Lecture 1: The intertemporal approach to the current account

Open economy macroeconomics, Fall 2006

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Intertemporal trade and the current account

- What determines when countries lend and when countries borrow in international capital markets?

- The current account (*driftsbalansen*)

  – Let B_{t+1} be the value of an economy's net foreign assets at the end of period t.

  – Definition of current account: net increase in foreign asset holdings

$$CA_t \equiv B_{t+1} - B_t \tag{1}$$

  or

$$CA_t = NX_t + rB_t \tag{2}$$

  where NX_t denotes net exports

Table 1
Global current account balances

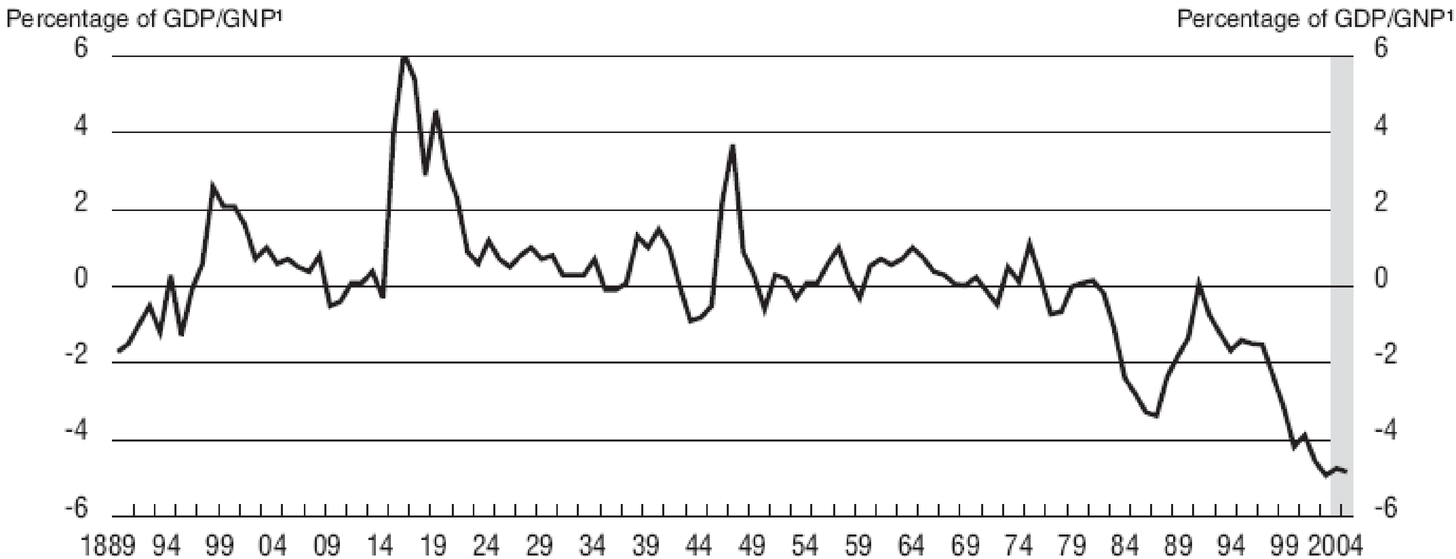
From Backus et al (2006) "Current account fact and fiction"

Country or Aggregate	Current Account Balance, 2004 US Dollars (billions)	% of GDP
(a) Largest Deficits		
United States	–668.1	–5.7
Spain	–55.3	–5.3
United Kingdom	–42.1	–2.0
Australia	–39.8	–6.4
Turkey	–15.5	–5.1
Italy	–15.0	–0.9
Portugal	–12.7	–7.5
Hungary	–8.8	–8.8
France	–8.4	–0.4
Greece	–8.0	–3.9
(b) Largest Surpluses		
Japan	172.1	3.7
Germany	103.8	3.8
China	68.7	4.2
Russia	59.9	10.3
Saudi Arabia	51.6	20.5
Switzerland	43.0	12.0
Norway	33.8	13.5
Sweden	28.5	8.2
Singapore	27.9	26.1
Korea	27.6	4.1
(c) Country Aggregates		
United States	–668.1	–5.7
Other advanced economies	354.1	—
Emerging economies	227.1	—
Middle East	102.8	12.4
Developing Asia	93.0	2.9
World (discrepancy)	–86.3	—

Source: International Monetary Fund, *World Economic Outlook Database*, September 2005.

