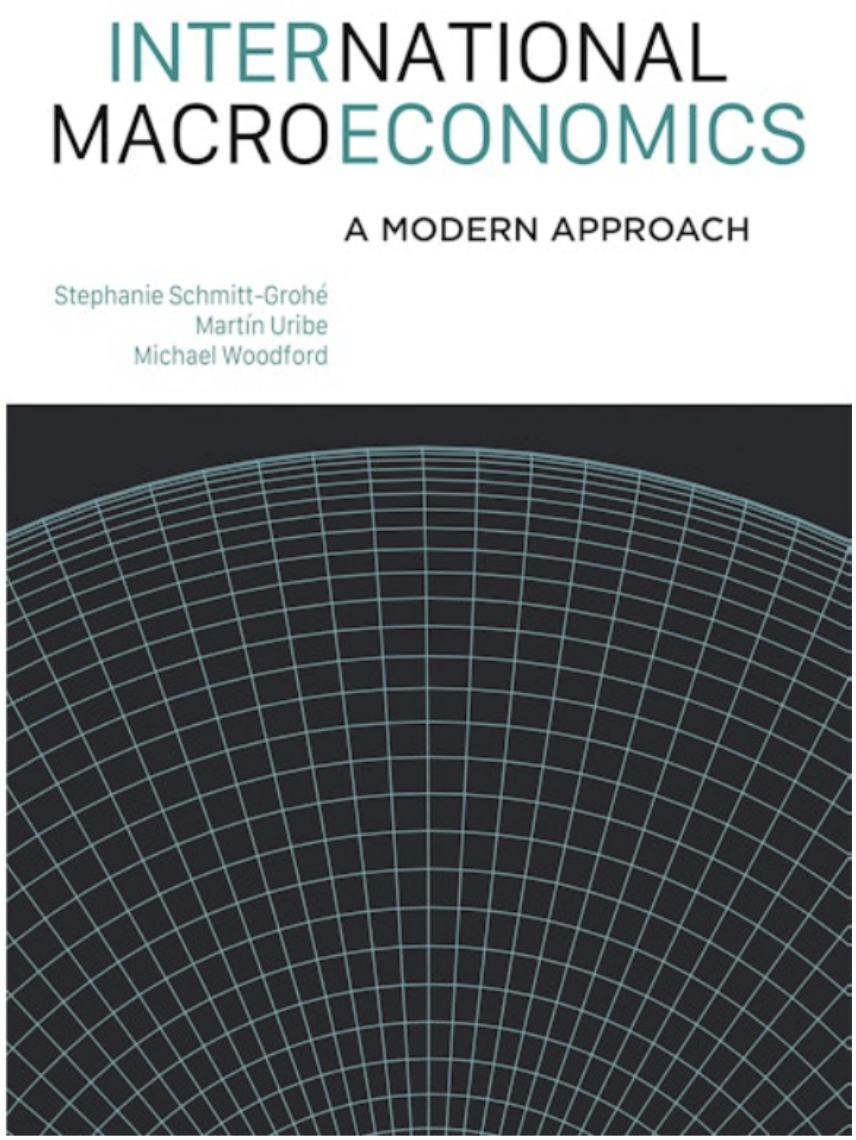


Princeton University Press, 2022

Slides EC201

Chapter 3

Intertemporal Theory of the Current Account

Motivation

Last week we said nothing about how trade balance and current account are determined. It will be our focus this week.

1. Build a model of an open economy to study the determinants of the trade balance and the current account.

2. Study the response of the trade balance and the current account to income shocks, paying special attention to how those responses depend on whether the shocks are perceived to be temporary or permanent.

A Small Open Economy

What does 'small' and 'open' mean in this context?

- An economy is small when world prices and world interest rates are independent of domestic economic conditions.

- An economy is open when it trades in goods and financial assets with the rest of the world.

Examples of Different Economy Types

- **Developed small open economies:** the Netherlands, Switzerland, Austria, New Zealand, Australia, Canada, Norway.

- **Emerging small open economies:** Argentina, Chile, Peru, Bolivia, Greece, Portugal, Estonia, Latvia, Thailand.

- **Developed large open economies:** United States, Japan, Germany, and the United Kingdom.

- **Emerging large open economies:** China, India

- **Closed economies:** North Korea, Venezuela, and to a lesser extent Cuba and Iran.

Economic and geographic size are not necessarily related: Australia and Canada are geographically large but economically small. The UK and Japan are geographically small but economically large.

1. The Model Economy

The Model Economy

- A two-period small open economy: periods 1 and 2.
- Households receive an endowment of Q_1 units of goods in period 1 and Q_2 units of goods in period 2.
- Goods are perishable.
- Initial asset holdings B_0 inherited from the past, paying the interest rate r_0 in period 1.
- In period 1, households choose consumption, C_1, and bond holdings, B_1, which pay the interest rate r_1 in period 2.

Sequential Budget Constraints of the Household

The period-1 budget constraint

$$C_1 + B_1 - B_0 = r_0 B_0 + Q_1 \tag{1}$$

The period-2 budget constraint

$$C_2 + B_2 - B_1 = r_1 B_1 + Q_2 \tag{2}$$

Because the world ends after period 2, no one is going to be around to pay or collect debts. So bond holdings must be nil at the end of period 2, that is,

$$B_2 = 0 \tag{3}$$

This expression is known as the transversality condition.

