Slides for Chapter 6:

Uncertainty and the Current Account

Columbia University

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These are the slides for the textbook, "International Macroeconomics: A Modern Approach," by Stephanie Schmitt-Grohé, Martín Uribe, and Michael Woodford, Princeton University Press, 2022, ISBN: 9780691170640.

Motivation

- In the postwar period, the U.S. economy was much more volatile prior to the 1980s than thereafter. The relatively tranquil period post-1984 is called the Great Moderation.

- The Great Moderation period coincided with the emergence of large U.S. current account deficits.

- This chapter expands the open economy model of Chapter 3 to introduce uncertainty.

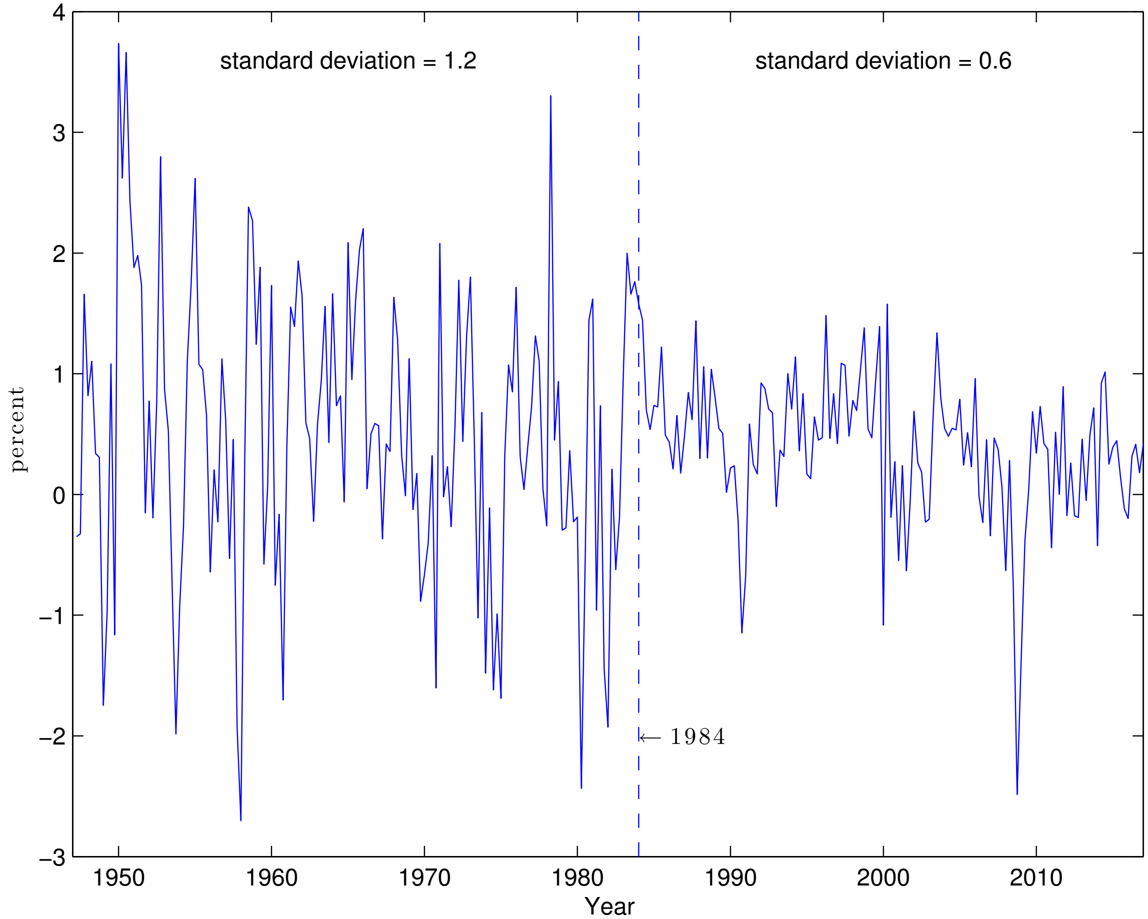
- This modification allows us to understand the effect of changes in the aggregate level of uncertainty on consumption, saving, the trade balance, and the current account.

