Chapter 16: Micro-foundations: Consumption

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Why Study Consumption?

- Consumption is about 2/3 of GDP.
- Is our consumption function $C = C(Y - T)$ too simplistic? Importantly, is it realistic?

J. M. Keynes's Conjectures about the Consumption Function

1. $0 \leq MPC \leq 1$: out of each additional dollar, we spend MPC and save $1 - MPC$ dollars.

2. The average propensity to consume, $APC = \frac{C}{Y}$, falls as income increases. I.e., richer people save a higher proportion of their incomes.

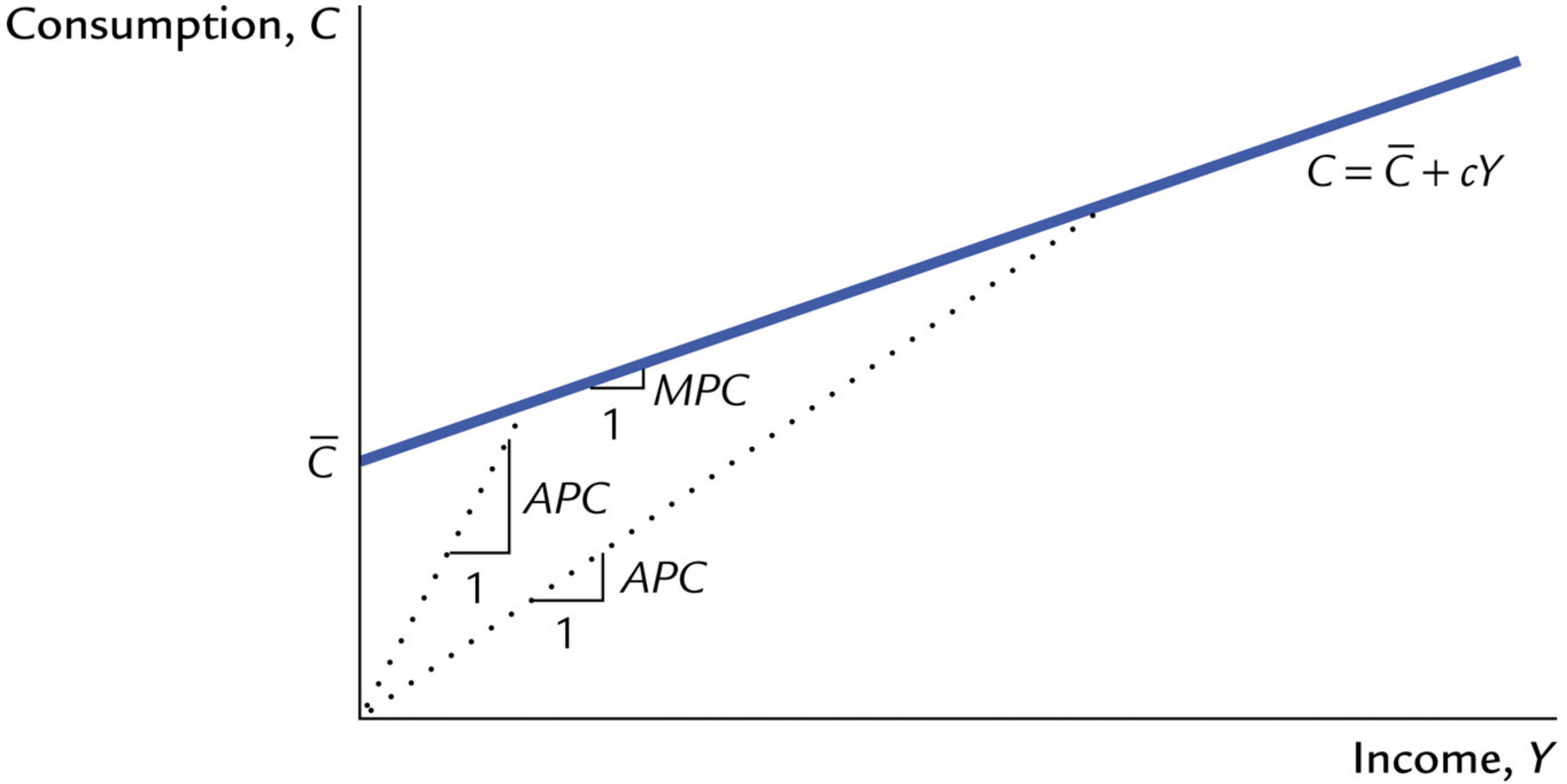
3. Consumption is irresponsive to the real interest rate.

