International Economics II

Theoretical Analysis of Current Account Determination

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Outline

1. The Current Account in an Endowment Economy
2. Impact of Shocks on the Current Account
3. Terms of Trade and the World Interest Rate

Motivation

- We will develop an economic model of an open economy to study the determinants of the trade balance and the current account.
- What is a model?
  - A simplified device that will allow us to measure and predict, in this case the CA.
  - Useful: the equations of the model map to national account.
- Using the model we can study the response of the trade balance and the current account to a variety of economic shocks
  - Changes in income (future and current),
  - Changes in the world interest rate,
  - Changes in commodity prices (e.g., oil, grain).
- Pay special attention to how those responses depend on whether the shocks are perceived to be temporary or permanent.

A Small Open Economy (SOE)

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

- An economy is small when world prices and 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.
- Most countries in the world are small open economies:
  - Developed SOE: the Netherlands, Switzerland, Austria, New Zealand, Australia, Canada, Norway.
  - Emerging SOE: 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.
  - Closed economies: Perhaps the most notable cases are North Korea, Venezuela, and to a lesser extent Cuba and Iran.

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The Endowment Economy

- A two-period small open economy: periods 1 and 2.
- Households receive endowments Q_1 and Q_2 in periods 1 and 2, respectively.
- Initial wealth $(1 + r_0)B_0^*$ inherited from the past.
- Here, B_0^* are bonds that paid the interest rate r_0.
- In period 1, households choose how much to consume, C_1, and save in bond holdings, B_1^*, which pay the interest rate r_1.

Sequential Budget Constraints

- The period-1 budget constraint is:

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

- The period-2 budget constraint is:

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

- 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.

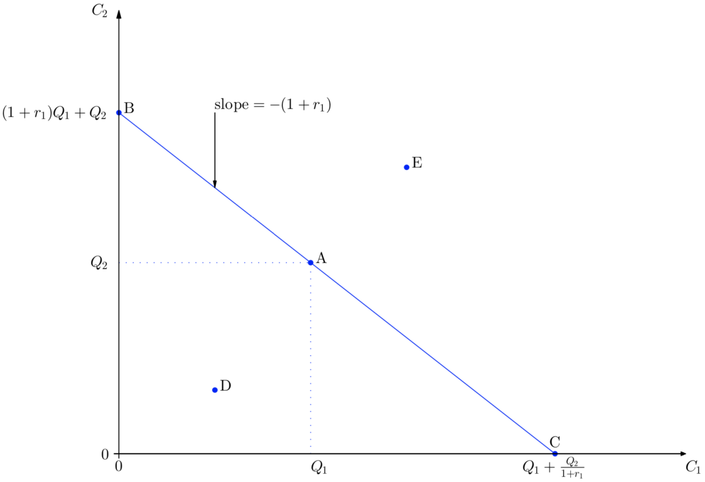
The Intertemporal Budget Constraint

- Combine (1), (2), and (3) to eliminate B_1^* and B_2^*:

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

- This is 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 enough to pay for the present discounted value of consumption (the left-hand side).

The Intertemporal Budget Constraint



Note: The figure is drawn under the assumption that the initial net foreign asset position is zero, $B_0^* = 0$.

The Intertemporal Budget Constraint

- Its slope is $-(1 + r_1)$, because if you sacrifice one unit of consumption and put it in the bank for one period, you get $1 + r_1$ units next period.
- The set of feasible consumption baskets are those inside or at the borders of the triangle formed by the vertical line, the horizontal line, and the intertemporal budget constraint.
- Points outside that triangle are infeasible.
- What feasible point will the household choose depends on its preferences. We turn to this issue next.