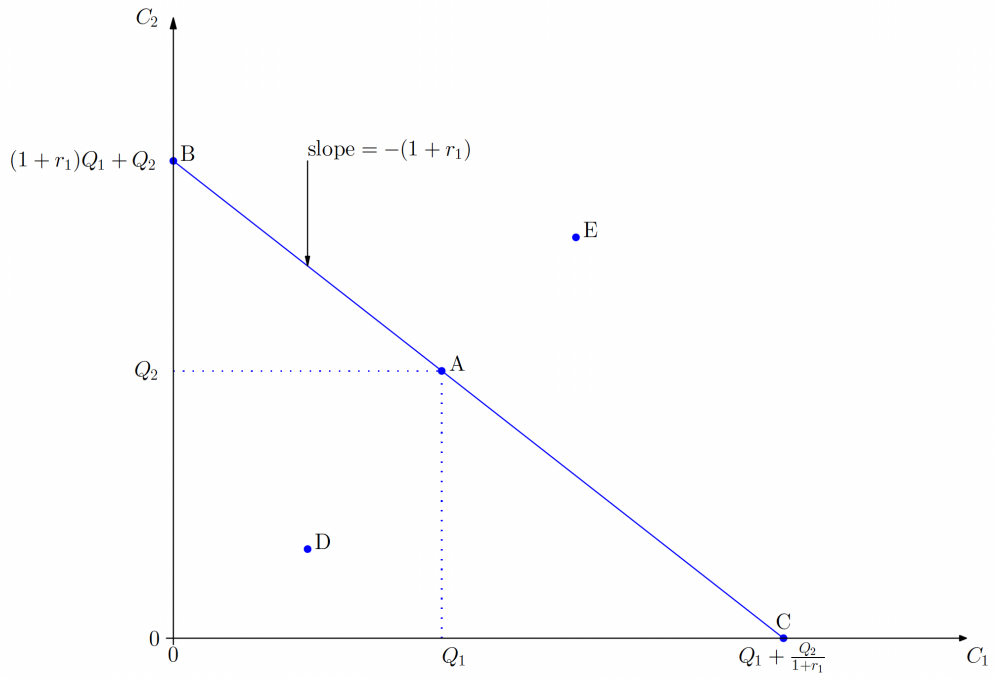
The Intertemporal Budget Constraint

Combine (1), (2), and (3) to eliminate B_1 and B_2. This yields

$$C_1 + \frac{C_2}{1+r_1} = (1+r_0)B_0 + Q_1 + \frac{Q_2}{1+r_1} \tag{4}$$

This expression represents the intertemporal budget constraint. It says that the present discounted value of the endowment plus the initial financial wealth (the right-hand side) must be equal to the present discounted value of consumption (the left-hand side).

The Intertemporal Budget Constraint



Notes. The downward-sloping line represents the consumption paths (C_1, C_2) that satisfy the intertemporal budget constraint (4). The figure is drawn under the assumption that the household's initial asset position is zero, $B_0 = 0$.

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Properties of the Intertemporal Budget Constraint

- It's downward sloping. Its slope is $-(1+r_1)$, because if you forgo one unit of consumption today and put it in the bank for one period, you get $1 + r_1$ units next period.

- The set of feasible consumption paths (C_1, C_2) are those inside or at the borders of the triangle formed by the vertical axis, the horizontal axis, and the intertemporal budget constraint. Points A, B, C, and D are all feasible consumption paths.

- Point D, while feasible, violates the transversality condition because households leave money on the table at the end of period 2 ($B_2 > 0$).

- Points outside that triangle, such as point E, are infeasible. They violate the transversality condition because households leave unpaid debts at the end of period 2 ($B_2 < 0$).

- What feasible point the household will choose depends on its preferences. We turn to this issue next.

The Lifetime Utility Function

- We assume that the household's happiness increases with the consumption of goods in periods 1 and 2.

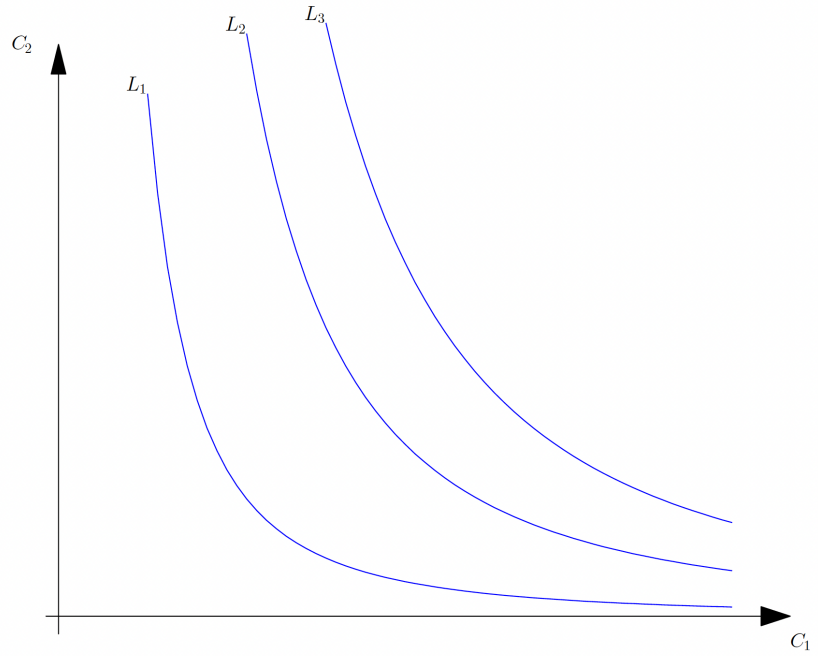
- Preferences for consumption in periods 1 and 2 are described by the lifetime utility function, which is assumed to be of the form