The Keynesian Consumption Function

Summarizing, the Keynesian consumption function can be written as:

$$C = \overline{C} + c \times Y, \quad \overline{C} > 0, \quad 0 < c < 1.$$

$$APC = \frac{C}{Y} = \frac{\overline{C}}{Y} + c.$$



Consumption, C
C = C̄ + cY
MPC
1
C̄
APC
1
APC
1
Income, Y

Successes and Failures

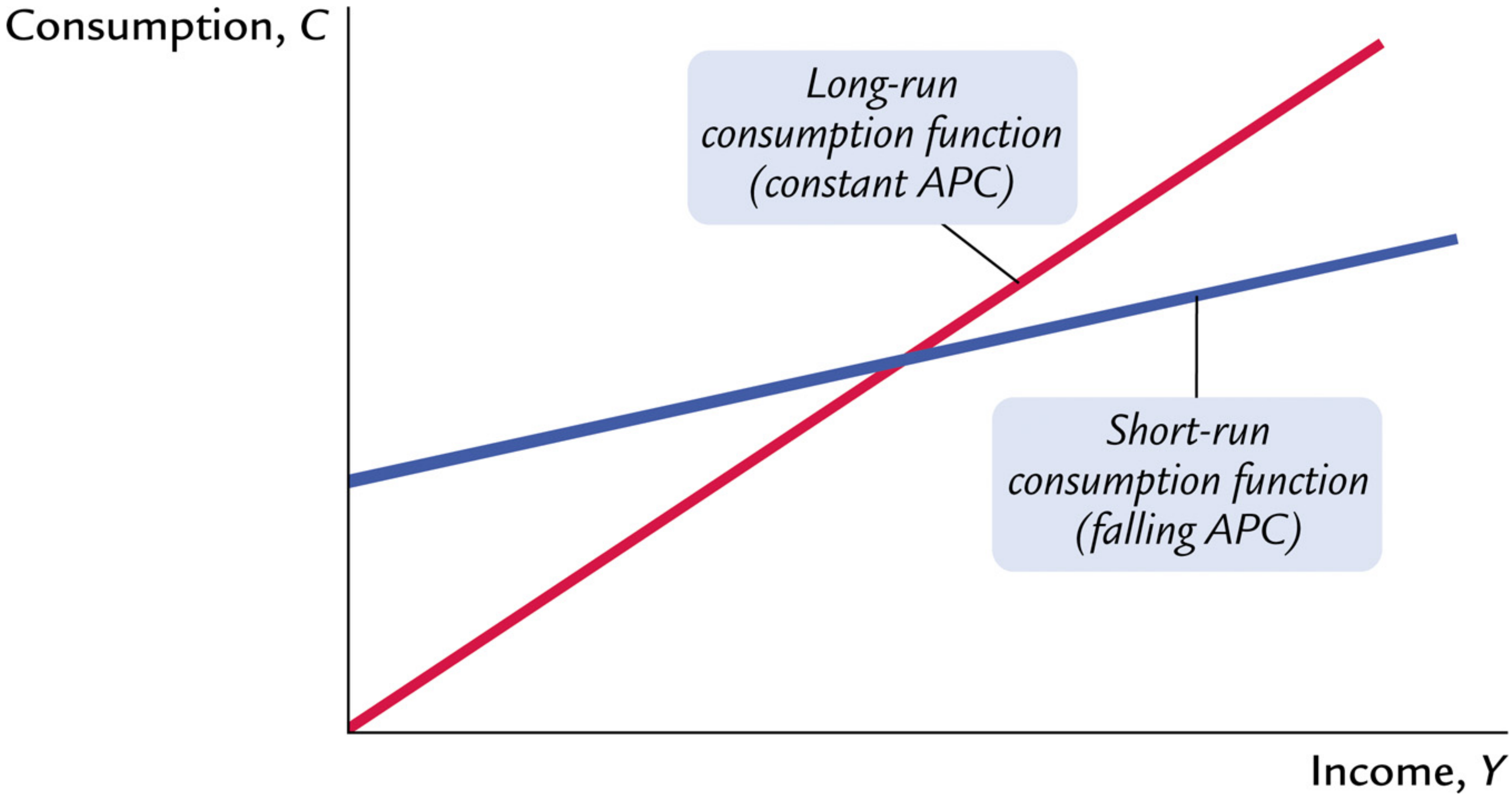
Successes:

- Household data: $0 < MPC < 1$, APC is smaller for higher income households.
- Aggregate data (in-between the wars, when income was low): the ratio of C to Y was high; Y was the primary determinant of C.