Figure 1. **The US current account in historical perspective**

Percentage of GDP/GNP[1]



1. GNP before 1929.

Source: OECD, US Bureau of Economic Analysis; and for the pre-1946 period Bureau of the Census: Historical Statistics of the United States, Washington DC, 1975.

- The simplest possible model:
  - small open economy
  - two periods, labeled 1 and 2
  - one good at each date
  - endowment economy: output in each period is given: Y_1 and Y_2
  - all individuals are identical, population size normalised to one.
  - perfect foresight (no uncertainty)

- The representative consumer's problem:

  – Lifetime utility

$$U = u(C_1) + \beta u(C_2), \qquad 0 < \beta < 1 \tag{3}$$

  where β is the subjective discount factor and $u'(C) > 0, u''(C) < 0$ and $\lim_{C \to 0} u'(C) = \infty$

  – Period budget constraints ($B_1 = B_3 = 0$)

$$\begin{aligned} C_1 &= Y_1 - B_2 & (4) \\ C_2 &= Y_2 + (1 + r)B_2 & (5) \end{aligned}$$

  where r is the (exogenous) world real interest rate

  – Current account

$$CA_2 = -B_2 = -(Y_1 - C_1) = -CA_1 \tag{6}$$

– Intertemporal budget constraint

$$\underbrace{C_1 + \frac{C_2}{1+r}}_{\text{Present value of consumption}} = \underbrace{Y_1 + \frac{Y_2}{1+r}}_{\text{Present value of output}} \tag{7}$$

– Consumer's optimisation problem: Maximise (3) subject to (7)

– From (7)

$$C_2 = (1+r)(Y_1 - C_1) + Y_2 \tag{8}$$

– Substitute into (3)

$$U = u(C_1) + \beta u((1+r)(Y_1 - C_1) + Y_2) \tag{9}$$

– First-order condition with respect to C_1

$$\begin{aligned} u'(C_1) - \beta u'(C_2)(1+r) &= 0 \\ u'(C_1) &= \beta(1+r)u'(C_2) \qquad (10) \end{aligned}$$

– This is the consumption Euler equation: at an optimum the consumer cannot increase utility by shifting consumption between periods.

  * A one unit increase in consumption in period 1 increases utility by $u'(C_1)$

  * Alternatively the consumer can save in period 1 and get $(1+r)$ extra units of consumption in period 2 which increases utility by $\beta(1+r)u'(C_2)$

– Consumers have incentive to *smooth* consumption over time

– Rearrangement yields

$$\underbrace{\frac{\beta u'(C_2)}{u'(C_1)}}_{\substack{\text{Marginal rate of substitution of} \\ \text{present for future consumption}}} = \underbrace{\frac{1}{1+r}}_{\substack{\text{Price of future consumption in} \\ \text{terms of current consumption}}}$$

– Optimal consumption plan found by combining (10) and (7)

- What determines whether a country runs a current account deficit or a current account surplus?
  - Autarky real interest rate r_A: interest rate that would prevail in economy which could not borrow or lend internationally
  - In autarky: $C_1 = Y_1$ and $C_2 = Y_2$
$$\frac{\beta u'(Y_2)}{u'(Y_1)} = \frac{1}{1 + r_A} \tag{11}$$
  - An increase in Y_1 or a fall in Y_2 causes the autarky interest rate to increase
  - If $Y_1 = Y_2 \Longrightarrow \beta = \frac{1}{1+r_A}$
  - Gains from intertemporal trade as long as $r \neq r_A$