$$U(C_1) + \beta U(C_2),$$

  - $U(\cdot)$ denotes the period utility function and is assumed to be increasing and concave;

  - The parameter $\beta > 0$ denotes the subjective discount factor. Typically it is assumed that $\beta \leq 1$, which means that in period 1 households care less about period-2 consumption than about period-1 consumption.

Indifference Curves



An *indifference curve* is the set of consumption paths (C_1, C_2) that delivers the same level of welfare.

An indifference curve is the set of consumption paths (C_1, C_2) that delivers the same level of utility.

Properties of Indifference Curves

- If C_1 and C_2 are goods (i.e., objects for which more is preferred to less), indifference curves are downward sloping.

- An indifference curve located northeast of another one yields higher utility.

- One (and only one) indifference curve is associated with each point in the positive quadrant; they densely populate it.

- Indifference curves do not cross one another.

- The negative of the slope of the indifference curve is known as the intertemporal marginal rate of substitution of C_2 for C_1.

- The indifference curves we focus on are convex. This property of preferences is known as diminishing marginal rate of substitution of C_2 for C_1.

The Optimal Intertemporal Allocation of Consumption

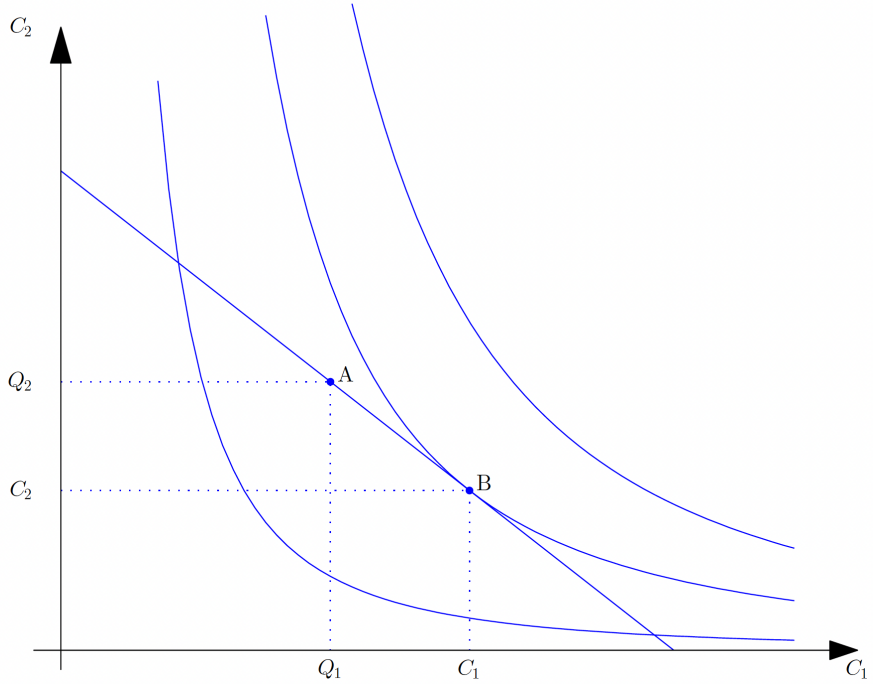
- The household chooses consumption in periods 1 and 2 to maximize its lifetime utility function, subject to its intertemporal budget constraint (4).

- The endowment point (Q_1, Q_2) is point A.

- The optimal consumption path is point B. This point is on the intertemporal budget constraint and belongs to an indifference curve that is tangent to the intertemporal budget constraint.

- The graph is drawn so that at point B, the household consumes more than its endowment. This means that it must borrow in period 1. In period 2, the household consumes less than his endowment, and uses the difference to pay back its debt including interest.

The Optimal Consumption Path



Notes: The optimal consumption path (C_1, C_2) is at point B, where an indifference curve is tangent to the intertemporal budget constraint. As the figure is drawn, the household borrows in period 1 $(C_1 > Q_1)$ and pays back its debt in period 2 $(C_2 < Q_2)$. The figure is drawn under the assumption that the household's initial asset position is zero, $B_0 = 0$.