Failures:

- Falling APC+rising incomes during the *WWII* would lead to a *secular stagnation*—a long depression in absence of changes in G or T. This prediction about falling APC did not hold.
- S. Kuznets assembled consumption and income data back to 1869. $\frac{C}{Y}$, i.e. the APC was stable.

Reconciliation of successes and failures: two consumption functions—for the short- and the long-runs.


Consumption, C
Long-run consumption function (constant APC)
Short-run consumption function (falling APC)
Income, Y

I. Fisher and the Intertemporal Choice

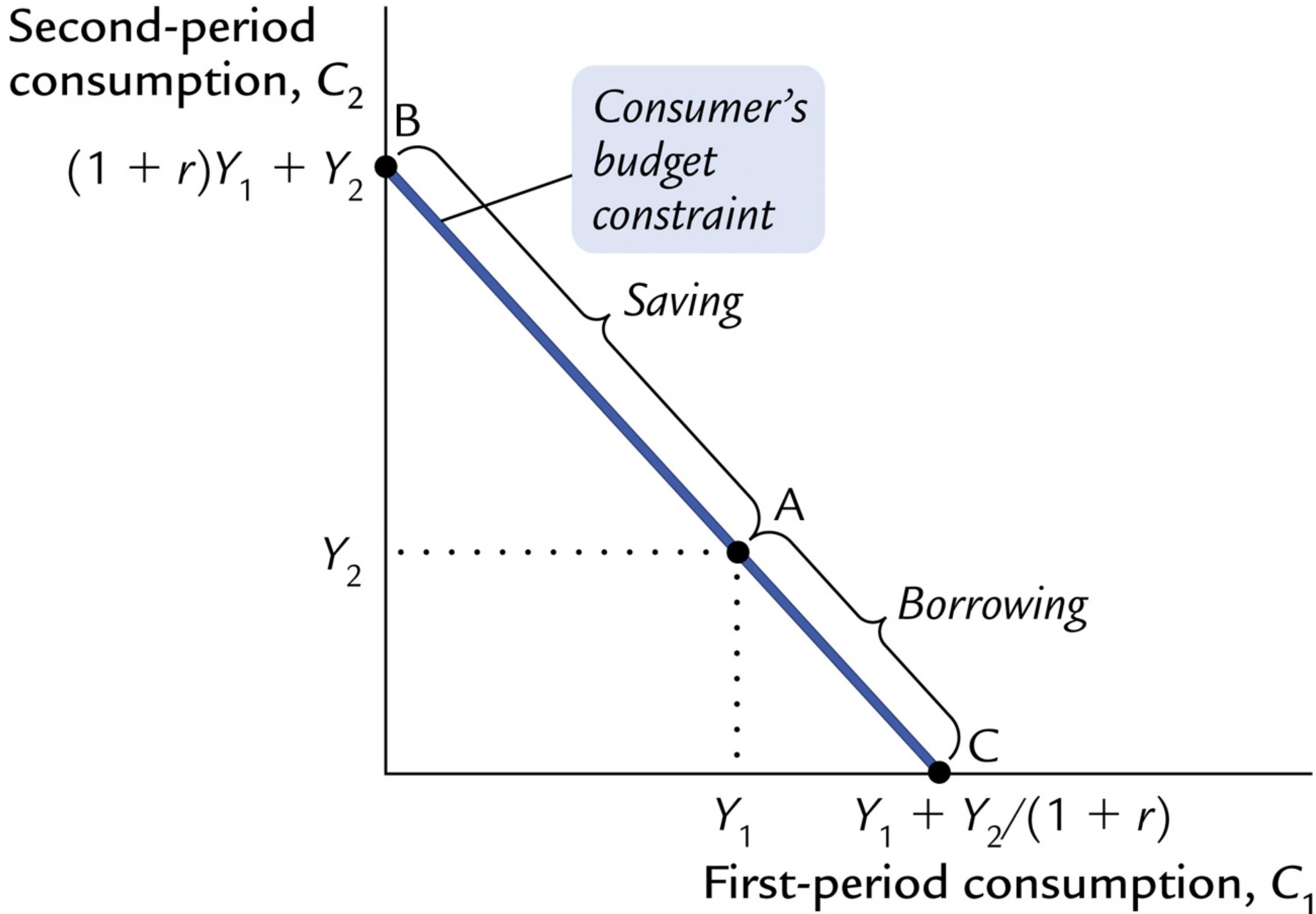
- In reality consumption responds not only to changes in *current* income but also to changes in *(expected)* income from future periods.