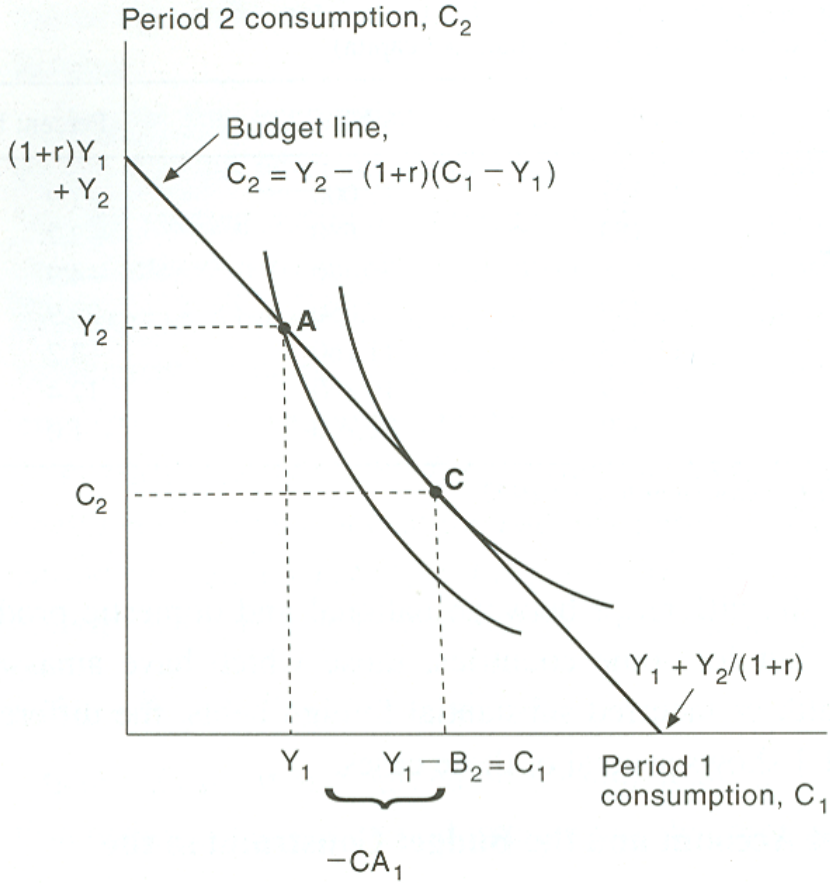


Figure 1.1
Consumption over time and the current account

- Special case: $\beta = \frac{1}{1+r}$
  - Euler equation implies $C_1 = C_2 = C$ (perfect consumption smoothing)
  - Budget constraint yields

$$
\begin{aligned}
C + \frac{C}{1+r} &= Y_1 + \frac{Y_2}{1+r} && (12)\\
\frac{2+r}{1+r}C &= Y_1 + \frac{Y_2}{1+r} && (13)\\
C &= \frac{Y_1\,(1+r) + Y_2}{2+r} && (14)
\end{aligned}
$$

  - Autarky interest rate

$$
\frac{u'(Y_2)}{u'(Y_1)} = \frac{1+r}{1+r_A} \qquad (15)
$$

- Assume economy initially expects $Y_1 = Y_2 \Longrightarrow r = r_A$ and $CA_1 = 0$.

- Permanent changes in output ($dY_1 = dY_2 = dY$): no effect on r_A or CA_1

- Temporary increase in output in period 1 ($dY_1 > 0, dY_2 = 0$): r_A falls ($r_A < r$), $CA_1 > 0$

- Temporary increase in output in period 2 ($dY_1 = 0, dY_2 > 0$): r_A increases ($r_A > r$), $CA_1 < 0$.