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Deriving the Optimal Consumption Path

Formally, the household problem is

$$\max_{\{C_1,C_2\}} \quad U(C_1) + \beta U(C_2)$$

subject to

$$C_1 + \frac{C_2}{1+r_1} = (1+r_0)B_0 + Q_1 + \frac{Q_2}{1+r_1} \tag{5}$$

The household takes as given all objects on the right-hand side of the intertemporal budget constraint. Therefore, to save notation, let's call the right-hand side $\bar{Y}$:

$$\bar{Y} = (1+r_0)B_0 + Q_1 + \frac{Q_2}{1+r_1}$$

Solve the intertemporal budget constraint for C_2 to get

$$C_2 = (1+r_1)(\bar{Y} - C_1) \tag{6}$$

Deriving the Optimal Consumption Path (Continued)

The household maximization problem then becomes

$$\max_{\{C_1\}} U(C_1) + \beta U((1 + r_1)(\bar{Y} - C_1)) \tag{7}$$

To maximize this expression, take the derivative with respect to C_1, equate it to zero, and rearrange:

$$U'(C_1) = \beta(1 + r_1)U'(C_2) \tag{8}$$

This optimality condition is known as the consumption Euler equation.

Rearrange terms to write the Euler equation as

$$-\frac{U'(C_1)}{\beta U'(C_2)} = -(1 + r_1), \tag{9}$$

which says that at the optimal consumption path, the (negative of the) marginal rate of substitution, $\frac{U'(C_1)}{\beta U'(C_2)}$, is equal to the (negative of the) gross interest rate $(1 + r_1)$.

The Interest Rate Parity Condition

Assumption: Free Capital Mobility

- Households can borrow and lend freely in international financial markets
- No restrictions on cross-border capital flows

The Condition

- Let r^* = world interest rate
- Under free capital mobility, domestic rate must equal world rate:

$$r_1 = r^* \tag{10}$$

Why Must This Hold? The Arbitrage Argument

- Any deviation from $r_1 = r^*$ creates arbitrage opportunities
- **If $r_1 > r^*$:**
  - Borrow abroad at r^*, lend domestically at r_1 making infinite profits
- **If $r_1 < r^*$:**
  - Borrow domestically at r_1, lend abroad at r^* making infinite profits

Equilibrium in the Small Open Economy

- All domestic households are identical and make identical decisions. By studying the behavior of an individual household, we are also learning about the behavior of the country as a whole.

- Country is small and its saving decisions do not affect world interest rate.

- Consequence: They don't borrow or lend to each other which also implies that we can interpret B_t, for $t = 0, 1, 2$, as the country's net foreign asset position or NIIP at the end of period t.

- Intertemporal budget constraint of an individual household can be interpreted as the country's intertemporal resource constraint.

An equilibrium then is a consumption path (C_1, C_2) and an interest rate r_1 that satisfy:

$$C_1 + \frac{C_2}{1+r_1} = (1+r_0)B_0 + Q_1 + \frac{Q_2}{1+r_1} \tag{11}$$

$$U'(C_1) = (1+r_1)\beta U'(C_2) \tag{12}$$

$$r_1 = r^* \tag{13}$$

given the exogenous variables r_0, B_0, Q_1, Q_2, and r^*.

- **Endogenous variables** - these are determined within the model: (C_1, C_2) and an interest rate r_1

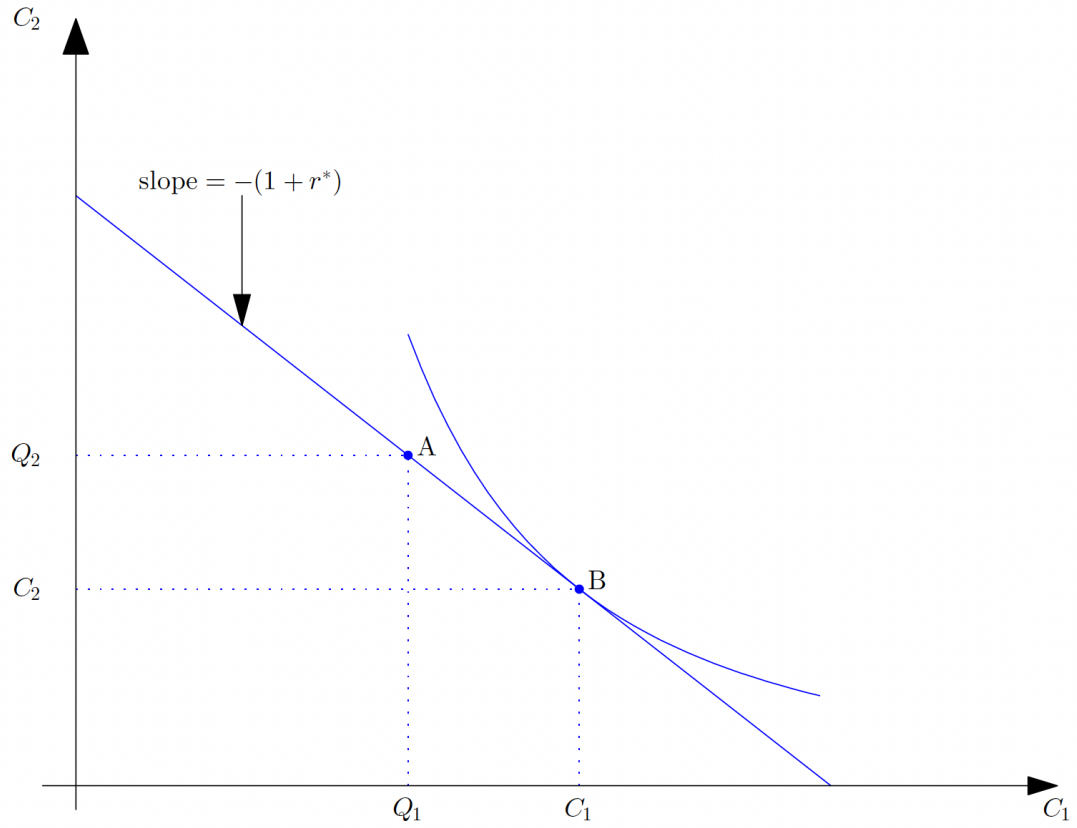
- **Exogenous variables** - these are determined outside of the model: r_0, B_0, Q_1, Q_2, and r^*.

