ECON7520 Int'l Macroeconomics and Finance Lecture 05

Shino Takayama

University of Queensland

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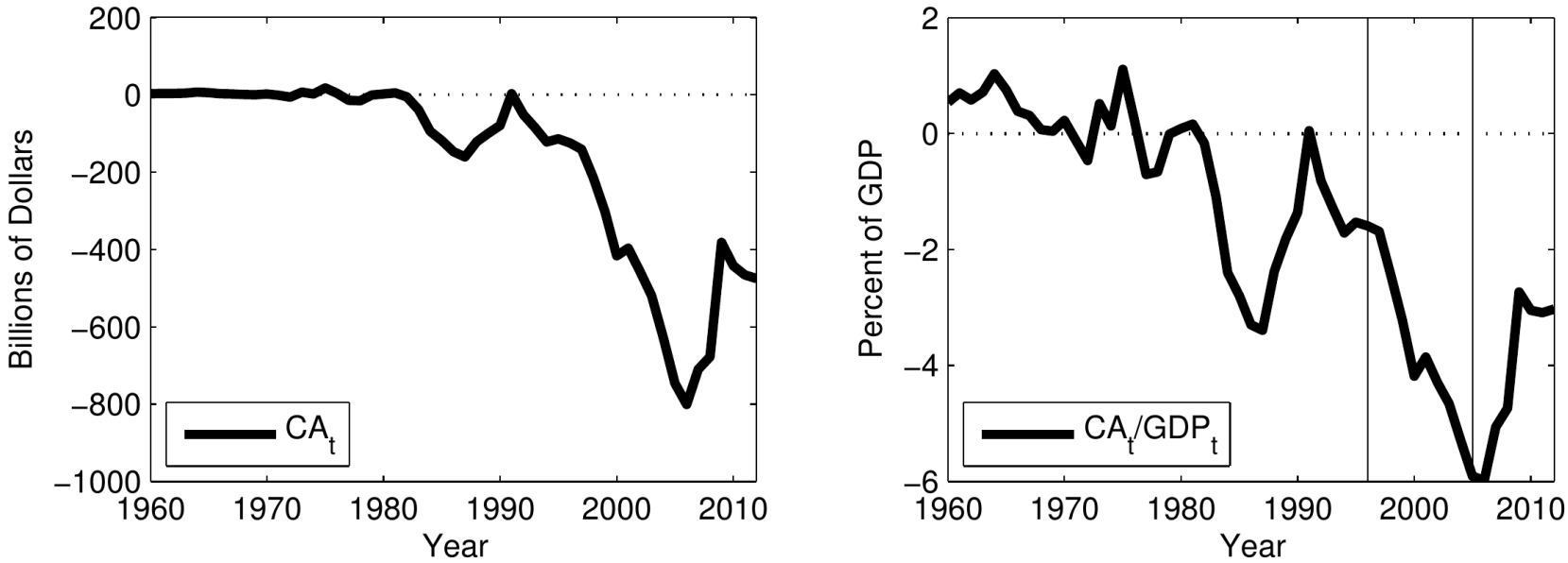
Week 5: External Adjustment in Open Economies

Motivation: The U.S. Current Account Deficit

Figure: The U.S. Current Account Balance: 1960-2012



Data Source: BEA. The vertical lines indicate the years 1996 and 2005.

- Question: Were the rise and fall in the current account deficit during 1996-2010 driven by domestic or external factors?

Current Account Schedule

Key Points

- We will develop a graphical tool to analyze a current account balance.
- Following the previous lecture, we will derive
  1. Investment schedule
  2. Saving schedule
  3. Current Account schedule
- We use the graphical representation of the CA schedule to analyze various shocks.
- The advantage is that we can analyze both household's and firm's sides at the same time.

Recap: Setup

- Time period: 1 and 2.
- Agent: A representative household in the country.
  - Make intertemporal consumption and saving decisions.
- Good: A single consumption good in this world
- Asset: A single asset, bond, in this world
  - The household holds B_0^h units of a bond at the beginning.
- Household's Income from a firm: The household owns a firm, and obtain profits.
- Interest Rate: r_0 for the initial asset, and r_1 for the asset held at the end of period 1.

Recap: Firm

- Firm's problem is
  - A firm makes investments one period ahead and produces outputs.
  - Investment in period 0: I_0 is exogenously given.
  - Investment in period 1: I_1 is chosen by the firm.
- Production: The productions in period 1 and 2 are given by

$$Q_1 = A_1 F(I_0)$$
$$Q_2 = A_2 F(I_1)$$

where $F(\cdot)$ is a specific function, and $A_1 > 0$ and $A_2 > 0$ are technologies.

Recap: Investment Schedule

- As in the last week, we assume a representative firm in the small open economy.
- How does the firm choose the investment level I_1?
- They will choose the investment level by equating the marginal product to the marginal cost. (**MP=MC**)
- The firm's marginal product is given by:

$$\text{(Marginal Product of Capital (MPK))} = \frac{\Delta A_2 F(I_1)}{\Delta I_1} = A_2 F'(I_1).$$

- The firm's marginal cost is given by:

$$\text{(Marginal Cost of Capital (MCK))} = (1 + r_1).$$

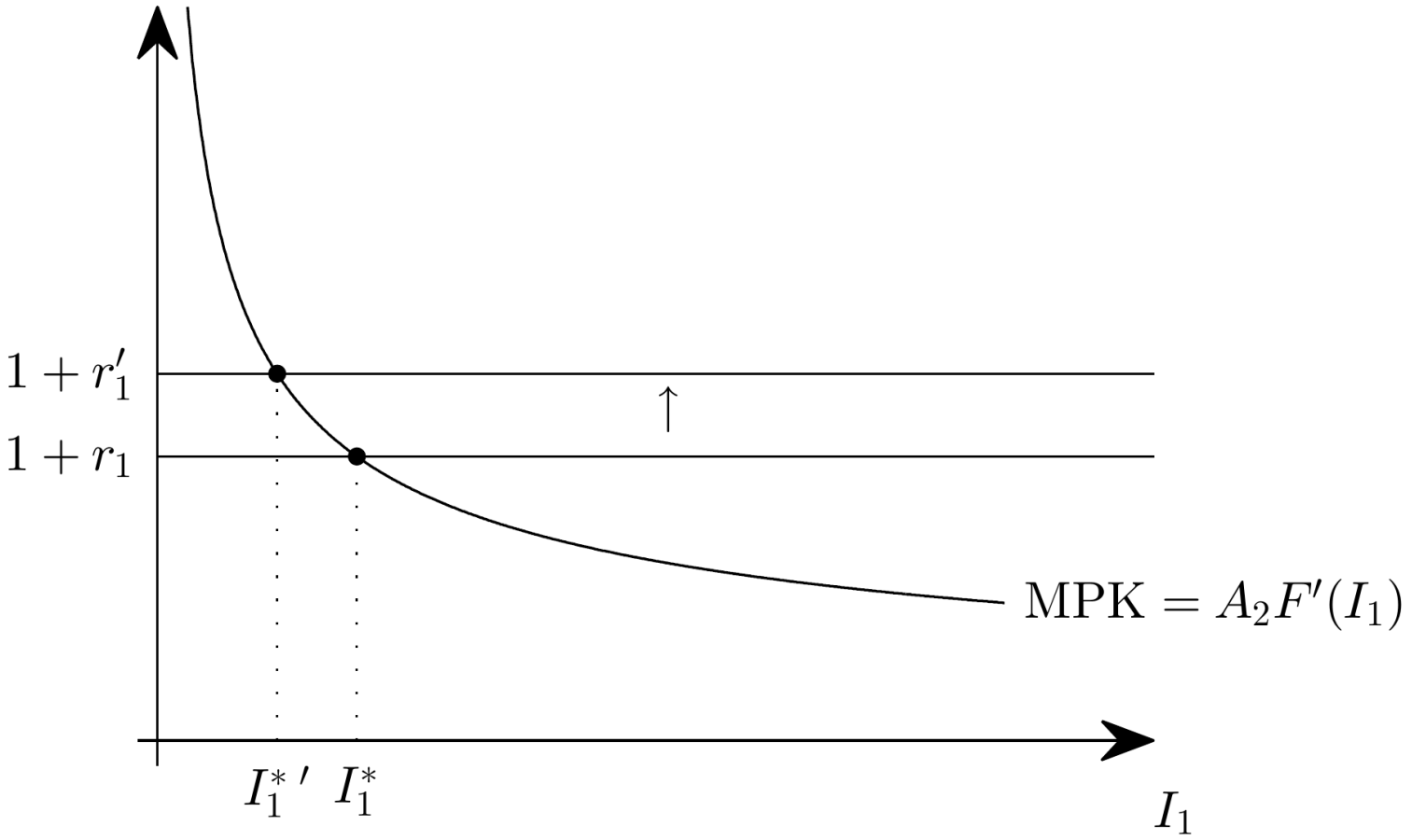
- Therefore, we have

$$A_2 F'(I_1) = (1 + r_1)$$

as the firm's optimal investment condition.