The Lifetime Utility Function

- We assume that the household happiness increases with consuming goods in periods 1 and 2. We assume that the lifetime utility function is of the form:

$$\ln C_1 + \ln C_2 \tag{5}$$

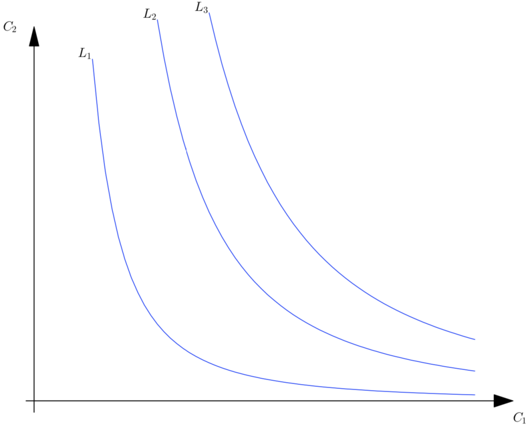
  where $\ln$ denotes the natural logarithm. Other specifications are possible (e.g., Cobb-Douglas, CES).

- Note that as written the household places equal weight on whether she consumes in period 1 or period 2.

- We could imagine that she prefers consumption in period 1, and therefore discounts period 2 consumption by some factor $\beta > 0$:

$$\ln C_1 + \beta \ln C_2 \tag{6}$$

Indifference Curves

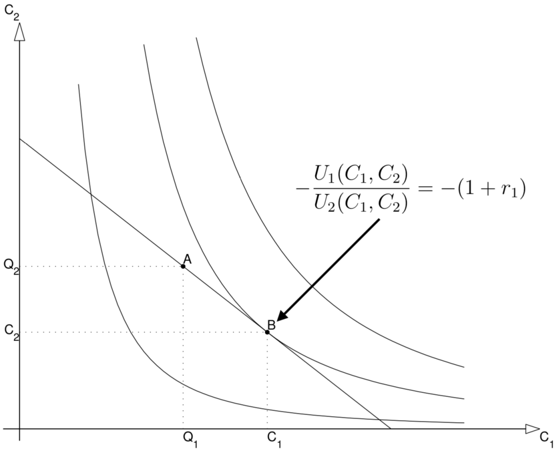


An indifference curve is the set of consumption baskets (C_1, C_2) that delivers the same level of utility.

The Household Utility Maximization Problem

- The household chooses consumption in periods 1 and 2 to maximize its utility function, subject to its intertemporal budget constraint.
- Following figure shows a solution to maximization problem assuming zero initial assets, B_0^*.

The Optimal Consumption Basket



The Marginal Rate of Substitution (MRS) must be equal to their relative price $(1 + r_1)$.

Deriving the Optimal Consumption Basket

- Formally, the household problem is

$$\max_{\{C_1>0, C_2>0\}} \ln C_1 + \ln C_2 \tag{7}$$

subject to

$$C_1 + \frac{C_2}{(1+r_1)} = \underbrace{(1+r_0)B_0^* + Q_1 + \frac{Q_2}{(1+r_1)}}_{W=\text{lifetime wealth}}. \tag{8}$$

- Solve the intertemporal budget constraint for C_2 to get

$$C_2 = (1+r_1)(W - C_1) \tag{9}$$

- Use this expression to eliminate C_2 from the lifetime utility function.

Deriving the Optimal Consumption Basket

- The household maximization problem then becomes

$$\max_{\{C_1>0, C_2>0\}} \ln C_1 + \ln[(1+r_1)(W - C_1)] \tag{10}$$

- To maximize this expression, take the derivative with respect to C_1, equate to zero, and solve for C_1. This yields

$$C_1 = \frac{1}{2}W \tag{11}$$

- Intuitively, the household consumes half of its lifetime wealth. Plugging (11) into (9) yields

$$C_2 = \frac{1}{2}W(1+r_1) \tag{12}$$

- This is also intuitive. The household consumes half of W in period 1 and puts the other half in the bank, receiving $W(1+r_1)$ for consumption in period 2.

Deriving the Optimal Consumption Basket

- Now recall that $W = (1 + r_0)B_0^* + Q_1 + \frac{Q_2}{(1+r_1)}$. Then:

$$C_1 = \frac{1}{2}\left[(1 + r_0)B_0^* + Q_1 + \frac{Q_2}{(1 + r_1)}\right] \tag{13}$$

- According to this expression, consumption is
  - increasing in Q_1, Q_2 and $(1 + r_0)B_0^*$.
  - decreasing in the interest rate r_1.