Graphical Representation of Equilibrium

The three equilibrium conditions determine C_1, C_2, and r_1:

- The equilibrium is at point B.
- Point B is on the intertemporal resource constraint, as required by equilibrium condition (11).
- The indifference curve that crosses point B is tangent to the intertemporal budget constraint, whose slope is $-(1+r_1)$. This means that equilibrium condition (12) holds.
- And the slope of the intertemporal resource constraint is $-(1+r^*)$, which means that $r^* = r_1$, as required by equilibrium condition (13).

Equilibrium in the Endowment Economy



Notes: The figure displays the equilibrium in a small open economy with free capital mobility and a zero initial net foreign asset position, $B_0 = 0$. The equilibrium is at point B, where an indifference curve is tangent to the intertemporal budget constraint. Because of free capital mobility, the domestic interest rate is equal to the world interest rate, r^*, so that the slope of the intertemporal resource constraint is $-(1+r^*)$. As the figure is drawn, the country runs trade and current account deficits in period 1, $C_1 > Q_1$.

2. Response of Trade Balance and the Current Account to Income Shocks

The Trade Balance and the Current Account

We can now answer the question posed at the beginning: What determines the trade balance and the current account? The trade balance is the difference between output and consumption,

$$TB_1 = Q_1 - C_1$$
$$TB_2 = Q_2 - C_2$$

The current account equals the trade balance plus net investment income (NII)

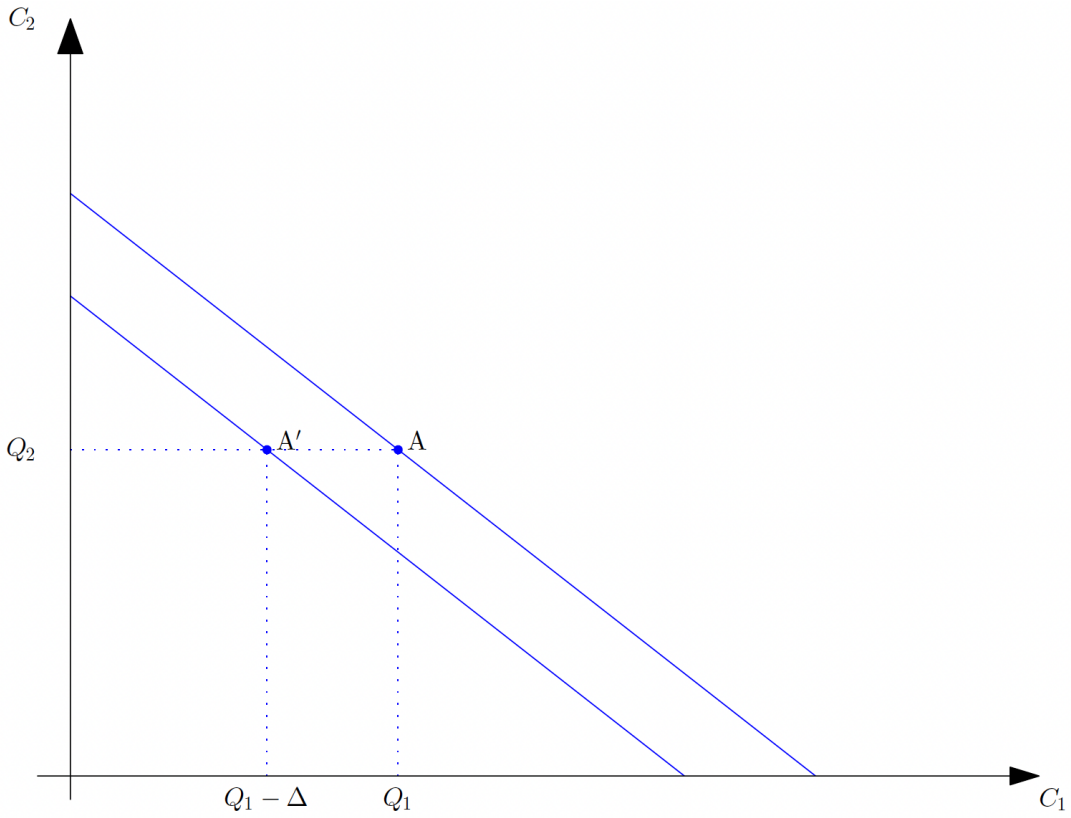
$$CA_1 = TB_1 + r_0 B_0$$
$$CA_2 = TB_2 + r_1 B_1$$

We have shown that the endogenous variables, C_1 and C_2 and r_1, depend on the exogenous variables Q_1, Q_2, r_0, B_0, and r^*. Therefore, we have that preferences, endowments, the world interest rate, and the initial net international investment position of a country are the determinants of the trade balance and the current account.