The Great Moderation

The volatility of U.S. output declined significantly starting in the early 1980s. This phenomenon has become known as *the Great Moderation*.

The next slide illustrates this point by showing that output growth has been much smoother in the post-1984 subsample than it was in the pre-1984 subsample.

Quarterly real per capita GDP growth in the United States: 1947Q2-2017Q4



Notes. The figure displays the growth rate of real GDP per capita in the United States during the postwar period. This variable became less volatile after 1984. Its standard deviation was twice as large in the pre-1984 period than thereafter, 1.2 versus 0.6 percent. This phenomenon is known as the Great Moderation.

A commonly used measure of *volatility* in macroeconomic data is the standard deviation.

According to this statistic, postwar U.S. output growth became half as volatile after 1983.

The standard deviation of quarter-to-quarter real per capita output growth was 1.2 percent over the period 1947Q1 to 1983Q4 and only 0.6 percent over the period 1984Q1 to 2017Q4.

Causes of the Great Moderation

3 explanations:

good luck

good policy

structural change.

The good-luck hypothesis

says that by chance starting in the early 1980s the U.S. economy has been blessed with smaller shocks.

The good-policy hypothesis

gives credit to the government:

— good monetary policy: aggressive low inflation policy started by the Volcker Fed and continued by the Greenspan Fed.

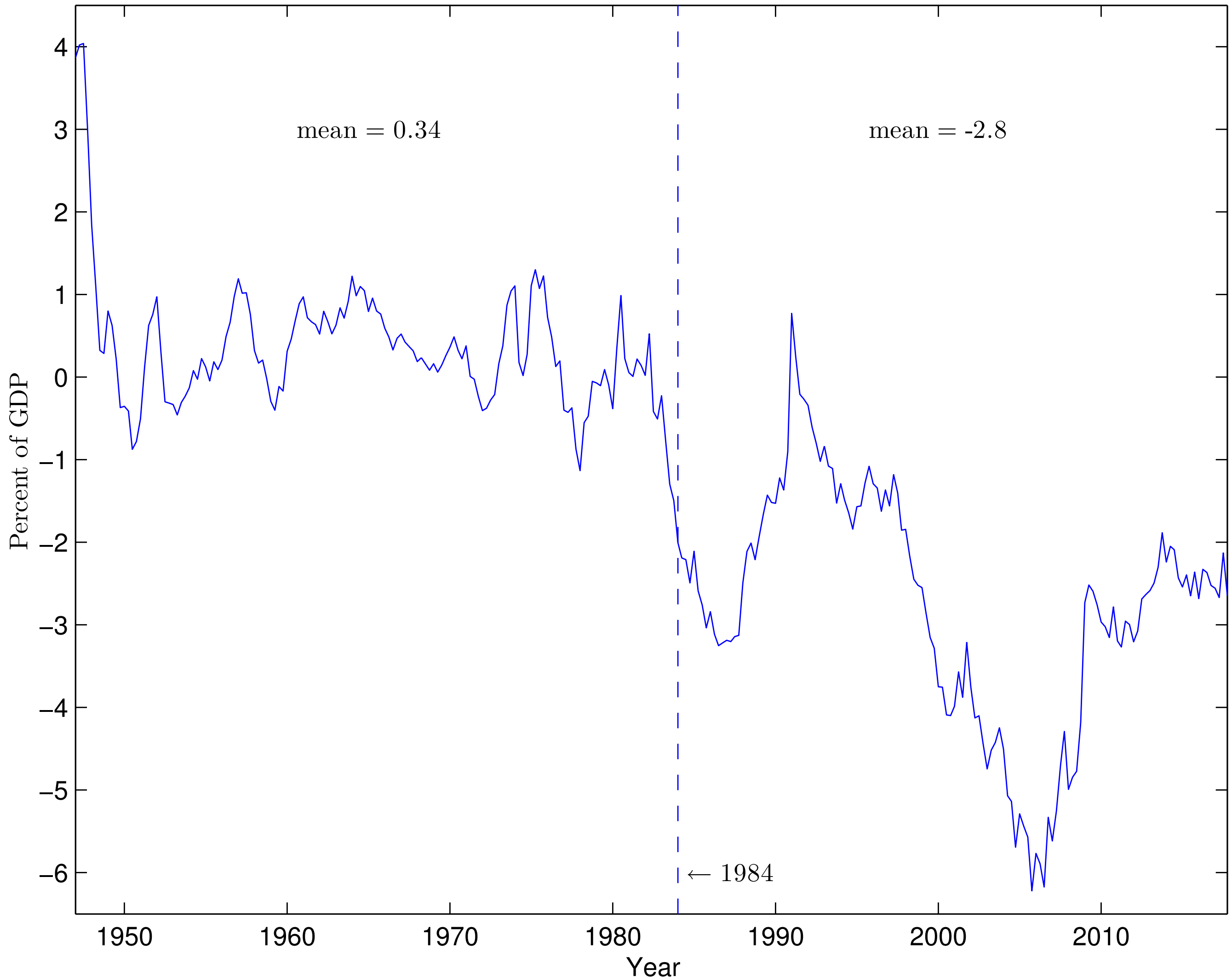
— good regulatory policy: early 1980s regulation Q (or Reg Q) was abandoned. Reg Q imposed a ceiling on the interest rate that banks could pay on deposits. Regulation Q introduces a financial distortion that exacerbates with inflation. When expected inflation goes up (as it did in the 1970s) the real interest rate on deposits, given by the difference between the interest rate on deposits and expected inflation, falls and can even become negative, inducing depositors to withdraw their funds from banks. As a consequence, banks are forced to reduce the volume of loans generating a credit-crunch-induced recession.