Lagrangian Methodology

- The above approach is useful for a two-period model, but for more general problems we need a different method. Using a Lagrangian is one approach:

$$\mathcal{L} = \ln C_1 + \ln C_2 + \lambda \left[W - C_1 - \frac{C_2}{(1+r_1)} \right] \tag{14}$$

- Taking the derivative of $\mathcal{L}$ w.r.t. C_1 and C_2 gives the following FOCs:

$$\frac{1}{C_1} = \lambda \tag{15}$$

$$\frac{1}{C_2} = \frac{\lambda}{(1+r_1)} \tag{16}$$

- which combined, yields the intertemporal Euler equation:

$$C_2 = (1+r_1)C_1. \tag{17}$$

- ... Solve for $C_1 = W/2$, etc.

The Euler Equation

- The Euler Equation is an essential piece of modern macroeconomics theory. In a more general form is given by:

$$\frac{U'(C_1)}{\beta U'(C_2)} = (1 + r_1). \tag{18}$$

- It says that at the optimal consumption path, the marginal rate of substitution is equal to the gross interest rate.
- Or graphically that the slope of the indifference curve is equal to the slope of the intertemporal budget constraint.
- It establishes how present and future consumption are interconnected.
- The marginal cost of not consuming one unit today must be equal to marginal benefit of consuming $(1 + r)$ units tomorrow (discounted by β).

Free Capital Mobility and the Determination of the Interest Rate

- To "close" the model we need to determine how the interest rate r_1 is defined. Note we are a small open economy.
- We assume that there is free international capital mobility. That is, households can borrow and lend in the international financial market.
- Hence, free capital mobility guarantees that the domestic interest rate be equal to the world interest rate r^*: $r_1 = r^*$
- Any difference between r_1 and r^* to give rise to an arbitrage opportunity that would allow someone to make infinite profits:
  - If $r_1 > r^*$, then one could make infinite amounts of profits by borrowing in the international market and lending in the domestic market.
  - if $r_1 < r^*$, unbounded profits could be obtained by borrowing domestically and lending abroad.

Equilibrium in the Small Open Economy

- Equilibrium in the model is defined by the solution of the three endogenous variables: the two consumption allocations C_1 and C_2, and their relative price (the interest rate): r_1.

$$C_1 = \frac{1}{2}\left[(1+r_0)B_0^* + Q_1 + \frac{Q_2}{(1+r_1)}\right] \tag{19}$$

$$C_2 = (1+r_1)C_1 \tag{20}$$

$$r_1 = r^* \tag{21}$$

- The solution can be fully calculated given the exogenous variables of the model: B_0^*, r_0, Q_1, Q_2 and r^*.

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, $TB_1 = Q_1 - C_1$ and $TB_2 = Q_2 - C_2$.
- Replacing C_1 by its optimal value:

$$TB_1 = \frac{1}{2}\left[Q_1 - (1+r_0)B_0^* - \frac{Q_2}{(1+r_1)}\right] \tag{22}$$

- The current account equals the trade balance plus investment income. Thus,

$$CA_1 = TB_1 + r_0 B_0^* \qquad CA_2 = TB_2 + r_1 B_1^* \tag{23}$$

- Note that B_1^* can be calculated using the period-1 budget constraint.

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Effect of a Temporary Output Shock on the CA

- Suppose that output increases in period 1, but is expected not to change in period 2:

$$\Delta Q_1 > 0 \text{ and } \Delta Q_2 = 0 \tag{24}$$

- Graphically, the increase in output shifts the intertemporal budget constraint up and to the right.
- Then, differentiating the expression for the trade balance in (22):

$$\Delta CA_1 = \Delta TB_1 = \frac{1}{2}\Delta Q_1 \tag{25}$$

- The current account improves by half the increase in output. Households know the output increase is temporary. Because they like to smooth consumption over time, they save half of it for consumption next period.
- **Think about it:** how the households will behave if they expect an increase in the future output ($\Delta Q_2 > 0$ and $\Delta Q_1 = 0$)?