Investment Schedule

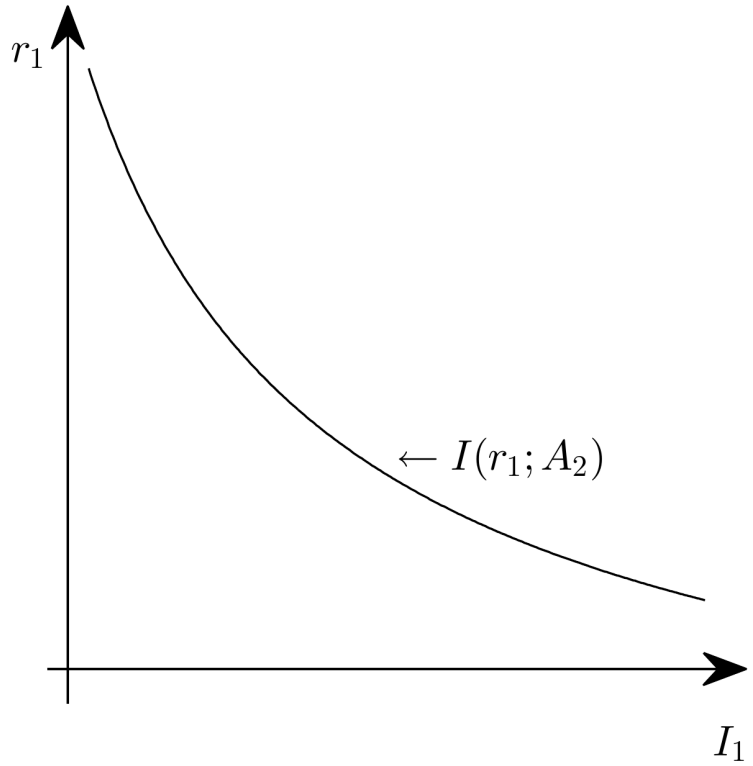
Figure: Firm's Optimal Investment Decision



- By assumption, F' is positive but decreasing.

Investment Schedule

Figure: Firm's Optimal Investment Decision



- Investment schedule has a negative relationship with the world interest rate.

Saving Schedule

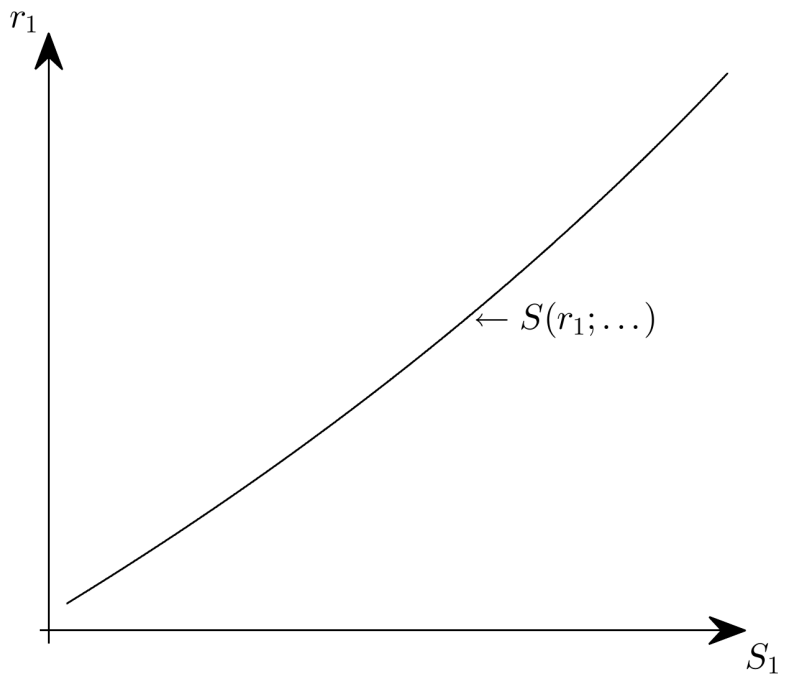
- As we discussed in the last week, there are two potentially opposing effects:
  1. Substitution effect
     - An increase in the interest rate makes savings more attractive.
  2. Income effect
     1. An increase in the interest rate makes debtors poorer.
     2. An increase in the interest rate makes creditors richer.

Assumption of Strong Substitution Effects

The substitution effect dominates the income effect.

Saving Schedule

Figure: Firm's Optimal Investment Decision



- Saving schedule has a positive relationship with the world interest rate.

Current Account Schedule

- Now, we analyse how the current account reacts to the changes in the interest rate.

Current Account Schedule

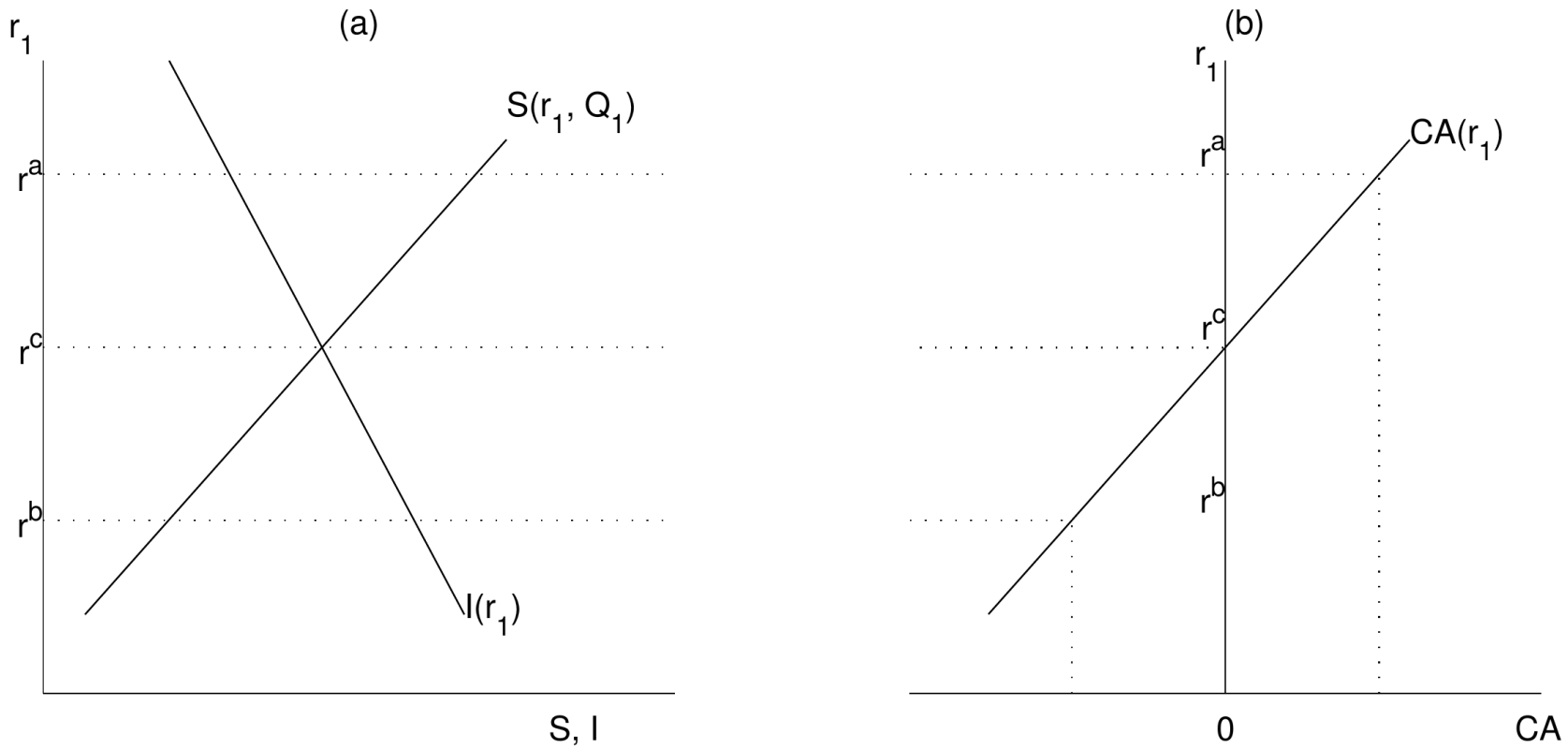
The current account is defined as

$$CA_1 = S_1(r) - I_1(r).$$

- Note that both S_1 and I_1 depend on the interest rate r_1.
- Therefore, we can also consider CA_1 as a function of the interest rate r_1.