The structural change hypothesis

maintains that the Great Moderation was in part caused by structural change, particularly in inventory management and in the financial sector. These technological developments, the argument goes, allowed firms to display smoother flows of production, distribution, sales, employment, and inventories, thereby reducing the amplitude of the business cycle.

We will not dwell on which of the proposed explanations of the Great Moderation has more merit. Our interest is in possible connections between the Great Moderation and the significant current account deterioration observed in the United States over the post-1984 period.

The Great Moderation and the Emergence of Current Account Imbalances



Notes. Current-account-to-GDP ratio in the United States from 1947Q1 to 2017Q4.

During the period 1947Q1-1983Q4 the United States experienced on average positive current account balances of 0.34 percent of GDP. Starting in the early 1980s, large current account deficits averaging 2.8 percent of GDP opened up.

The emergence of persistent current account deficits in the United States coincided with the beginning of the Great Moderation in 1984.

U.S. Summary Statistics

Statistic	**1947Q1-1983Q4**	**1984Q1-2017Q4**
Std. Dev. Output Growth	1.2%	0.6%
Average CA/GDP	0.34%	-2.8%

An Open Economy With Uncertainty

Motivation: Is there a causal relation linking the Great Moderation with the emergence of current account deficits?

To address this question, we will modify the endowment economy of chapter 3 by assuming that the endowment in period 2, Q_2, is uncertain.

Intuition: Facing an uncertain income in period 2, households are likely to engage in *precautionary saving* in period 1. This would allow them to hedge against a bad income realization in period 2. Thus, consumption should fall in period 1. Since the period-1 endowment is unchanged, the trade balance must improve.

Implication: If this intuition is right, the decline in income uncertainty observed during the Great Moderation should lead to an elevation in current account deficits.