Effect of a Permanent Output Shock on the CA

- Suppose that output increases by the same amount in periods 1 and 2:

$$\Delta Q_1 = \Delta Q_2 > 0 \tag{26}$$

- Then, differentiating the expression for the trade balance in (22):

$$\Delta CA_1 = \Delta TB_1 = \frac{1}{2}\left[\Delta Q_1 - \frac{\Delta Q}{(1+r^*)}\right] \tag{27}$$

- Since $\Delta Q_1 = \Delta Q_2$, we can write:

$$\Delta CA_1 = \frac{1}{2}\frac{r^*}{(1+r^*)}\Delta Q_1 \tag{28}$$

- The current account increases now only by a fraction $\frac{r^*}{(1+r^*)}\frac{1}{2}$ of output, which is smaller than in the case of a temporary shock.
- There is no reason to save a large part of the Q_1 increase if Q_2 is also expected to increase.

A General Principle

- If you lose your lunch money one day, its not a problem. You simply borrow from a friend. Next time, you pay his lunch.
- However, if you father cuts your monthly allowance, you will have to make plans to reduce your spending accordingly.
- We have seen that a similar principle is at work with the current account.
- Economies tend to finance temporary shocks (by running current account deficits or surpluses without much change in spending) and adjust to permanent ones (by changing spending, without much change in the current account).
- Temporary shocks tend to produce large movements in the current account while permanent shocks tend to leave the current account largely unchanged.

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Terms-of-Trade Shocks

- Thus far, we have assumed that there is just one good that can be consumed, imported, or exported. In reality, the final goods a country imports are different from the goods it exports.
- Changes in the relative price of exports can have macroeconomic effects on consumption, the trade balance, and the current account. We will show that these effects are very similar to endowment shocks.
- The relative price of exportable goods in terms of importable goods is known as the terms of trade.
- Letting P^X denote the price of exports and P^M the price of imports, the terms of trade, which we denote by TT, are given by

$$TT_1 \equiv \frac{P_1^X}{P_1^M} \tag{29}$$

Importable Goods, Exportable Goods, and the Terms of Trade

- Q_1 is a good that households do not consume, say oil, but exports at the world price P_1^X.
- Country does not produce consumption goods, say food, but can import them at the world price P_1^M.
- The terms of trade say that with one barrel of oil the economy can import TT_1 units of food.
- The endowment, Q_1, buys $TT_1 Q_1$ units of consumption.
- Bonds are denominated in units of importable goods.
- Let's see how that works in the budget constraint.

Importable Goods, Exportable Goods, and the Terms of Trade

- The budget constraint of the household in period 1 is then given by:

$$P_1^M C_1 + P_1^M B_1^* = P_1^M (1 + r_0) B_0^* + P_1^X Q_1. \tag{30}$$

- Dividing both sides by P_1^M, we obtain

$$C_1 + B_1^* = (1 + r_0) B_0^* + TT_1 Q_1. \tag{31}$$

- Similarly, in period 2, the budget constraint of the household is C_2:

$$C_2 + B_2^* = (1 + r_1) B_1^* + TT_2 Q_2. \tag{32}$$

The Intertemporal Budget Constraint

- Combining (31) with (32) and using $B_2 = 0$:

$$C_1 + \frac{C_2}{(1+r_1)} = (1+r_0)B_0^* + TT_1 Q_1 + TT_2 \frac{Q_2}{(1+r_1)} \tag{33}$$

- This expression is identical to its counterpart in the one-good model, except that the endowments Q_1 and Q_2 in the one-good model are replaced by $TT_1 Q_1$ and $TT_2 Q_2$.
- The present economy is small, so it takes TT_1 and TT_2 as given, just as it takes as given Q_1 and Q_2.
- It follows that changes in the terms of trade are just like changes in the endowment.