- Adding government consumption
  - Period utility
$$u(C) + \nu(G) \tag{16}$$
  - Assume balanced budget each period (no government deficits or surpluses)
  - Representative agent's budget constraint
$$C_1 + \frac{C_2}{1+r} = Y_1 - G_1 + \frac{Y_2 - G_2}{1+r} \tag{17}$$
  - Euler equation same as above

- What is the effect on the current account?
- Assume $\beta = \frac{1}{1+r}$, $Y_1 = Y_2 = Y$, $G_1 > 0$ and $G_2 = 0$.
- Closed form solution for consumption

$$
\begin{aligned}
C + \frac{1}{1+r}C &= Y - G_1 + \frac{Y}{1+r} && (18)\\
\frac{2+r}{1+r}C &= \frac{2+r}{1+r}Y - G_1 && (19)\\
C &= Y - \frac{1+r}{2+r}G_1 && (20)
\end{aligned}
$$

- Current account

$$
\begin{aligned}
CA_1 &= Y - C - G_1 && (21)\\
&= \frac{1+r}{2+r}G_1 - G_1 && (22)\\
&= -\frac{G_1}{2+r} && (23)
\end{aligned}
$$

- Adding investment
  - Production function

$$Y = F(K), \qquad F'(K) > 0, F''(K) < 0, F(0) = 0, \lim_{K \longrightarrow 0} F'(K) = \infty \tag{24}$$

  - Investment (ignoring depreciation)

$$I_t = K_{t+1} - K_t \tag{25}$$

  - Current account

$$CA_t = B_{t+1} - B_t = \underbrace{Y_t + rB_t - C_t - G_t}_{\text{National saving } S_t} - I_t = S_t - I_t \tag{26}$$

  - Current account balance $=$ national saving minus investment

- Returning to the two-period model
- $B_1 = B_3 = 0$, $K_3 = 0 \Longrightarrow I_2 = -K_2$
- Period budget constraints

$$\begin{aligned} Y_1 &= C_1 + G_1 + I_1 + B_2 && (27) \\ Y_2 + (1+r)B_2 &= C_2 + G_2 + I_2 && (28) \end{aligned}$$

- Intertemporal budget constraint

$$\underbrace{C_1 + I_1 + \frac{C_2 + I_2}{1+r}}_{\text{Present value of consumption and investment}} = \underbrace{Y_1 - G_1 + \frac{Y_2 - G_2}{1+r}}_{\text{Present value of output}} \qquad (29)$$

- Solve for C_2 and substitute in for $Y = F(K)$, $I_2 = -K_2$ and $K_2 = I_1 + K_1$

$$\begin{aligned} C_2 &= (1+r)(Y_1 - G_1 - C_1 - I_1) + Y_2 - G_2 - I_2 && (30) \\ &= (1+r)(F(K_1) - G_1 - C_1 - I_1) + F(K_2) - G_2 + K_2 \\ &= (1+r)(F(K_1) - G_1 - C_1 - I_1) + F(K_1 + I_1) - G_2 + K_1 + I_1 \end{aligned}$$

– Optimisation problem

$$\max_{C_1, I_1} u(C_1) + \beta u \left(\begin{array}{c} (1+r)(F(K_1) - G_1 - C_1 - I_1) \\ +F(K_1 + I_1) - G_2 + K_1 + I_1 \end{array} \right) \tag{31}$$

– First-order condition with respect to C_1

$$u'(C_1) = \beta(1+r)u'(C_2) \tag{32}$$

– First-order condition with respect to I_1 (note that K_1 is given at date 1)

$$\begin{aligned} -(1+r) + F'(K_2) + 1 &= 0 \\ F'(K_2) &= r \end{aligned} \tag{33}$$

∗ Note! Desired capital stock is independent of preferences

∗ Note! Government consumption does not crowd out investment

- Equilibrium
  - Assume for now $G_1 = G_2 = 0$
  - Intertemporal production possibilities frontier (PPF): the technological possibilities for transforming period 1 consumption into period 2 consumption (in autarky)

$$\begin{aligned} C_2 &= Y_2 + K_2 \\ &= Y_2 + I_1 + K_1 \\ &= F(I_1 + K_1) + K_1 + I_1 \\ &= F(Y_1 - C_1 + K_1) + K_1 + Y_1 - C_1 \\ &= F(F(K_1) - C_1 + K_1) + K_1 + F(K_1) - C_1 \end{aligned} \tag{34}$$