Let consumer live for 2 periods: period 1—youth/adulthood, period 2—old age. Let S_1 be savings in period 1; C_j and Y_j are consumption and income in period j (j=1,2); r—the real interest rate.
Then, $S_1 = Y_1 - C_1$, $C_2 = S_1(1+r) + Y_2$. Plugging S_1 into the second equation, we obtain the intertemporal budget constraint:

$$C_1 + \frac{C_2}{1+r} = Y_1 + \frac{Y_2}{1+r}.$$

Optimization

If the preferences are represented by utility function $U = U(C_1, C_2)$, then the consumer chooses C_1 and C_2 that bring the highest utility index such that the budget constraint is exhausted.



Second-period consumption, C_2
B
$(1 + r)Y_1 + Y_2$
Consumer's budget constraint
Saving
A
Y_2
Borrowing
C
Y_1
$Y_1 + Y_2/(1 + r)$
First-period consumption, C_1

Optimization Contd. (1)

- The *indifference curve*: any combination of C_1 and C_2 that bring the same utility index U. The slope of indifference curve is defined from: $dU = MU_1 dC_1 + MU_2 dC_2$, or $0 = MU_1 dC_1 + MU_2 dC_2$, i.e., $\frac{dC_2}{dC_1} = -\frac{MU_1}{MU_2}$.

- The slope of the budget constraint: $-(1+r)$.

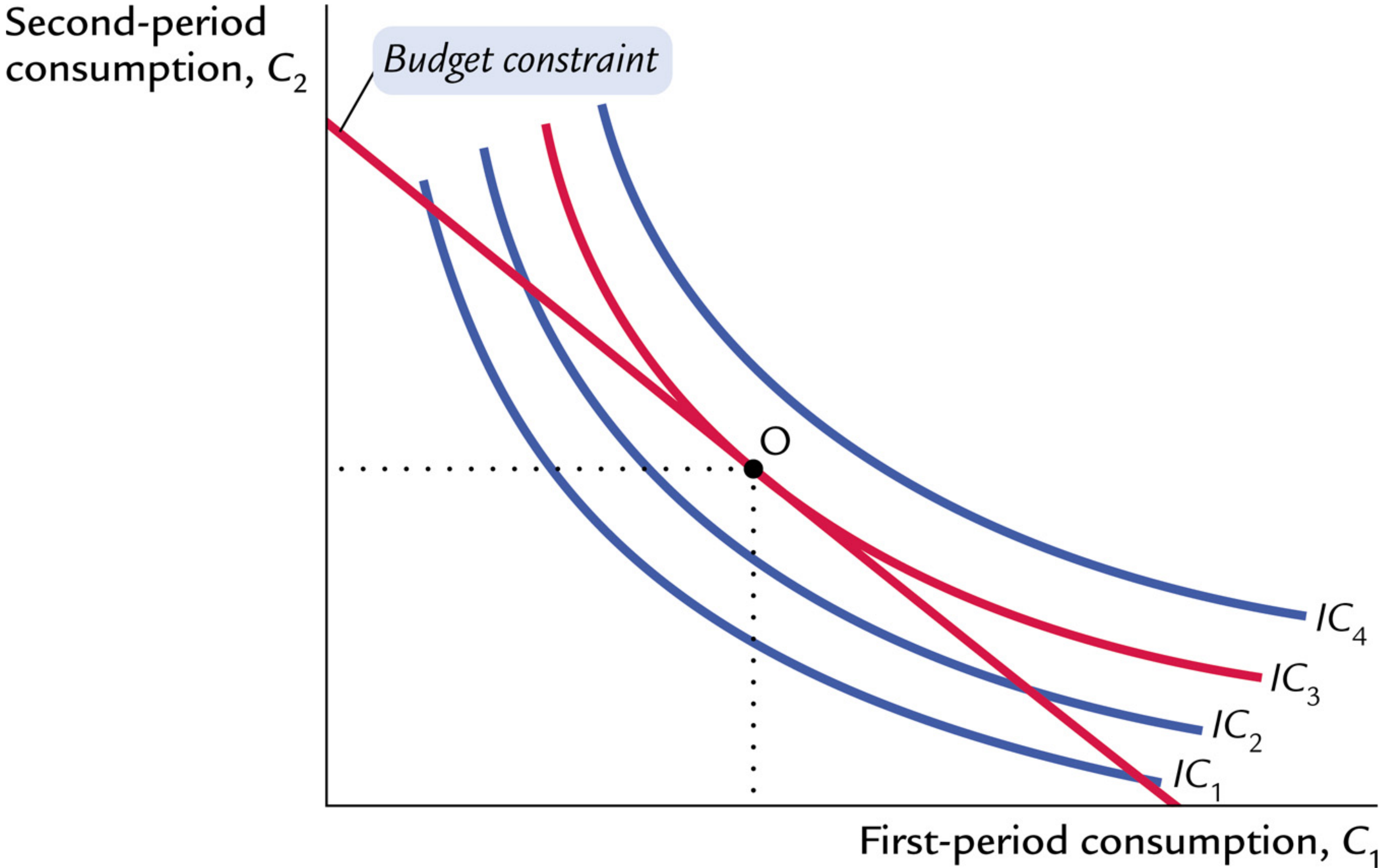
- When consumer maximizes utility, *on the margin*, the benefit of adjusting his optimal bundle of (C_1^*, C_2^*) should be zero. *The period-1 cost* of reducing consumption by dC_1 is $MU_1 \times dC_1$, and *the period-2 benefit* of this reduction is $MU_2 \times dC_1 \times (1+r)$.