Starting Point: An Economy without Uncertainty

Assumptions

- Endowments $Q_1 = Q_2 = Q$ and Q is known with certainty.
- The utility function is $\ln C_1 + \ln C_2$
- Zero initial assets, $B_0 = 0$, and zero interest rate, $r^* = 0$.

Then, the intertemporal budget constraint is $C_1 + C_2 = 2Q$. Using this expression to get rid of C_2 in the utility function, the optimization problem of the household is

$$\max_{\{C_1\}} \ln C_1 + \ln(2Q - C_1)$$

First order condition: $\frac{1}{C_1} = \frac{1}{2Q - C_1}$
Solution: $C_1 = Q$. Thus, we have $TB_1 = Q - C_1 = 0$, $CA_1 = r_0 B_0 + TB_1 = 0$.

Intuition: Output is perfectly smooth so consumption is also perfectly smooth. No need to use the current account to smooth consumption over time.

Introducing Uncertainty

Suppose now that the period-1 endowment continues to be Q, but that the period-2 endowment is uncertain. Specifically,

$$Q_2 = \begin{cases} Q+\sigma & \text{with probability } 1/2 \\ Q-\sigma & \text{with probability } 1/2 \end{cases}.$$

This is a *mean preserving increase in uncertainty*:

$$E(Q_2) = \frac{1}{2}(Q+\sigma) + \frac{1}{2}(Q-\sigma) = Q$$

The parameter σ measures the degree of uncertainty:

Variance of $Q_2 = E(Q_2 - E(Q_2))^2 = \frac{1}{2}(Q+\sigma-Q)^2 + \frac{1}{2}(Q-\sigma-Q)^2 = \sigma^2$

$$\text{Standard deviation of } Q_2 = \sqrt{\text{var}(Q_2)} = \sigma$$

Intertemporal Budget Constraints

$$C_2 = \begin{cases} 2Q + \sigma - C_1 & \text{with probability } 1/2 \text{ (good state)} \\ 2Q - \sigma - C_1 & \text{with probability } 1/2 \text{ (bad state)} \end{cases}$$

Expected Utility

Assume that households care about the expected value of utility.

$$\ln C_1 + E \ln C_2, \tag{1}$$

The Household's Maximization Problem

Using the two state contingent intertemporal budget constraints shown in slide 17 to eliminate C_2 from the lifetime utility function (1), the household problem is to choose C_1 to maximize

$$\ln C_1 + \frac{1}{2}\ln(2Q + \sigma - C_1) + \frac{1}{2}\ln(2Q - \sigma - C_1).$$

The first-order optimality condition associated with this problem is

$$\frac{1}{C_1} = \frac{1}{2}\left[\frac{1}{2Q + \sigma - C_1} + \frac{1}{2Q - \sigma - C_1}\right]. \tag{2}$$

LHS: marginal utility of consumption in period 1.
RHS: expected marginal utility of consumption in period 2.

Precautionary Saving

Is the optimal consumption level under certainty, $C_1 = Q$, also optimal under uncertainty? Let's check this by setting $C_1 = Q$ in optimality condition (2)

$$\frac{1}{Q} \stackrel{?}{=} \frac{1}{2}\left[\frac{1}{2Q+\sigma-Q} + \frac{1}{2Q-\sigma-Q}\right]$$
$$= \frac{Q}{Q^2-\sigma^2} = \frac{1}{Q}\left(\frac{Q^2}{Q^2-\sigma^2}\right) > \frac{1}{Q}$$

So $C_1 = Q$ isn't the solution, as it makes the LHS of (2) less than the RHS. Since the LHS is decreasing in C_1 and the RHS increasing in C_1, we have that the optimal C_1 satisfies

$$C_1 < Q$$

We conclude that a mean-preserving increase in uncertainty induces a fall in consumption and an increase in saving. This increase in saving is called *precautionary saving*.