Current Account Schedule

Figure: Savings, Investment, and the Current Account



- Note that the current account balance is an increasing function of r_1.

Current Account Schedule

Three possible cases:

1. Positive current account:

$$CA(r^a) = S(r^a) - I(r^a) > 0.$$

2. Negative current account:

$$CA(r^b) = S(r^b) - I(r^b) < 0.$$

3. Zero (balanced) current account:

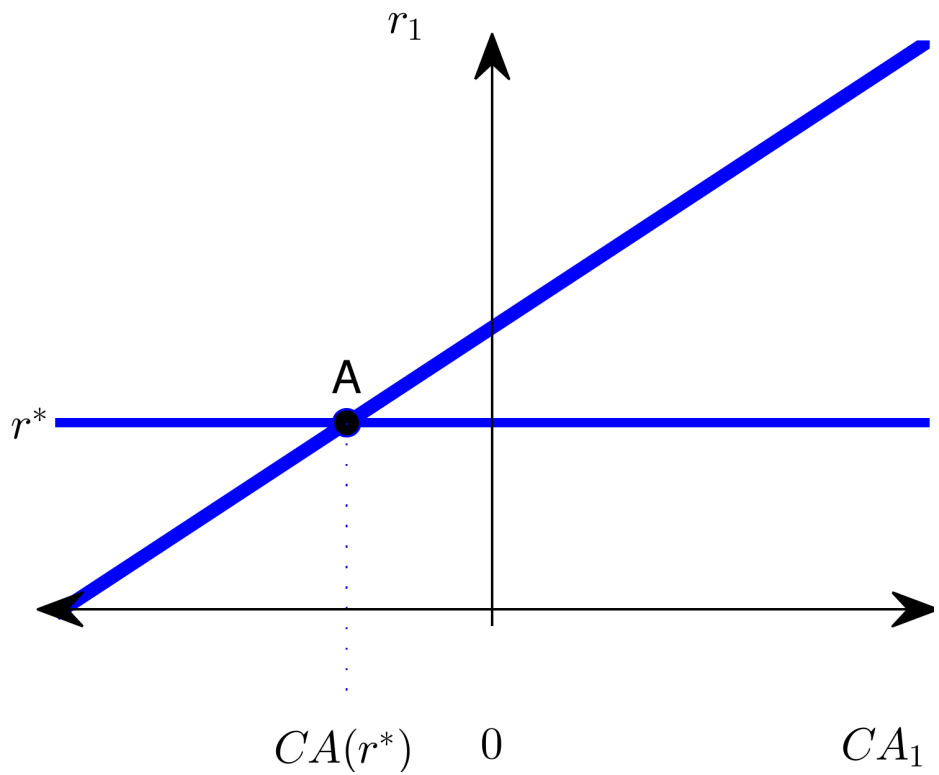
$$CA(r^c) = S(r^c) - I(r^c) = 0.$$

- The current account is determined by the difference between supply of capital (saving) and demand of capital (investment) given a world interest rate.

Summary for Small Open Economy Case

1. Current account is an increasing function of the interest rate.
2. In a small open economy, the world interest rate r^* is given.
3. CA is determined as the point A, where the CA schedule intersects with the interest rate line.

Figure: Current Account Determination in a Small Open Economy



Shocks in the Graphical Framework

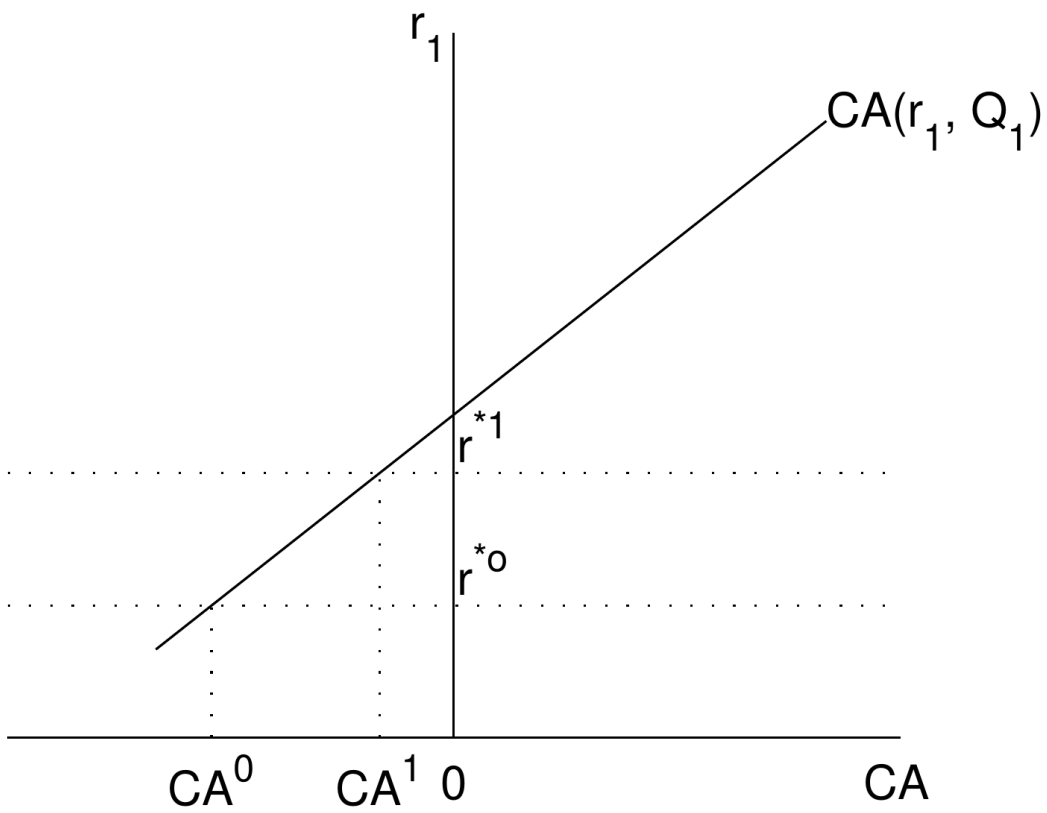
Shocks in the Graphical Framework

- We consider the following three types of shocks in this framework.

1. Interest rate shock.
   - A positive shock to the world interest rate r^*.
2. Output shock
   - A positive shock to the current period output Q_1
3. Productivity shock
   - A positive shock to the next-period productivity A_2.

Interest Rate Shock

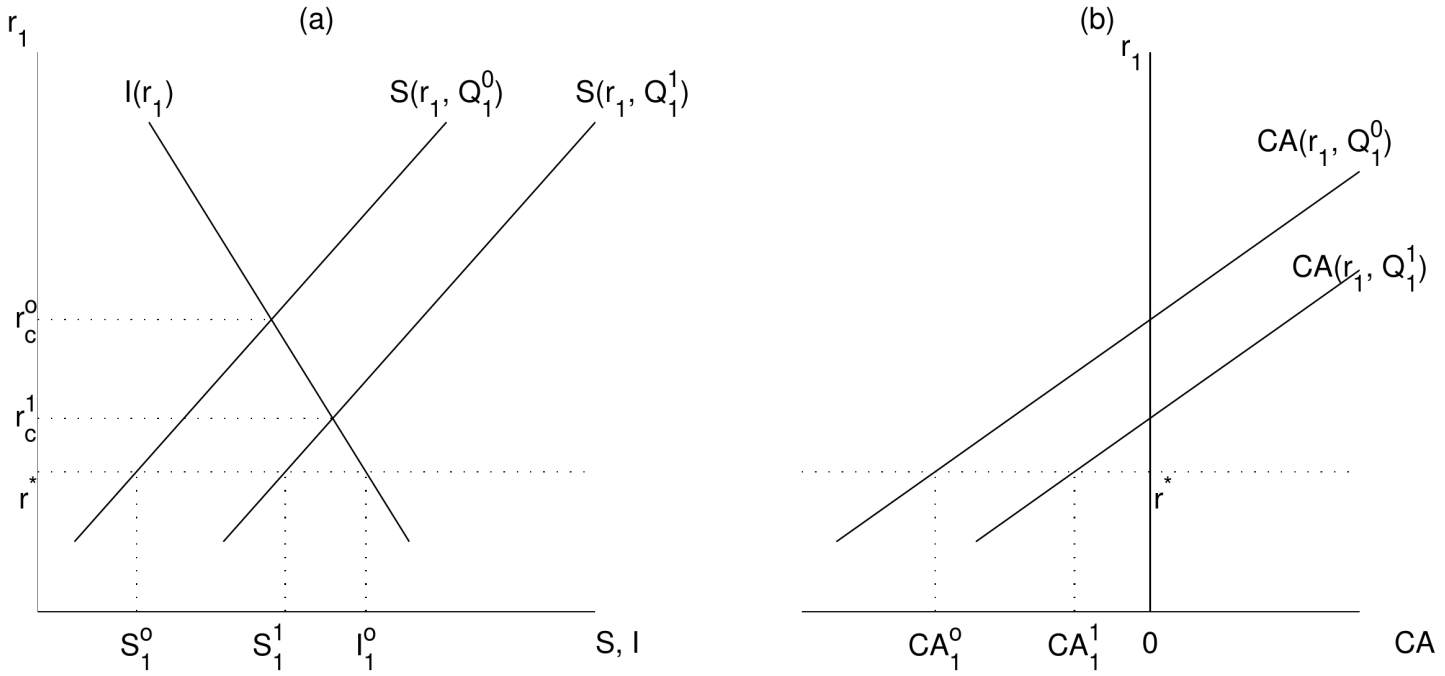
Figure: Current Account Adjustment to an Increase in the World Interest Rate