Adjustment to Temporary Output Shocks

Assume that output in period 1 falls from Q_1 to $Q_1 - \Delta < Q_1$ and output in period 2, Q_2 is unchanged. How does this temporary output decline affect the intertemporal budget constraint?

A Temporary Decline in Output and the Intertemporal Budget Constraint



Notes: In response to a decline in Q_1 equal to Δ, the intertemporal budget constraint shifts to the left by Δ. Point A indicates the endowment point prior to the output decline and point A′ indicates the endowment point after it. The figure is drawn under the assumption that the household's initial asset position is zero, $B_0 = 0$.

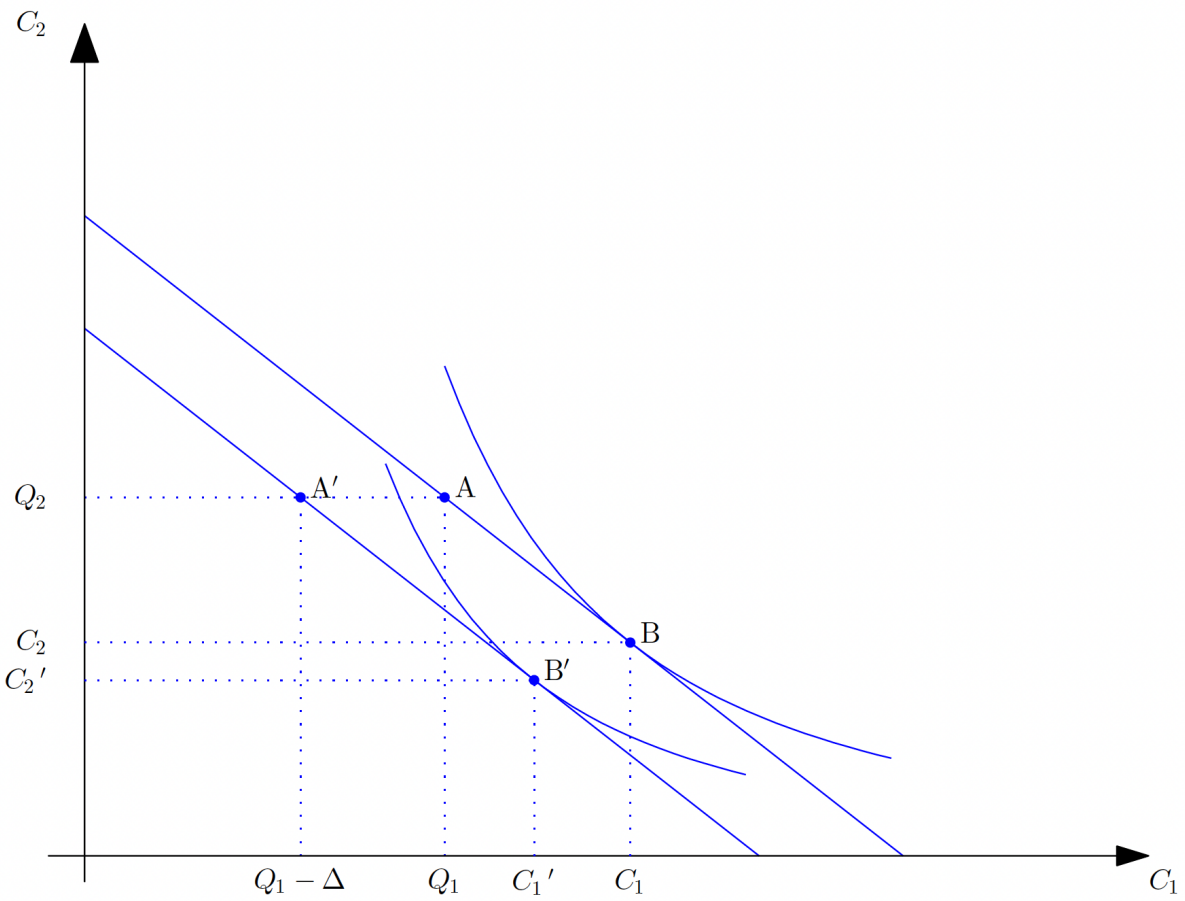
How Will the Household Adjust?

Assume that both C_1 and C_2 are normal goods (i.e., goods whose consumption increases with income)

Then the household would want to cut both C_1 and C_2. By also cutting C_2, the household does not need to cut C_1 by Δ but by less.

The next figure illustrates the adjustment.

Adjustment to a Temporary Decline in Output



Notes: The figure depicts the adjustment of the economy to a decline in the period 1 endowment equal to Δ. The endowment point shifts left from point A to point A′ and the optimal consumption path shifts from point B to point B′. Period 1 consumption declines by less than Δ. The period 1 trade balance becomes more negative, $Q_1 - \Delta - C_1' < Q_1 - C_1$. The figure is drawn under the assumption that the household's initial asset position is zero, $B_0 = 0$.