Uncertainty, the Trade Balance, and the Current Account

An increase in uncertainty causes an improvement in the trade balance and the current account:

$$TB_1 = Q - C_1 > 0.$$

$$CA_1 = r_0 B_0 + TB_1 > 0$$

(since B_0 is assumed to be 0.) Recalling that under certainty $TB_1 = CA_1 = 0$, we have that a mean-preserving increase in uncertainty leads to an improvement in the trade balance and the current account. Similarly, a fall in uncertainty causes a deterioration in the trade balance and the current account.

Viewed through the lens of this model, the reduction in output volatility that came with the Great Moderation should have contributed to the observed concurrent deterioration of the U.S. current account.

Incomplete Asset Markets

In period 1, bond holding is given by

$$B_1 = Q - C_1$$

If σ increases, C_1 falls, so B_1 increases.

So, an increase in uncertainty raises the country's net foreign asset position.

Notice that B_1 is a bond that pays the same return in period 2—namely $1 + r^*$—regardless of the state of nature in period 2. Thus, the household cannot buy a portfolio of assets with desired state-contingent payments in period 2—such as one that pays more in the low-endowment state and less in the high-endowment state.

For this reason, we say that the present model has *incomplete asset markets.*

Complete Asset Markets and the Current Account

Introduction

• In the economy studied thus far households face uninsurable income risk. This is because the only financial instrument available to them ($B_1 = Q - C_1$) is one whose period-2 payoff (B_1) is the same in the good and bad state.

• Households would like to buy a portfolio of assets that pays more in the state in which the endowment is low than in the state in which the endowment is high.

• Here, we introduce such possibility by assuming the existence of *state-contingent claims*.

• In this environment, households do not need to rely on precautionary saving to cover themselves against the occurrence of the low-endowment state.

State Contingent Claims

Suppose that in period 1 there exist the following two assets, known as state contingent claims:

• One asset pays 1 unit of goods in the good state of period 2 and 0 in the bad state. Its price is P^g.

• The other asset pays 1 unit in the bad state and 0 in the good state. Its price is P^b.

• This economy is said to have *complete asset markets* because households can buy asset portfolios with any payoff pattern across states in period 2:
–If the household wishes to have a portfolio that pays x units of goods in the good state and y units in the bad state, then, in period 1, it must simply purchase x units of the asset that pays in the good state and y units of the asset that pays in the bad state. This portfolio costs $P^g x + P^b y$. This was not possible in the economy with a single bond studied earlier in this chapter.

Redundancy of Additional Assets

The 2 state contingent claims allow us to replicate any conceivable asset.

Example: A Risk-Free Bond

A risk-free bond is an asset that costs one unit of good in period 1 and pays $1 + r_1$ units of good in every state of period 2, where r_1 is the risk-free interest rate. Consider now constructing a portfolio of contingent claims that has the same payoff as the risk-free bond, that is, a portfolio that pays $1 + r_1$ in every state of period 2. This portfolio must contain $1 + r_1$ units of each of the two contingent claims. The price of this portfolio in period 1 is $(P^g + P^b)(1 + r_1)$. This price must equal the price of the risk free bond, namely 1, otherwise a pure arbitrage opportunity would allow agents to become infinitely rich. So we have that

$$1 + r_1 = \frac{1}{P^g + P^b}.$$

Thus, the gross risk-free interest rate is the inverse of the price of a portfolio that pays one unit of good in every state of period 2.

The Household's Budget Constraints

The budget constraint in period 1 is

$$C_1 + P^g B^g + P^b B^b = Q, \tag{3}$$

where B^g and B^b are the quantities of state contingent claims purchased in period 1.

In period 2, there is one budget constraint for each state

$$\text{good state:} \quad C_2^g = Q + \sigma + B^g \tag{4}$$

$$\text{bad state:} \quad C_2^b = Q - \sigma + B^b \tag{5}$$

The Household's Optimization Problem

Use these budget constraints to eliminate C_1, C_2^g, and C_2^b from the expected utility function $\ln C_1 + E \ln C_2$.