- A positive shock to the interest rate ($r^{*0} \rightarrow r^{*1}$) .
- CA balance improves when there is a positive interest rate shock.

Output Shock

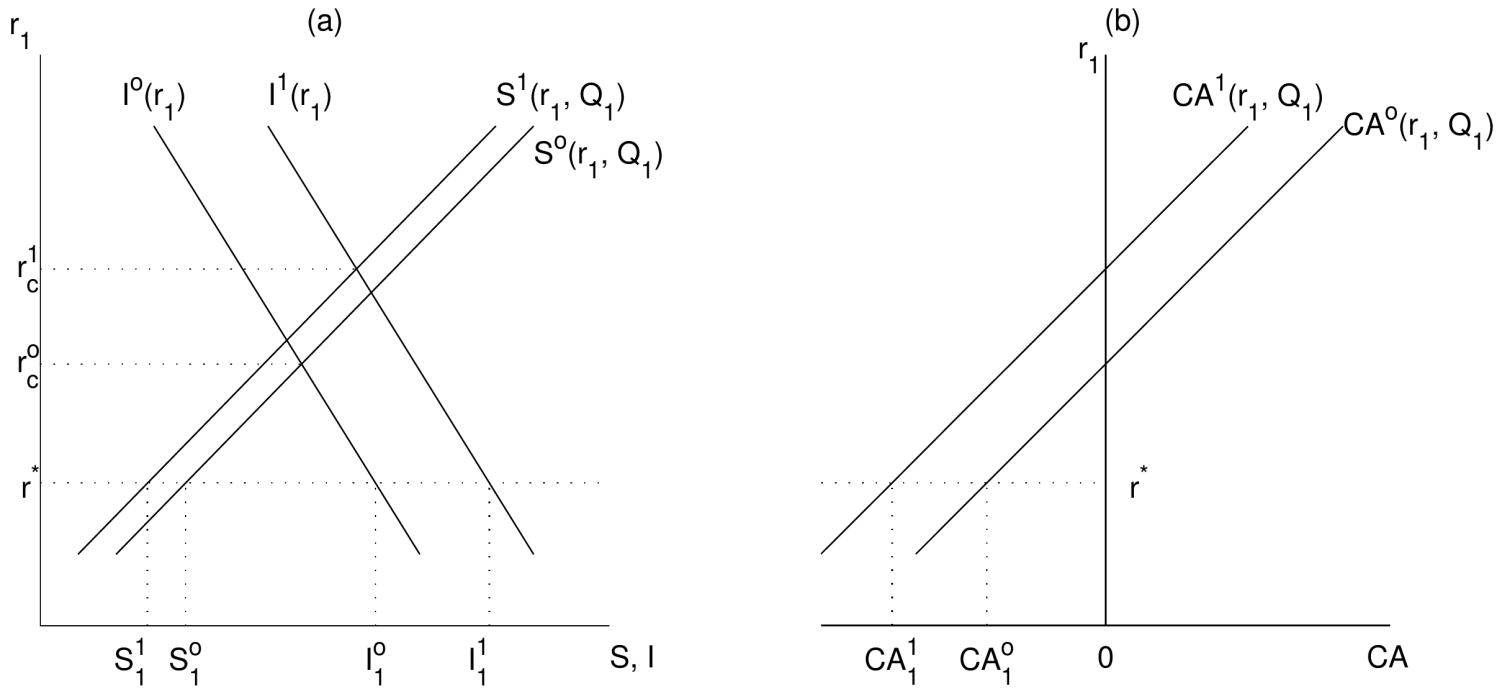
Figure: Current Account Adjustment to a Temporary Increase in Output



- A positive shock to the current-period output ($Q_1^0 \rightarrow Q_1^1$).
- CA balance gets better when there is a positive output shock.

Investment Surge (Productivity Shock)

Figure: Productivity Shock (Investment Surge)



- A positive shock the next-period productivity ($A_2 \rightarrow A_2'$).
- CA balance gets worse when there is a productivity shock.

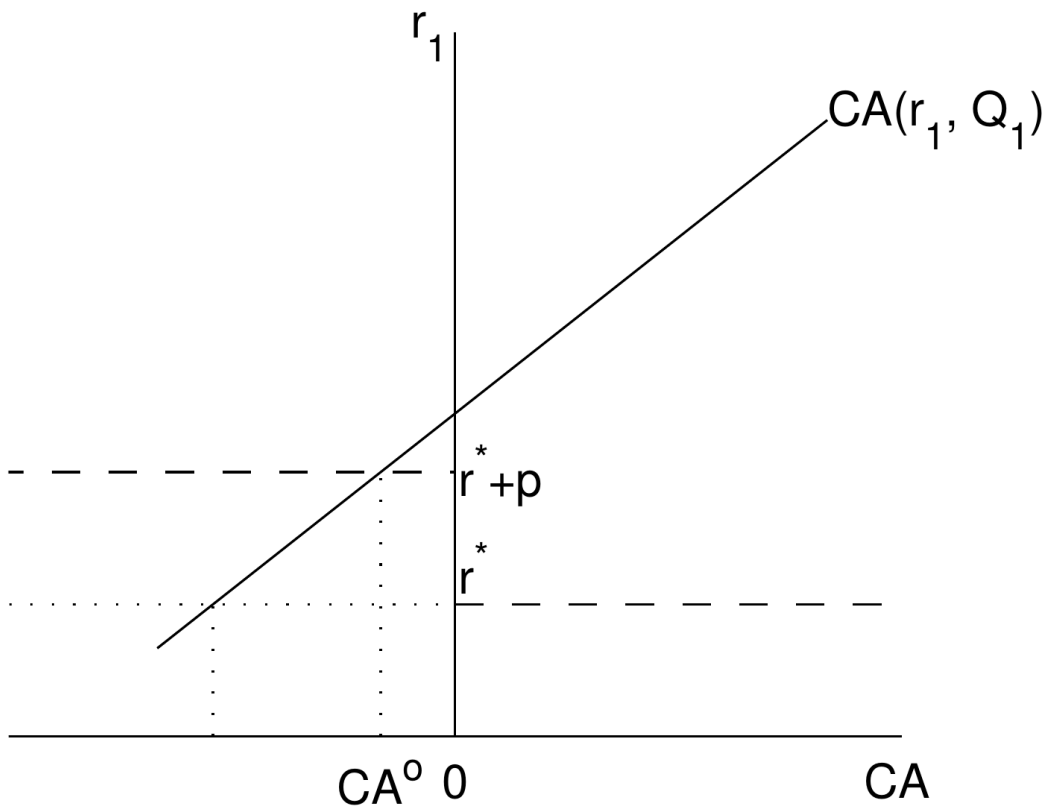
Shocks Extension: Country Risk Premium

Country Risk Premium

- Emerging countries often face a higher interest rate.
- It is especially the case when the country is a debtor.
- How can we analyze those cases in the framework?
- Assume that, when the country is a debtor, the world interest rate is raised by a country risk premium, p.