  Thus, at the optimum: $MU_1 \times dC_1 = MU_2 \times dC_1 \times (1+r)$, or

$$-\frac{MU_1}{MU_2} = -(1+r).$$

Optimization Contd. (2)

I.e., the highest possible utility is achieved at the point (C_1^*, C_2^*), where *the slope of the indifference curve* is equal to *the slope of the budget constraint*.


Second-period consumption, C_2
Budget constraint
O
IC_4
IC_3
IC_2
IC_1
First-period consumption, C_1

From the constraint in nominal terms to the constraint in real terms

In nominal terms, the budget constraint can be derived going through the following steps. If you save \$1 of income in period 1, you will be entitled to \$(1 + i) in period 2. Denote the price of 1 unit of consumption in period 1 as P_1, P_2 is the same for period 2.

Your endowments of goods 1 and 2 are equal to Y_1 and Y_2, respectively. Their nominal value is $P_1 C_1$ and $P_2 C_2$.

Savings in the first period in nominal terms are $S_1 = P_1(Y_1 - C_1)$. Next-period nominal resources are $(1 + i)P_1(Y_1 - C_1) + P_2 Y_2$ and $P_2 C_2 = (1 + i)P_1(Y_1 - C_1) + P_2 Y_2$. Divide the RHS and the LHS of the equation by P_2 to obtain,

$$
\begin{aligned}
C_2 &= (1+i)\frac{P_1}{P_2}(Y_1 - C_1) + Y_2 \\
&= \frac{1+i}{1+\pi}(Y_1 - C_1) + Y_2 = (1+r)(Y_1 - C_1) + Y_2.
\end{aligned}
$$

Income and substitutions effects (1)

This boils down to the lifetime constraint in **real** terms:

$$C_1 + \frac{C_2}{1+r} = Y_1 + \frac{Y_2}{1+r}.$$

Compare it to the constraint for static optimization with two distinct goods and income, I:

$$P_X X + P_Y Y = I.$$

In terms of this notation, $1 = P_X$, $\frac{1}{1+r} = P_Y$, and $Y_1 + \frac{Y_2}{1+r} = I$. In our dynamic constraint, the price of C_1 is normalized to 1, and the price of C_2 in terms of C_1 is $\frac{1}{1+r}$.

If r increases, C_2 becomes cheaper in terms of C_1.

Income and Substitution Effects (2)

$$C_1 + \frac{C_2}{1+r} = Y_1 + \frac{Y_2}{1+r}.$$

If Y_1 or Y_2 changes, this impacts only the lifetime income. Hence, these changes will cause changes in (C_1^*, C_2^*) due to the *income effect*.

If r changes, it impacts both the lifetime income *and* the relative price of consumption in periods 1 and 2. Thus, the *substitution* effect will be more complicated and will be different for savers $(C_1^* < Y_1)$ versus borrowers $(C_1^* > Y_1)$.