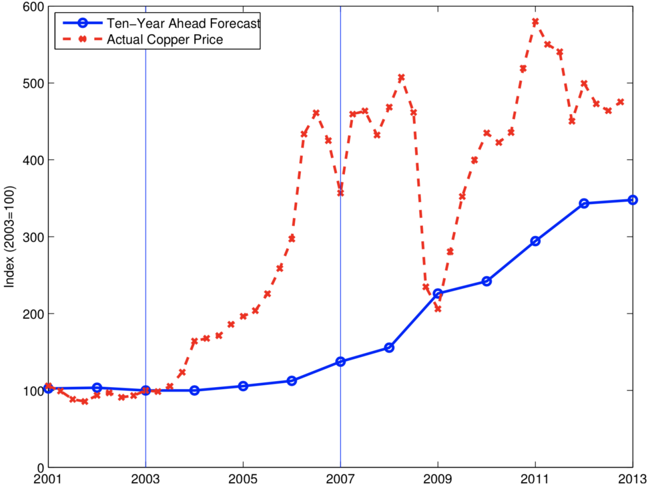
Effect of Term-of-Trade Shocks on the CA

- We have shown that terms-of-trade shocks are just like endowment shocks.
- It follows that the effect of TT shock on the trade balance and the current account depend crucially on whether the TT shock is perceived as temporary or permanent.
  - Finance temporary terms-of-trade shocks shocks (by running current account deficits or surpluses without much change in spending).
  - Adjust to permanent terms-of-trade shocks shocks (by changing spending, without much change in the current account).
- We now test how this principle works in real life.

A Case Study of the Copper Price in Chile 2001-2013

- Copper is the main export product of Chile (more than 50% of exports).
- After two decades of stability, the price of copper began to grow vigorously in the early 2000s (around 2003).
- What does our theory of current account determination say, should have happened to the CA between 2003 and 2007 in response to the copper price increase?
- Recall the principle, "finance temporary shocks and adjust to permanent ones".

Forecast versus Actual Real Price of Copper, Chile, 2001-2013

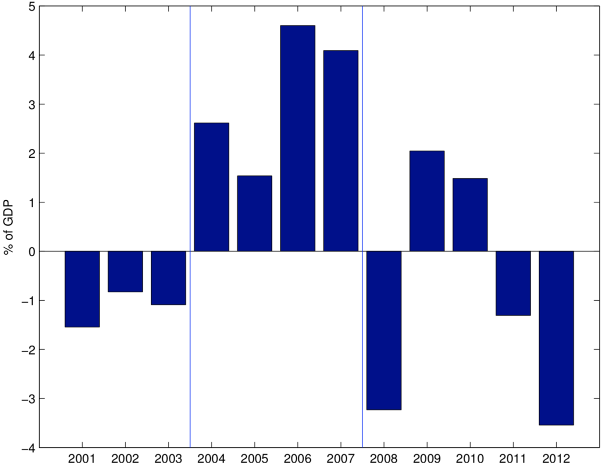


Are the change in prices transitory or permanent?

A Case Study of the Copper Price in Chile 2001-2013

- Agents thought the copper price increase was temporary, but the actual increase turnout to be permanent!
- If we assume that forward looking agents were anticipating the gradual increase of the copper price, they should have initially borrowed against this permanent terms of trade appreciation. So our model predicts either no CA change or, if anything, a CA deterioration.
- But the assumption that people could foresee a rising price of copper is misplaced. Until 2007 the experts expected the increase in the copper price to be transitory.
- In that case, our model predicts that the CA should improve.

The Current Account, Chile, 2001-2013



Source: Fornero and Kirchner (2014)

A Case Study of the Copper Price in Chile 2001-2013

- The CA actually improved in the period that agents thought the increase in price was transitory.
- For our model what counts is not what is true ex post but what people were thinking while the copper price was sky-rocketing, that is, during 2003-2007.
- Under these expectations, the observed improvement in the current account observed between 2003 and 2007 are in line with our theory of current-account determination.