Key Principle for Temporary Shocks

In smoothing consumption over time, the country runs a larger trade deficit in period 1 (recall that it was running a trade deficit even in the absence of the shock) and finances it by acquiring additional foreign debt. Thus, the current account deteriorates. In period 2, the country must generate a larger trade surplus than the one it would have produced in the absence of the shock in order to pay back the additional debt acquired in period 1.

The important principle: Temporary negative income shocks are smoothed out by borrowing from the rest of the world rather than by fully adjusting current consumption by the size of the shock.

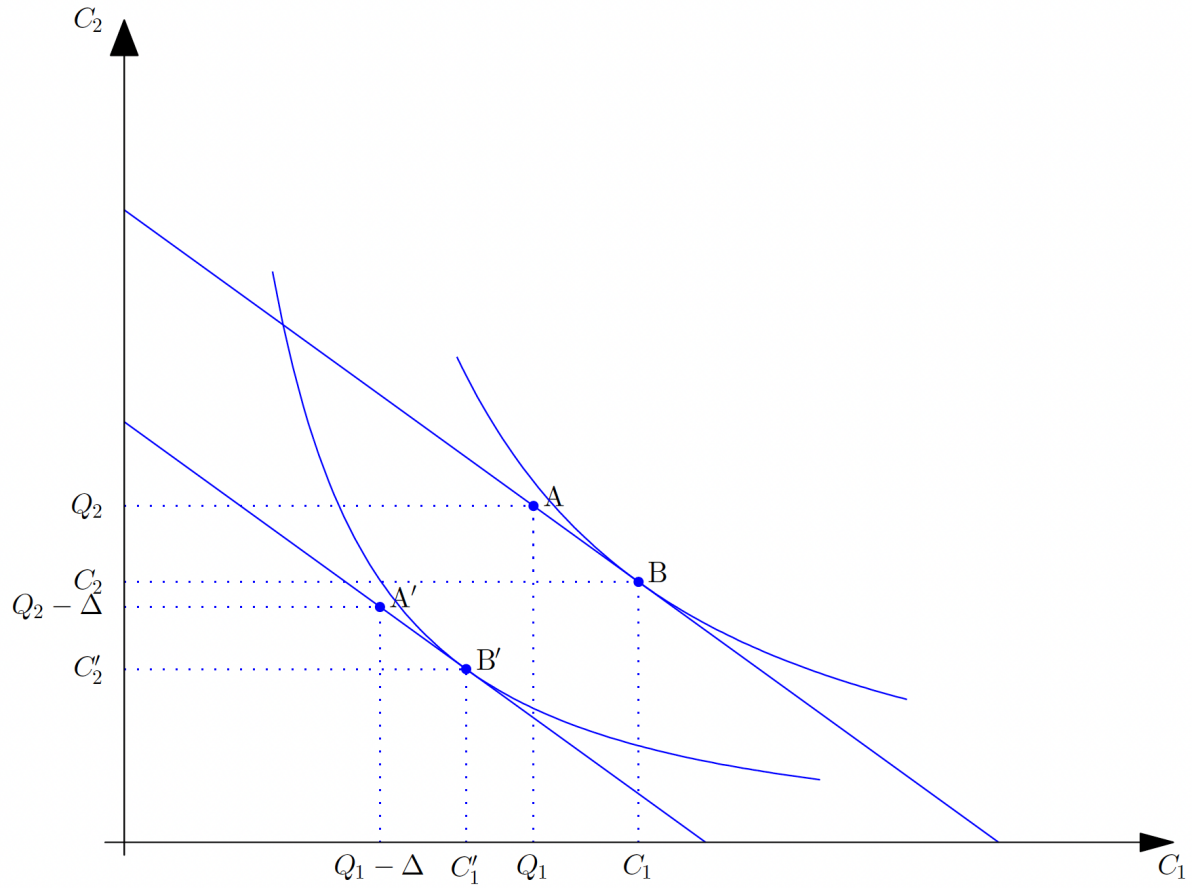
Adjustment to Permanent Output Shocks

Suppose Q_1 and Q_2 both fall by Δ.

In general the decline in consumption should be expected to be close to Δ, implying that a permanent output shock has little consequences for the trade balance and the current account.

The figure on the next slide illustrates this point.

Adjustment to a Permanent Decline in Output



Notes: The figure depicts the adjustment to a decline in Q_1 and Q_2 equal to Δ. The endowment point A shifts down and to the left to point A′. The intertemporal budget constraint shifts down in a parallel fashion. The optimal consumption path (C_1, C_2) shifts from point B to point B′. The figure is drawn for the case $B_0 = 0$. The period 1 trade balance is little changed.

General Principle

Comparing the effects of temporary and permanent output shocks on the current account, the following general principle emerges:

- Economies tend to finance temporary shocks (by borrowing or lending on international capital markets) and

- adjust to permanent ones (by varying consumption in both periods up or down).

Thus, temporary shocks tend to produce large movements in the current account while permanent shocks tend to leave the current account largely unchanged.