The household's problem is then to choose B^g and B^b to maximize

$$\ln(Q - P^g B^g - P^b B^b) + \frac{1}{2}\ln(Q + \sigma + B^g) + \frac{1}{2}\ln(Q - \sigma + B^b).$$

The associated optimality conditions are:

$$\frac{1}{C_1} = \frac{1}{P^g}\frac{1}{2}\frac{1}{C_2^g} \tag{6}$$

and

$$\frac{1}{C_1} = \frac{1}{P^b}\frac{1}{2}\frac{1}{C_2^b}. \tag{7}$$

Note: 2 optimality conditions, 1 per state. Compare with the incomplete market economy with just one risk-free bond, where we only have 1 such optimality condition (1 Euler equation).

Free International Capital Mobility

In this case, the prices of state contingent claims must be the same domestically and abroad:

$$P^g = P^{g*}$$

and

$$P^b = P^{b*}.$$

Thus, the world interest rate, $1 + r^*$, must satisfy

$$1 + r^* = \frac{1}{P^{g*} + P^{b*}}.$$

As we did in the one-bond economy we assume that

$$r^* = 0.$$

Assumption: Foreign Investors Make 0 Expected Profits

The revenue in period 1 of a foreign investor who sells B^g and B^b units of state contingent claims is

$$P^{g*}B^g + P^{b*}B^b$$

If this amount was invested in a risk-free bond, in period 2 it pays

$$(1 + r^*)(P^{g*}B^g + P^{b*}B^b)$$

in both states. But foreign investor must pay B^g if the state is good and B^b if the state is bad:

$$\text{payoff in good state: } (1 + r^*)(P^{g*}B^g + P^{b*}B^b) - B^g$$
$$\text{payoff in bad state: } (1 + r^*)(P^{g*}B^g + P^{b*}B^b) - B^b$$

So, expected profits is $(1 + r^*)(P^{g*}B^g + P^{b*}B^b) - \frac{1}{2}B^g - \frac{1}{2}B^b = 0$, or, rearranging and recalling the assumption that $r^* = 0$,
$(P^{g*} - 1/2)B^g + (P^{b*} - 1/2)B^b = 0$.
Since B^g and B^b are arbitrary, we have that

$$P^g = P^b = \frac{1}{2}$$

Equilibrium

Using the result that $P^g = P^b = 1/2$, to replace P^g and P^b in the household's optimality conditions (6) and (7), we obtain

$$C_1 = C_2^g = C_2^b.$$

Thus, complete asset markets allows households to completely smooth consumption across time and states of nature.

Equilibrium (cont.)

Combine the result that $C_1 = C_2^g = C_2^b$ with the budget constraints (3), (4), and (5) to get

$$\begin{aligned} B^g &= -\sigma, \\ B^b &= \sigma, \\ C_1 &= C_2^g = C_2^b = Q. \end{aligned}$$

Thus, the household takes a short position in contingent claims that pay in the good state and a long position in claims that pay in the bad state.

The trade balance and current account are

$$\begin{aligned} TB_1 &= Q - C_1 = 0 \\ CA_1 &= r_0 B_0 + TB_1 = 0. \end{aligned}$$

Thus, under complete financial markets precautionary saving is zero and the link between the level of uncertainty and the current account disappears.

Note that the net asset position is nil ($B^g + B^b = 0$), but gross positions ($B^g = -\sigma$ and $B^b = \sigma$) increase with uncertainty.

Summing Up

- Great Moderation (1984-): lower output growth volatility. Three main explanations: good luck, good policy, and structural change.

- The Great Moderation coincided with the beginning of sizable U.S. current account deficits.

- A model of an open economy with uncertain future endowments predicts that an increase in uncertainty causes an increase in precautionary saving and improvements in the trade balance and the current account.

- Under complete markets the positive relationship between the level of uncertainty and the current account disappears.