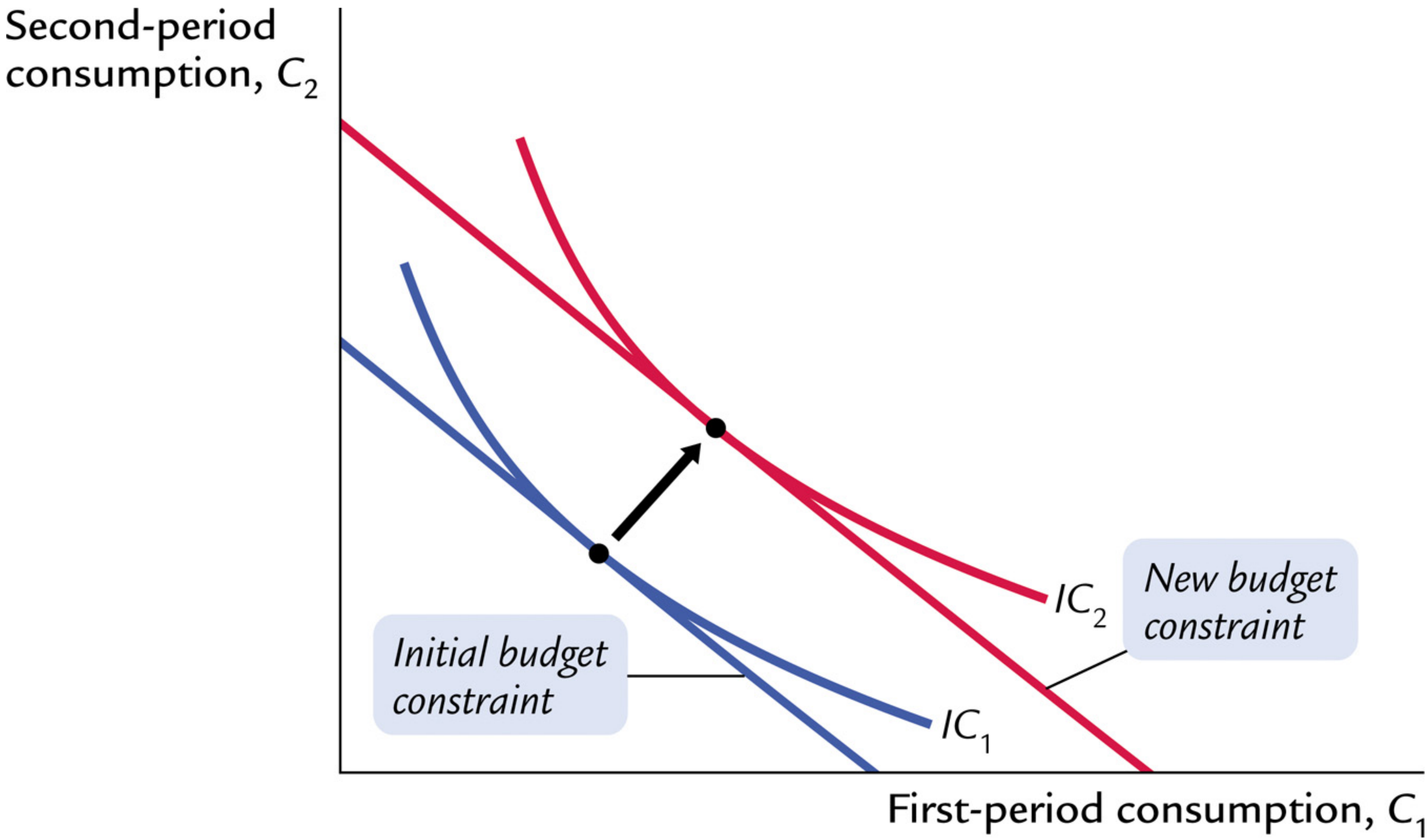
Income and Substitution Effects (3)

- If Y_1 or Y_2 increases, both C_1 and C_2 increase, provided they are *normal* goods.