Anticipated Income Shocks

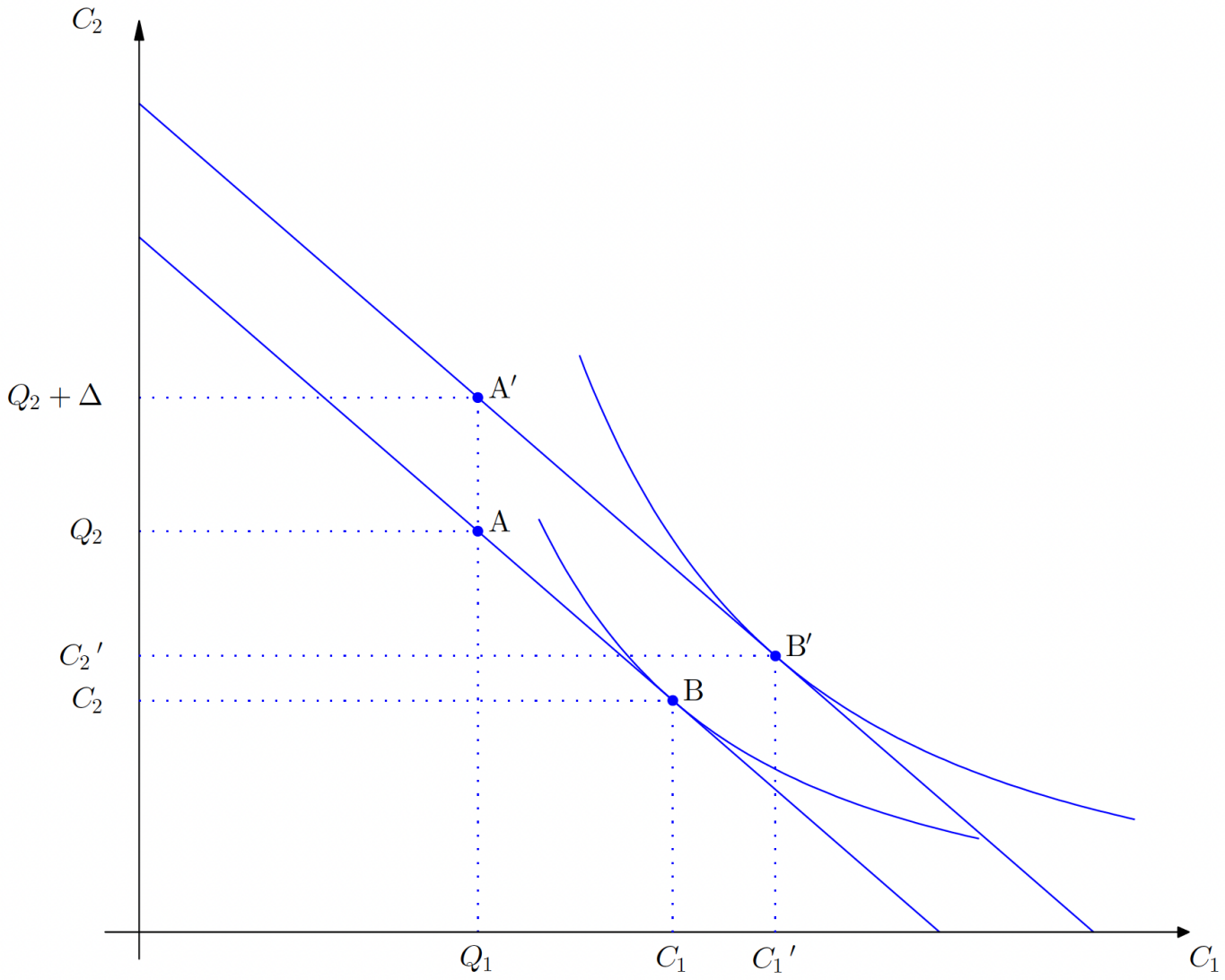
Consider now the case that in period 1 households learn that their endowment, Q_2, will be higher in period 2.

What will be the effect of this news on: consumption, the domestic interest rate, the trade balance, and the current account?

The figure on the next slide depicts the adjustment to an anticipated increase in Q_2 equal to $\Delta > 0$. The intertemporal budget constraint shifts up by Δ. The increase in the period-2 endowment causes an increase in period-1 consumption from C_1 to C_1'. Because the endowment in period 1 is unchanged, the period-1 trade balance and current account deteriorate.

Thus, good news about the future lead to a deterioration of the current account. This shows that current account deficits are not necessarily an indication of a weak economy.

Adjustment to an Anticipated Increase in Output



Summing Up

This week we studied about an intertemporal model of the current account with the following building blocks:

- Households face an intertemporal budget constraint.
- Households have preferences over present and future consumption.
- Households choose a consumption path that maximizes lifetime utility subject to the intertemporal budget constraint.
- Free capital mobility equalizes the domestic and world interest rates.

The model delivers the following key insights:

- In response to temporary income shocks, countries use the current account to smooth consumption over time. Positive temporary shocks cause an improvement in the current account and negative temporary shocks cause a deterioration.

- In response to permanent income shocks, countries adjust consumption without much movement in the current account.

- In response to an anticipated increase in future income, the trade balance and the current account deteriorate.