1$ and $w_2 > b_2$. Then:
 - GDP: w_2
 - Employment: 1
 - Utility: $w_2 - b_2$.

Recession! GDP falls, and employment falls. (Consistent with the data.)

- **Check point:** Compare the model performance with data quantitatively. (Here we skip it since the model is just for illustration.) Once we gained some confidence in our model (it describes the reality well), we can move on to the policy analysis.

Fiscal policy

- Suppose that $w_1 < b_1$ and $w_2 > b_2$. To increase GDP, the government decides to pay g_1 additionally to the workers, so that $w_1 + g_1 > b_1$. Then, people start to work:
 - GDP: $w_1 + w_2$
 - Employment: 2

But g_1 has to come from somewhere. Suppose that it is taxed from consumption in period 2. Then

$$C = \underbrace{(w_1 + g_1)}_{\text{income in period 1}} + \underbrace{w_2}_{\text{income in period 2}} - \underbrace{g_1}_{\text{tax}} = w_1 + w_2.$$

Thus:

- Utility: $w_1 + w_2 - b_1 - b_2$.

note that $w_1 - b_1$ is negative here \rightarrow Utility decreases.

An increase in GDP is not equivalent to an increase in welfare.

Employment regulation

- Slightly twist the model and consider that the household is working for a firm.
 w_1, w_2 are wages.

- Suppose that $w_1 = b_1 + 10$.

w_2 is uncertain in the beginning of the year, and it is $w_2^L = b_2 - 100$ with probability $1/2$ and $w_2^H = b_2 + 50$ with probability $1/2$. Then it is optimal to work at period 1 always, and work at period 2 only when w_2^H realizes.

- Expected value of GDP: $w_1 + w_2/2$
- Expected value of employment: $1 + 1/2$.
- Expected Utility: $10 + 50/2$.

- Suppose that, to enhance the employment in the second period (which is already a bad intention!) the government imposes a regulation—the firm cannot fire people in the middle of the year (between period one and two).

Then, the choices are:

1. Work for both periods: Utility $10 + 50/2 - 100/2$
2. Do not work in 1, work in 2 only when w_H : Utility $0 + 50/2$
3. Do not work for both periods: Utility 0.

Thus, people choose the second option—as a result, employment **falls**.

(European unemployment dilemma.)

Note that there are cases where the government is successful in increasing employment (consider a case where $w_1 = b_1 + 100$), but the utility falls in both cases.

Sticky wages

- Suppose that the wage is sticky—the firm has to pay the same wage in the second period as in the first period (w_1). Then, there are cases where even when $w_2 > b_2$, $w_1 < b_2$ holds and people choose not to work. (For example, $w_1 = 10$, $b_1 = 9$, $w_2 = 12$, $b_2 = 11$.)

- GDP: w_1
- Employment: 1
- Utility: $w_1 - b_1$.

In this case, policies (such as the fiscal policy above) may increase utility.

- GDP: $w_1 + w_2$
- Employment: 2
- Utility: $w_1 + w_2 - b_1 - b_2$.

Monetary policy

Consider an entirely different model.

- There are two different types of consumers, type X and type Y , who live forever.
- Type X produces good X but consumes only good Y . Type Y produces good Y but consumes only good X .
- Type X produces in odd periods, and consumes in even periods. Type Y produces in even periods, and consumes in odd periods.
- Goods cannot be stored (perish in one period), and people cannot borrow/lend, or write contracts.
- Utility is the amount people consume. Production cost is zero (or very small).

In this economy, people cannot trade, so nobody can consume.

Introduction of money (which can be stored) can solve the problem.

- In the first period, the government (central bank) gives M amount of money to type X . If both believe that money is valuable, then now type X can buy good Y from type Y , using this money.
- Next period, now the money is at the hand of Y , so Y can buy good X from type X .
- Suppose that the production of X at time t (t : odd) is x_t and the production of Y at time t (t : even) is y_t .
- Note that the price of good X is $p_t^X = M/x_t$ and the price of good Y is $p_t^Y = M/y_t$.
- If the prices adjust freely, every period people consume what is produced, and everyone is happy. There is no role for adjusting M . Increase/decrease in M will just result in increase/decrease in p_t (inflation/deflation).

- Suppose that price is sticky—in period t , the price is the same as $t - 2$.
- If x_t, y_t are constant (no shocks), then there is no problem.
- Suppose that y_t suddenly becomes large (technology shock). Consumer X brings M amount of money, but the price is still $p_{t-2}^Y = M/y_{t-2}$. So the consumer X can buy only $M/p_{t-2}^Y = y_{t-2}$ amount of good Y . $y_t - y_{t-2}$ amount of goods are wasted. Inefficiency!
- In this case, if the government can increase the money supply to $M y_t / y_{t-2}$, the consumer can buy $(M y_t / y_{t-2}) / p_{t-2}^Y = y_t$ amount of goods. Monetary policy can improve welfare.

Summary

- Dynamic, Stochastic, General Equilibrium.
- Impulse-propagation framework by Frisch.
- Quantitative policy experiment in the computer.