Constant Country Risk Premium

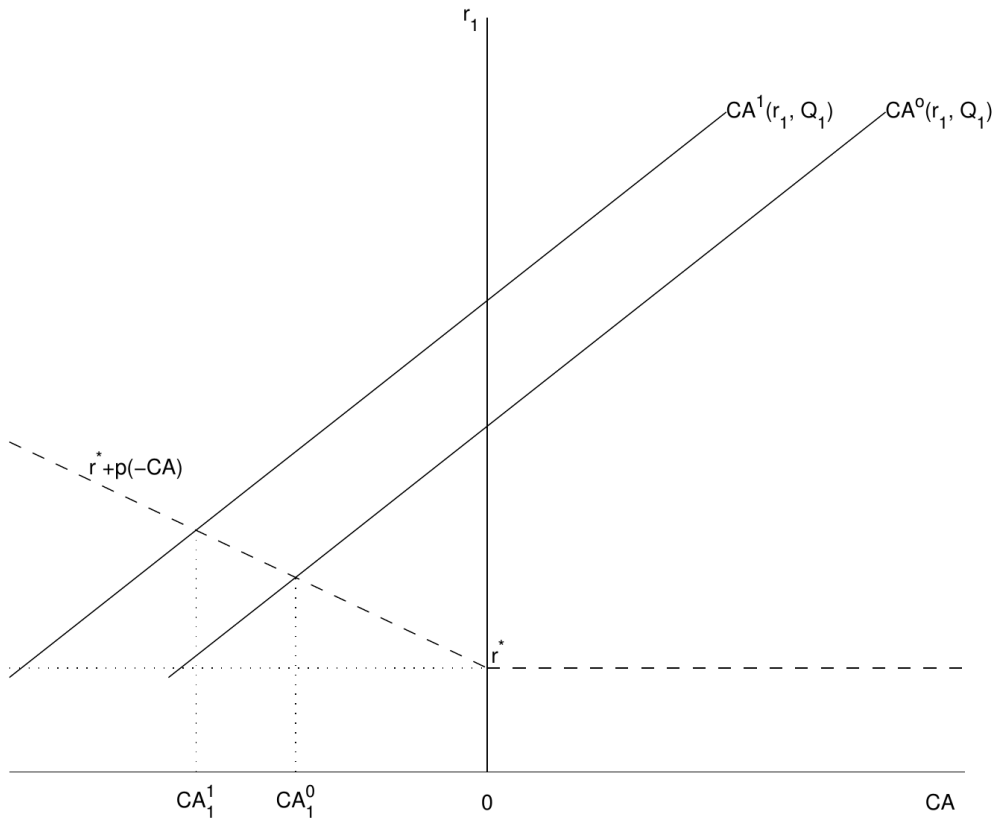
Figure: CA Determination in the Presence of a Constant Risk Premium.



- In this case, the CA line intersects with $r^* + p$.
- Therefore, the country is facing a higher interest rate, $r^* + p$.

Increasing Country Risk Premium

Figure: CA Determination in the Presence of an Increasing Risk Premium



- In this case, the country faces a higher interest rate as it accumulates more debt.
- The premium p is increasing in the amount of the CA deficit.

Extension: Large Open Economy

Large Open Economy

- Thus far, we have considered current account determination in a small open economy.
- How would the result(s) change if we consider a large open economy.
- To do so, we set up a two-country model: the US and the rest of the world (RW)
- The important assumption is that the US's CA balance affect the world interest rate.
- Also, note that

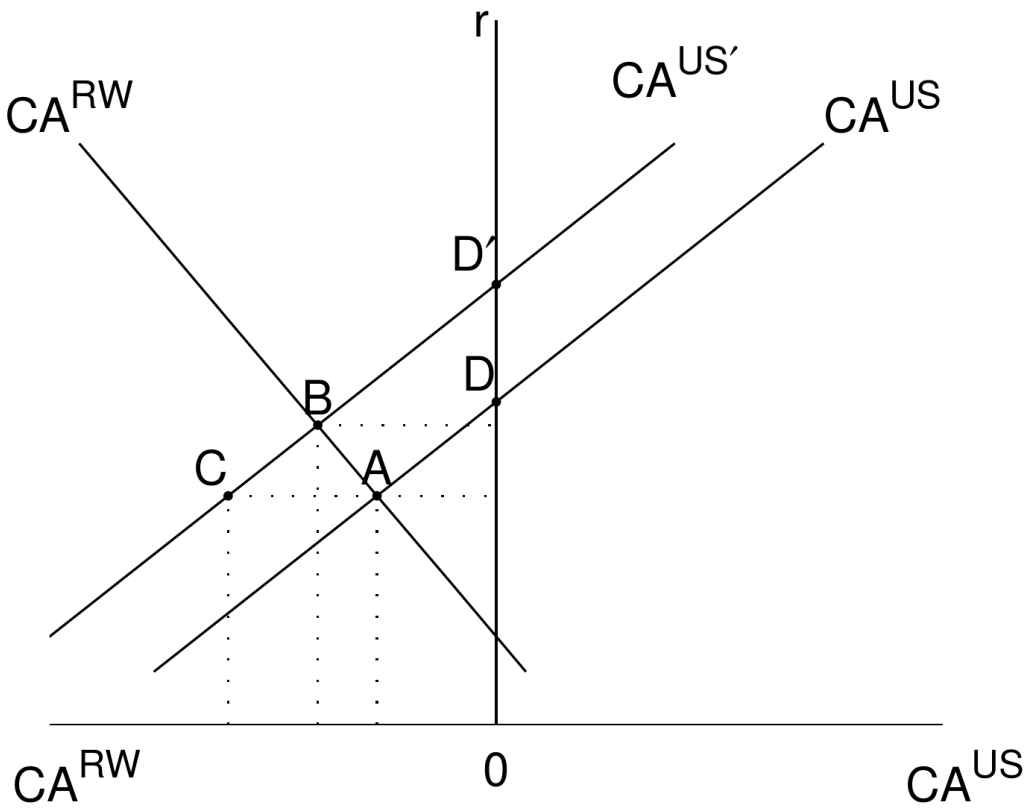
$$CA^{US} = -CA^{RW}$$

or

$$CA^{US} + CA^{RW} = 0.$$

- That is, the US's CA surplus implies the RW's CA deficit.

Figure: Current Account Determination in a Large Open Economy



- We draw the US's and RW's current accounts in a symmetric graph.
- The point A is the equilibrium ($CA^{US} = -CA^{RW}$).

Investment Surge in a Large Open Economy

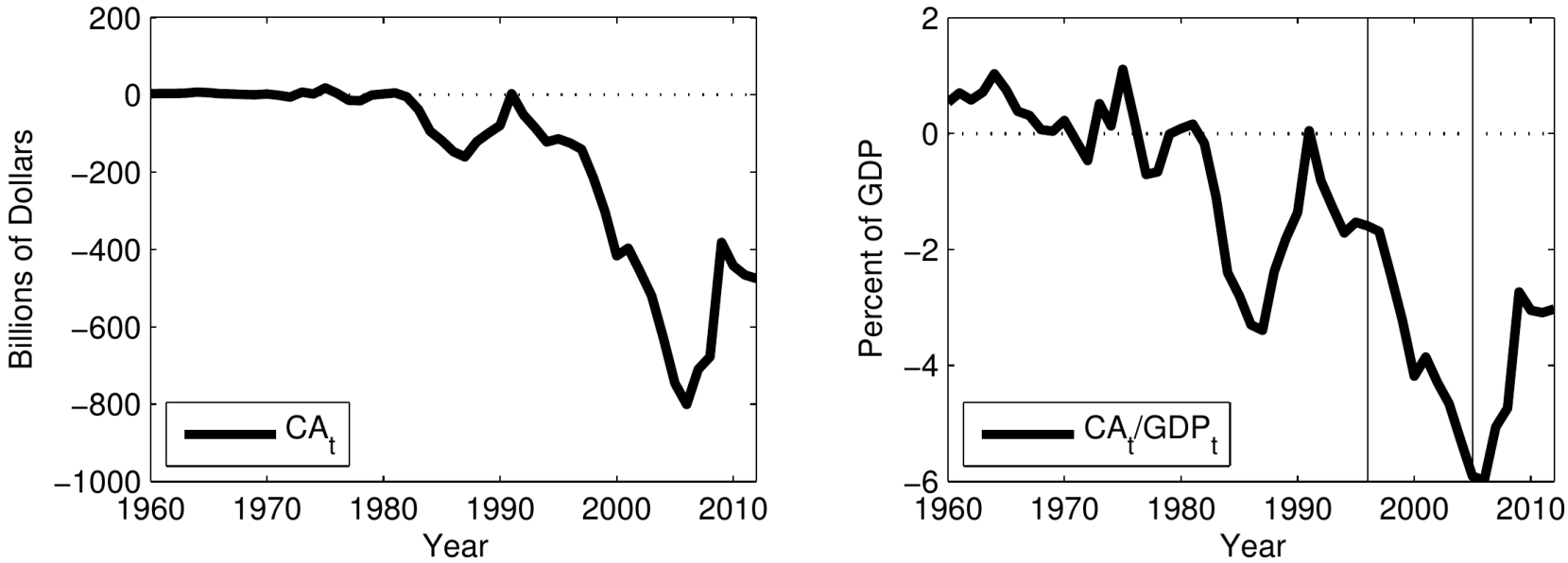
- Now consider an investment surge in the US economy.
- It shifts the CA line from CA^{US} to $CA^{US'}$.
- Thus, the equilibrium point moves from A to B.
- Note that;

1. The change in CA is smaller than the one in the small open economy setup.
   - In the small open economy, the point A moves to C.
2. The change in CA is large than the one in the closed economy setup.
   - In the closed economy, the point D moves to D′.