World Interest Rate Shocks

- An increase in r^* has multiple, potentially conflicting, effects on consumption, the trade balance and the current account:

  1. Substitution Effect: An increase in the interest rate makes savings more attractive, so households substitute present consumption with future consumption. Thus, consumption falls and the trade balance and the current account improve.

$$r^* \uparrow \Rightarrow C_1 \downarrow, TB_1 \uparrow, CA_1 \uparrow \tag{34}$$

  2. Income Effect: An increase in the interest rate makes debtors poorer and creditors richer.

$$r^* \uparrow \Rightarrow \begin{cases} C_1 \downarrow, TB_1 \uparrow, CA_1 \uparrow & \text{if debtor} \\ C_1 \uparrow, TB_1 \downarrow, CA_1 \downarrow & \text{if creditor} \end{cases} \tag{35}$$

- Which effect dominates? We will assume that the substitution effect always dominates. This is the case in the economy with log utility.

World Interest Rate Shocks

- Consider the economy with log preferences analyzed earlier.

$$C_1 = \frac{1}{2}\left[(1+r_0)B_0^* + Q_1 + \frac{Q_2}{(1+r^*)}\right], \tag{36}$$

$$TB_1 = \frac{1}{2}\left[-(1+r_0)B_0^* + Q_1 - \frac{Q_2}{(1+r^*)}\right], \tag{37}$$

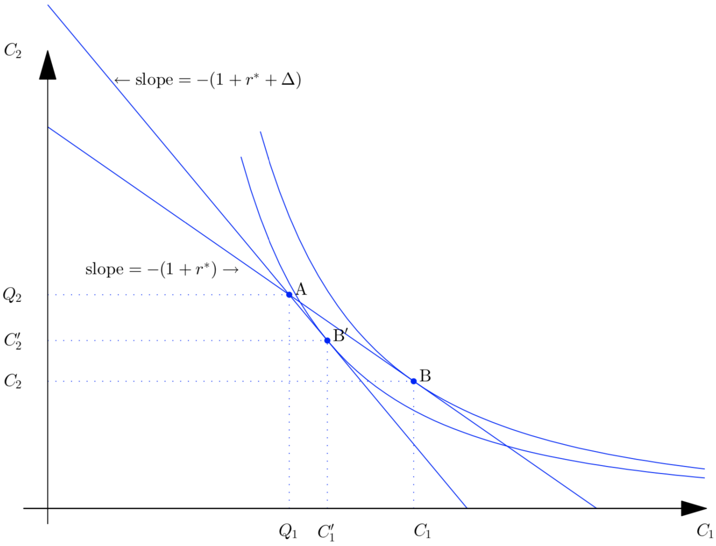
$$CA_1 = \frac{1}{2}\left[-(1+r_0)B_0^* - Q_1 - \frac{Q_2}{(1+r^*)}\right]. \tag{38}$$

- The first expression shows that consumption falls as the interest rate increases, and the last two expressions show that both the trade balance and the current account improve.

- In this economy, the substitution effect clearly dominates the wealth effect.

- The next graph illustrates what happens when r^* goes up.

World Interest Rate Shocks



World Interest Rate Shocks

- The initial position is point B, where the economy is borrowing and the trade balance and the current account are negative.
- The increase in r^* makes the intertemporal budget constraint rotate clockwise around the endowment point A, becoming steeper.
- The negative wealth effect is reflected in the fact that point B is no longer feasible. This induces households to consume less.
- The substitution effect goes in the same direction. The higher interest rate makes future consumption more attractive.
- The new equilibrium is a point B'. There, consumption is lower and the trade balance and the current account both improve relative to the initial position.

Taking Stock

- We presents an intertemporal model of the current account with 3 building blocks:
  1. Households face an intertemporal budget constraint
  2. Households have preferences over present and future consumption.
  3. Free capital mobility equalizes the domestic and world interest rates.

- The model delivers the following key insight:
  - Temporary shocks are "smoothed out" by CA deficits/surpluses.
  - Permanent shocks are adjusted through consumption without too much movement in the CA.

- We also study the model in the context of TT and World Interest Rate shocks.