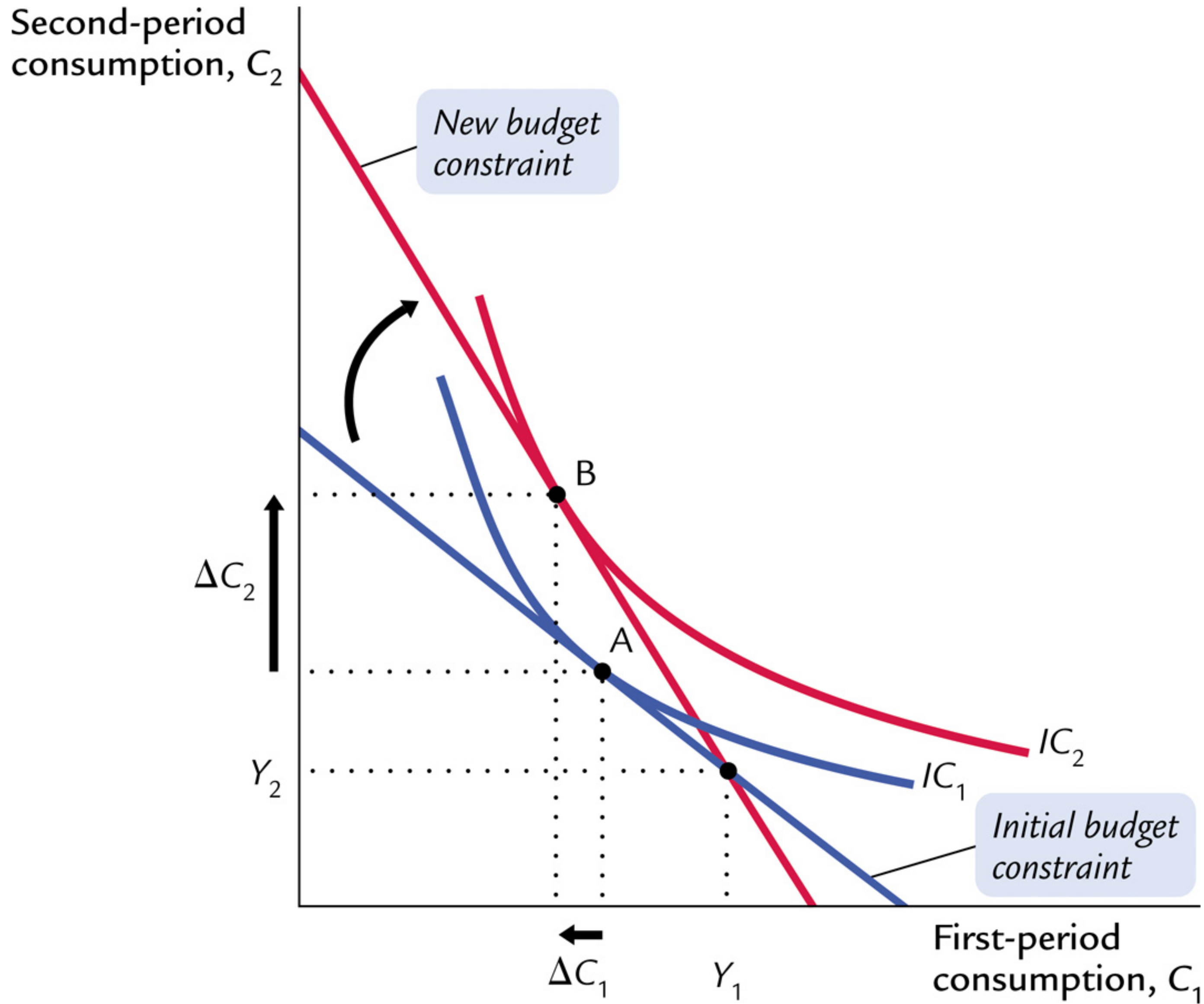
- Thus, the timing of income is irrelevant for current consumption decisions if the consumer is not constrained in borrowing.

- Effects on C_1^* and C_2^*, following a change in the real interest rate, depend on whether the consumer is a saver $(C_1 < Y_1)$, or a borrower, $(C_1 > Y_1)$.

- If the consumer is a *saver* and $r \uparrow$, C_1 should *increase* because of the <u>income effect</u>, and *decrease* because of the <u>substitution effect</u> (since the price of the period-2 consumption is now lower). The final change in C_1 is ambiguous; C_2, though, increases unambiguously.



Second-period consumption, C_2
New budget constraint
IC_2
Initial budget constraint
IC_1
First-period consumption, C_1