The U.S. Current Account Deficit

The U.S. Current Account Deficit

Figure: The U.S. Current Account Balance: 1960-2012



Data Source: BEA. The vertical lines indicate the years 1996 and 2005.

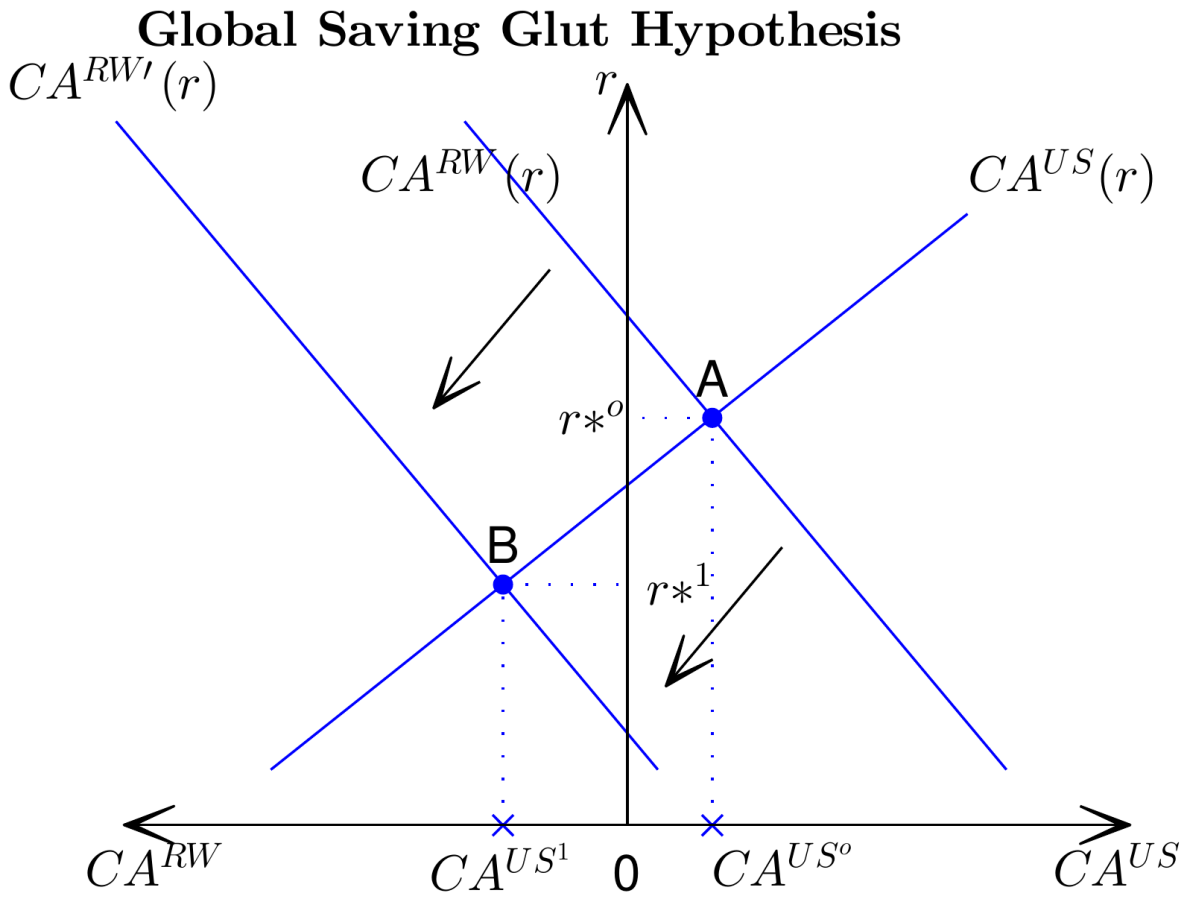
- Question: Were the rise and fall in the current account deficit during 1996-2010 driven by domestic or external factors?

The Global Saving Glut Hypothesis

- In 2005, Ben Bernanke, then a governor of the Federal Reserve, gave a speech on the U.S. CA deficits.
- He argue that the CA deficits between 1996 and 2004 were caused by "global saving glut".
  - The rest of the world experienced a heightened desire to save but did not have incentives to increase domestic capital formation.
- Can we test whether Bernanke's argument is true or not?

The Global Saving Glut Hypothesis

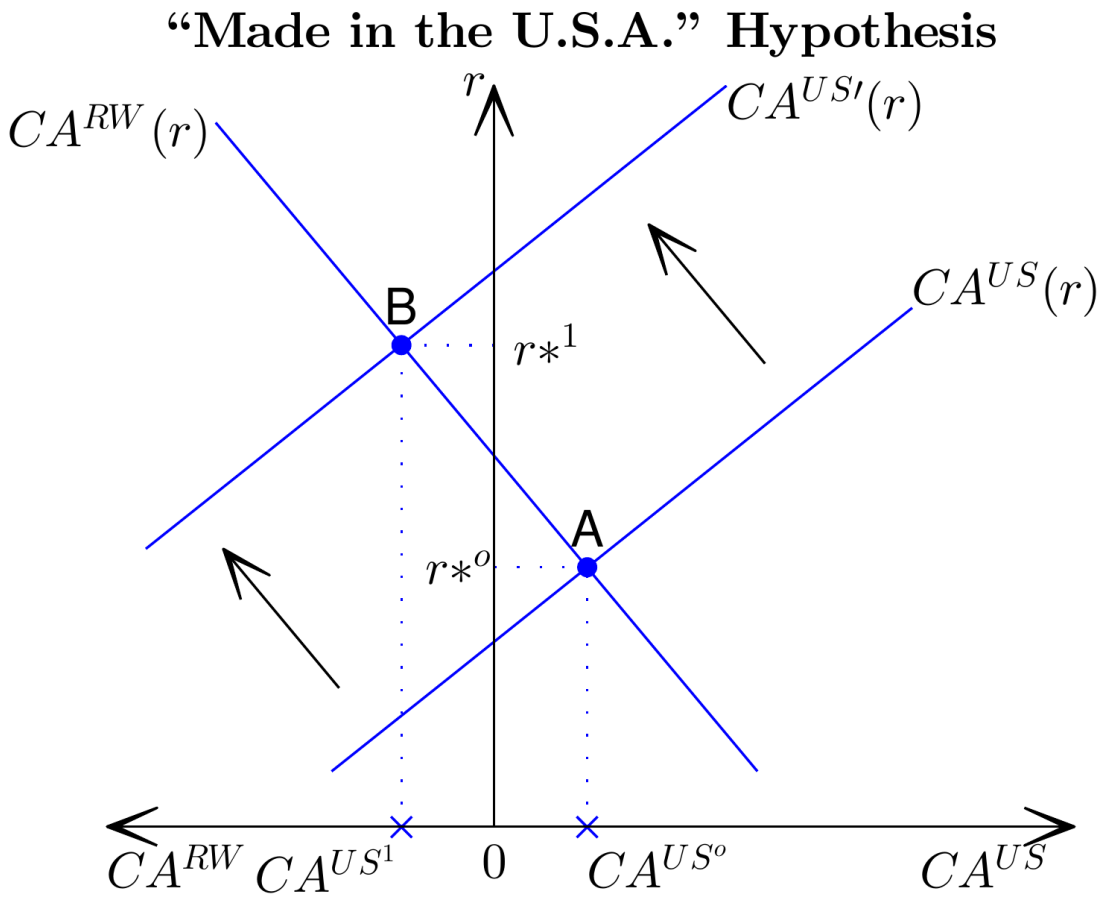
Figure:



- The case that the external factor(s) is responsible.