  - Maximum consumption in period 1 (horizontal intercept)

$$C_1^{\mathsf{max}} = F(K_1) + K_1 \tag{35}$$

  - Maximum consumption in period 2 (vertical intercept)

$$C_2^{\mathsf{max}} = F(F(K_1) + K_1) + K_1 + F(K_1) \tag{36}$$

– Shape of PPF

$$\frac{dC_2}{dC_1} = -F'(K_2) - 1 < 0, \qquad \frac{d^2C_2}{dC_1^2} = F''(K_2) < 0 \tag{37}$$

– Autarky equilibrium (point A)

$$\frac{\beta u'(C_2)}{u'(C_1)} = \frac{1}{1 + F'(K_2)} = \frac{1}{1 + r_A} \tag{38}$$

– Production in open economy (point B)

$$F'(K_2) = 1 + r \tag{39}$$

– Consumption in open economy (point C)

$$\frac{\beta u'(C_2)}{u'(C_1)} = \frac{1}{1 + r} \tag{40}$$

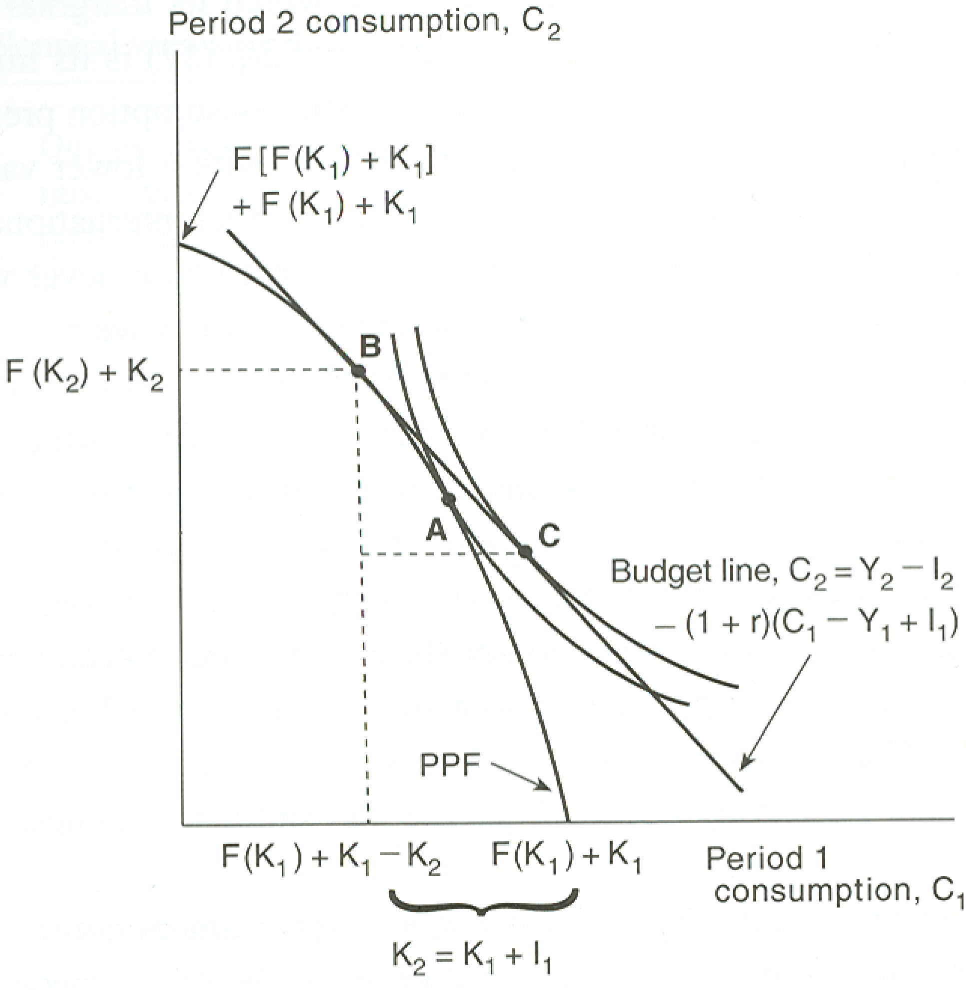


Figure 1.3
Investment and the current account