Made in the U.S.A. Hypothesis (Alternative Explanation)

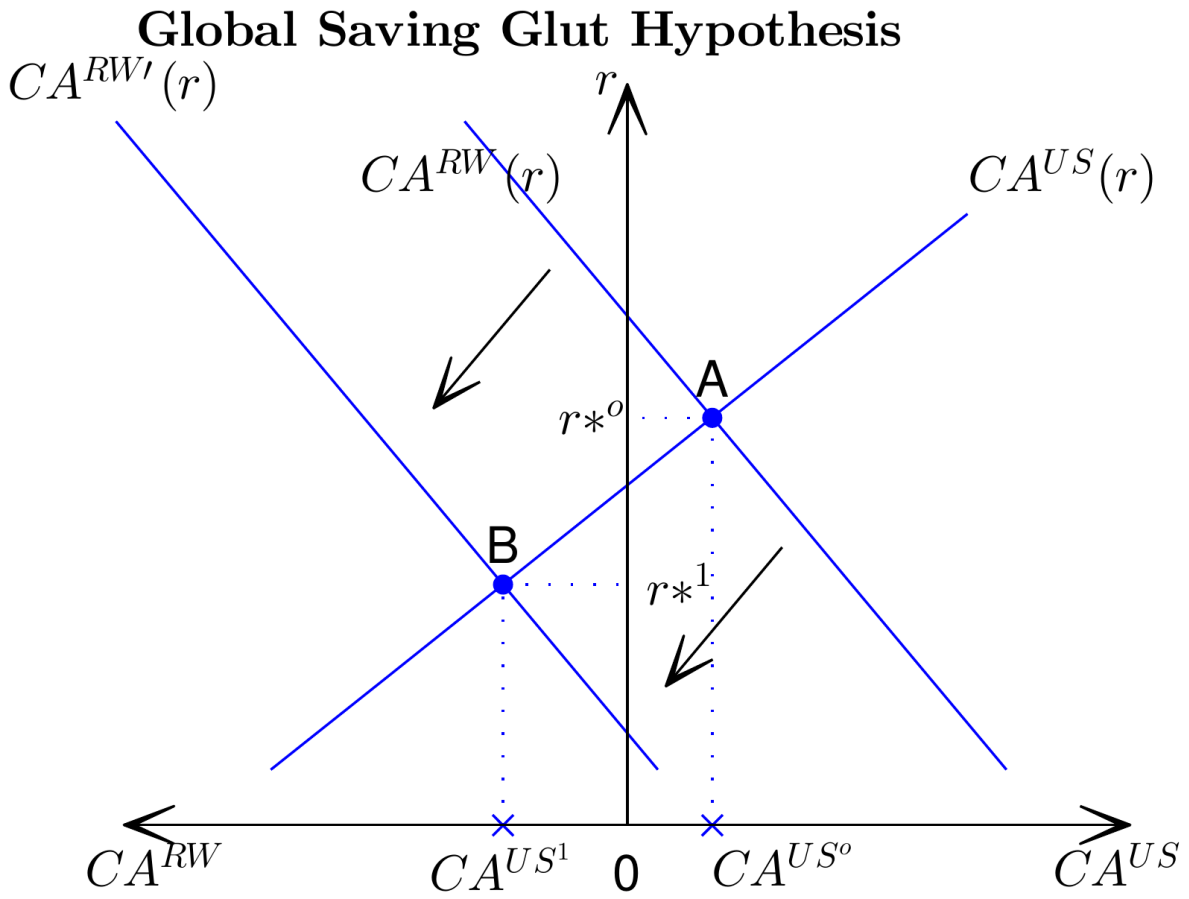
Figure: U.S. Current Account Deterioration



- The case that the US' domestic factor(s) is responsible.

The Global Saving Glut Hypothesis

Figure:



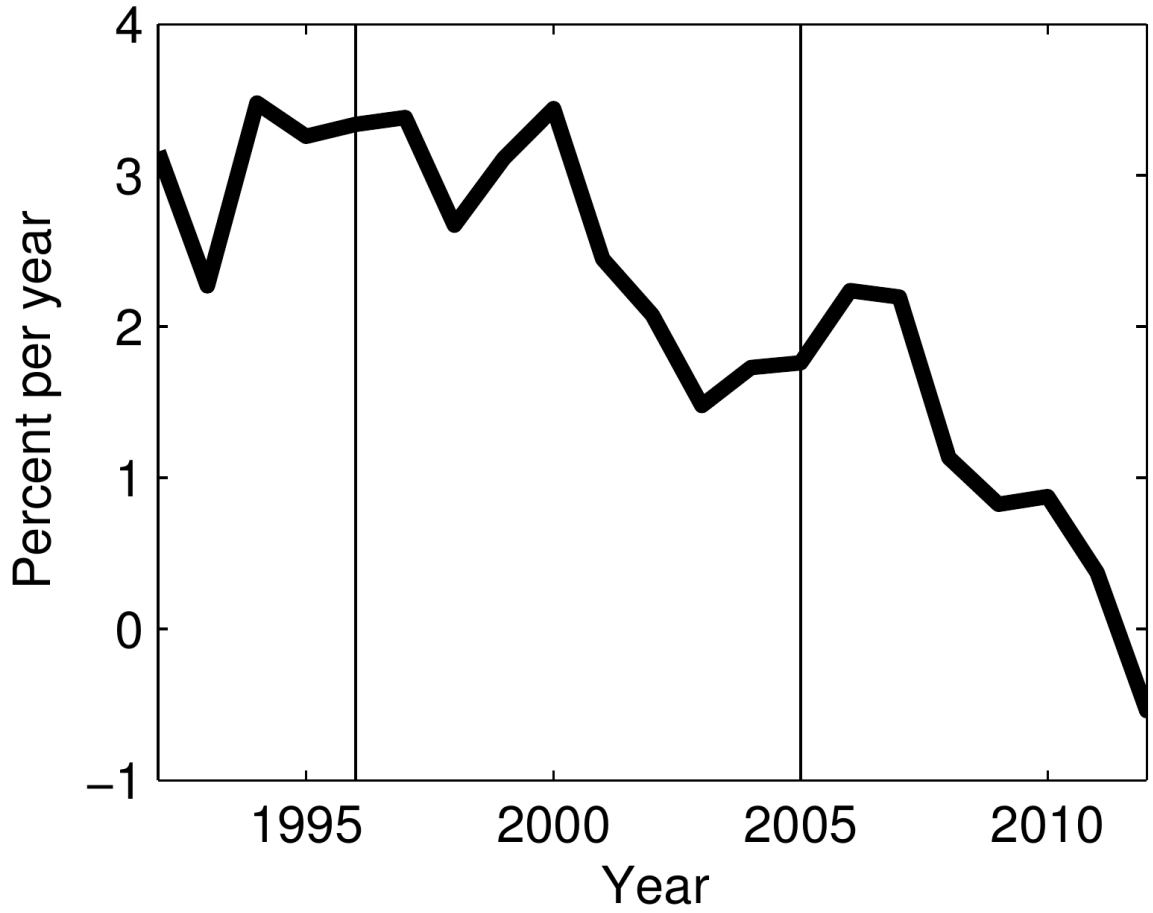
- The case that the external factor(s) is responsible.

Testing the Hypothesis

- How can we test these two competing hypotheses?
- Is there any way that allows us to identify two hypotheses?
- Hint: The world interest rate data.

Testing the Hypothesis

Figure: The World Interest Rate: 1992-2012



- Note that in both periods, 1995-2005 and 2006-2012, the world interest rate fell.

Key Difference

- The relationship between US' CA and the world interest rate is
  - The Global Saving Glut Hypothesis - Positive;
  - The Made in the U.S.A. Hypothesis - Negative.

Summary of the Global Saving Glut Hypothesis

- During 1996 - 2005
  - Note that the world interest rate had fallen during the period.
  - Therefore, we can say that the global saving glut hypothesis is true for the period.
- During 2005-2012
  - The world interest rate had fallen further during the period.
  - However, the CA actually got better during the period.
  - Therefore, we conclude that the made in the U.S.A. hypothesis applies for the period.

Large Open Economy

Key Points

- Here, we will analyze large open economies.
- Example of large open economies: The U.S., Japan, Germany, the U.K., China, and India.
- We use the two-country economic model: The U.S. and China.
- Key: Both countries have effects on the world interest rate.

Setup

- Time period: 1 and 2.
- Country: The United States (US) and China (C).
- Agent: A representative household in each country.
- Good: A single traded good in this world.
- Endowment: Each country receives endowment in each period.
  - For the U.S., Q_1^{US} in period 1, and Q_2^{US} in period 2.
  - For China, Q_1^{C} in period 1, and Q_2^{C} in period 2.
- Asset: A single asset, bond, in this world.
  - For simplicity, assume the initial assets for both countries are zero.
- Interest Rate: r_1 for the U.S., and r_1^{C} for China, and r_1^{*} for the world.

Equilibrium under Free Capital Mobility

An equilibrium is defined by the following conditions

1. (US) Maximization of $U\left(C_1^{US}, C_2^{US}\right)$ subject to its budget constraint for each period;
2. (China) Maximization of $U\left(C_1^{C}, C_2^{C}\right)$ subject to its budget constraint for each period;
3. The world current account balances:

$$CA_1^C + CA_1^{US} = 0.$$

4. The interest rate condition

$$r_1 = r_1^C = r_1^*.$$

Example: Large Open Economy

- Assume log utility for both countries.

$$U(C_1, C_2) = \ln C_1 + \ln C_2.$$

- Assume China's endowment is growing.
  - $Q_1^{US} = Q$, and $Q_2^{US} = Q$ where Q denotes for some specific amount.
  - $Q_1^C = \frac{1}{2}Q$, and $Q_2^C = Q$.
- In this case, we can show that

$$C_1^{US} = \frac{1}{2}\left(Q + \frac{Q}{1+r_1}\right), \quad C_2^{US} = \frac{1}{2}(1+r_1)\left(Q + \frac{Q}{1+r_1}\right)$$

$$C_1^C = \frac{1}{2}\left(\frac{1}{2}Q + \frac{Q}{1+r_1^C}\right), \quad C_2^C = \frac{1}{2}(1+r_1^C)\left(\frac{1}{2}Q + \frac{Q}{1+r_1^C}\right)$$

Derivation: the US

Choose consumptions and net foreign assets to maximize

$$U(C_1^{US}, C_2^{US}) = \ln C_1^{US} + \ln C_2^{US}.$$

subject to

$$C_1^{US} + B_1^{US} = Q_1^{US}$$
$$C_2^{US} = Q_2^{US} + (1 + r_1)B_1^{US},$$

where we impose $B_2^{US} = 0$.
Then

$$C_1^{US} + \frac{C_2^{US}}{1 + r_1} = Q_1^{US} + \frac{Q_2^{US}}{1 + r_1}.$$

Derivation: FOC of US

Substituting C_1^{US} into the utility function yields

$$\ln\left(-\frac{C_2^{US}}{1+r_1}+Q_1^{US}+\frac{Q_2^{US}}{1+r_1}\right)+\ln\left(C_2^{US}\right).$$

Take the first-order-condition and obtain

$$\frac{1}{\left(-\frac{C_2^{US}}{1+r_1}+Q_1^{US}+\frac{Q_2^{US}}{1+r_1}\right)}\times(-1)\frac{1}{1+r_1}+\frac{1}{C_2^{US}}=0.$$

Remember $(\ln f(x))'=\frac{f'(x)}{f(x)}$.
Then

$$\frac{1}{C_2^{US}}=\frac{1}{\left(-\frac{C_2^{US}}{1+r_1}+Q_1^{US}+\frac{Q_2^{US}}{1+r_1}\right)}\times\frac{1}{1+r_1}=\frac{1}{C_1^{US}(1+r_1)}.$$

So

$$C_1^{US}=\frac{C_2^{US}}{(1+r_1)}.$$

Derivation: Completing for the US

The budget constraint in period 1 states

$$C_1^{US} + \frac{C_2^{US}}{(1+r_1)} = Q_1^{US} + \frac{Q_2^{US}}{(1+r_1)}.$$

From the last line in the previous slide and our assumption,

$$C_1^{US} + C_1^{US} = Q + \frac{Q}{(1+r_1)}.$$

Thus

$$C_1^{US} = \frac{1}{2} Q \left(\frac{2+r_1}{1+r_1} \right).$$

From the second lecture, $CA_1^{US} = B_1^{US} - B_0^{US}$, and thus

$$CA_1^{US} = Q - C_1^{US} = \frac{1}{2} Q \left(\frac{r_1}{1+r_1} \right).$$

Derivation: China

The budget constraint in period 1 states

$$C_1^C + \frac{C_2^C}{(1+r_1^C)} = Q_1^C + \frac{Q_2^C}{(1+r_1^C)}.$$

Then

$$2C_1^C = \frac{Q}{2} + \frac{Q}{(1+r_1^C)}.$$

So,

$$CA_1^C = B_1^C - B_0^C = \frac{Q}{2} - C_1^C = \frac{Q}{4} - \frac{Q}{2(1+r_1^C)}.$$

Derivation: Market Clearing

The world current account balances

$$CA_1^{US} + CA_1^C = 0.$$

Then

$$C_1^{US} + C_1^C = \frac{3}{2}Q.$$
$$C_2^{US} + C_2^C = 2Q.$$

By imposing $r_1 = r_1^C = r_1^*$, we obtain

$$r_1^* = \frac{1}{3}.$$

We can compute

$$C_1^{US} = \frac{1}{2}\left(Q + \frac{Q}{1+1/3}\right) = \frac{7}{8}Q.$$

Then

$$CA_1^{US} = Q - C_1^{US} = \frac{1}{8}Q \text{ and } CA_1^{C} = -\frac{1}{8}Q.$$

- In this example,
  - China is a debtor in the first period.
  - The U.S. is a creditor in the first period.

Capital Control by China

- China tries to set the interest rate so as to maximize the welfare of its agents.

Remember that for $j = C, US$,

$$CA_1^j = B_1^j - B_0^j = B_1^j.$$

Remember

$$CA^{US}(r_1) = \frac{1}{2} Q \frac{r_1}{1 + r_1} = B_1^{US}(r_1)$$

and $CA_1^C + CA_1^{US} = 0$ implies

$$B_1^{US} + B_1^C = 0.$$

Then

$$CA_C^1 = B_1^C = -\frac{1}{2} Q \frac{r_1}{1 + r_1}.$$

Derivation: Consumption in China

From China's budget constraints in period 1 and 2:

$$C_1^C + B_1^C = \frac{1}{2}Q$$
$$C_2^C = Q + (1 + r_1)B_1^C,$$

we obtain

$$C_1^C = \frac{1}{2}Q\frac{1 + 2r_1}{1 + r_1} \text{ and}$$
$$C_2^C = Q - \frac{1}{2}r_1 Q = \frac{1}{2}Q[2 - r_1].$$

Derivation: Maximization of Indirect Utility

China's *indirect utility function* is given by

$$\begin{aligned} V(r_1) &= U(C_1^C(r_1), C_2^C(r_1)) = \ln C_1^C(r_1) + \ln C_2^C(r_1) \\ &= \ln\left(\frac{1}{2}Q\frac{1+2r_1}{1+r_1}\right) + \ln\left(\frac{1}{2}Q[2-r_1]\right) \\ &= \ln\left(\frac{1}{4}Q^2\right) + \ln(1+2r_1) - \ln(1+r_1) + \ln(2-r_1). \end{aligned}$$

By setting $\frac{\partial V(r_1)}{\partial r_1} = 0$, we obtain

$$\frac{2}{1+2r_1} - \frac{1}{1+r_1} - \frac{1}{2-r_1} = 0,$$

which is modified to

$$r_1^2 + 2r_1 - \frac{1}{2} = 0.$$

By the solution formula of a quadratic equation, we obtain

$$r_1 = -1 \pm \sqrt{\frac{3}{2}} \approx 0.22 \text{ or } -2.22.$$

Key Takeaway

r_1 without capital control $= 0.33 > 0.22 = r_1$ with capital control.

Intuition

We have computed $CA_1^{US}(r_1) = \frac{1}{2}Q(1 - \frac{1}{1+r_1})$.

$$r_1 \Downarrow \rightarrow \ CA_1^{US}(r_1) \Downarrow \ \& \ CA_1^{C}(r_1) \Uparrow .$$

Summary and Conclusion

- Today, we have studied:
  1. The external adjustment in open economies.
     - Developed a graphical tool to analyze the current account schedule.
  2. The large open economy.
     - Discussed on the capital control policy in the large open economy setup.