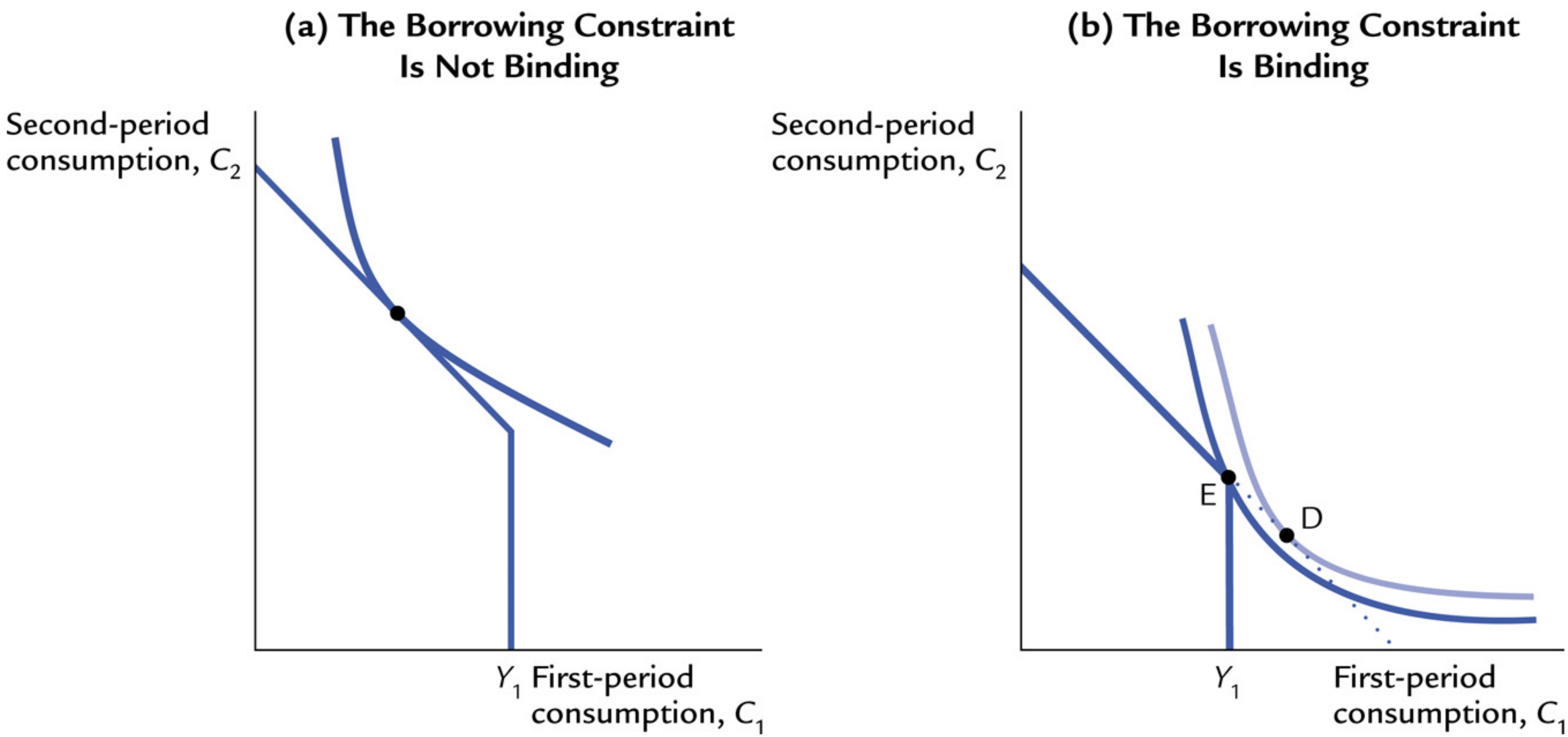


Second-period consumption, C_2
New budget constraint
B
A
ΔC_2
Y_2
IC_2
IC_1
Initial budget constraint
ΔC_1
Y_1
First-period consumption, C_1

Liquidity Constraints

If the consumer is a would-be-'borrower' but cannot borrow, i.e., is liquidity constrained, then this consumer's C_1 will be equal to Y_1.

Thus, for liquidity constrained consumers current consumption is determined by current income.


(a) The Borrowing Constraint Is Not Binding
Second-period consumption, C_2
Y_1
First-period consumption, C_1
(b) The Borrowing Constraint Is Binding
Second-period consumption, C_2
E
D
Y_1
First-period consumption, C_1

Consider first the problem without liquidity constraints. Then, (C_1^*, C_2^*) should satisfy 2 equations. The Euler equation:

$$MU_1(C_1^*) = (1+r)MU_2(C_2^*),$$

and the budget constraint:

$$C_1^* + \frac{C_2^*}{1+r} = Y_1 + \frac{Y_2}{1+r}.$$

We're assuming that the marginal utility in period 1 is a function of consumption in period 1 only. Similarly, for period 2.

With liquidity (borrowing) constraints, C_1 cannot be larger than Y_1, that is, $C_1 \leq Y_1$. If the unconstrained problem gives you $C_1^* \leq Y_1$, then we say the constraint is *not binding*—consumer is a saver anyways. Otherwise, if $C^* > Y_1$, the maximum this consumer can have in period 1 is Y_1. Summarizing, $C_{1,bc}^* = \min\{C_1^*, Y_1\}$; $C_{2,bc}^* = C_2^*$ if $C_{1,bc}^* = C_1^*$, $C_{2,bc}^* = Y_2$ otherwise.

Example

Let the utility function be $U(C_1, C_2) = \log(C_1) + \beta \log(C_2)$, where log is the natural logarithm. Let $Y_1 = 40$, $Y_2 = 80$, $r = 0.05$, $\beta = 0.90$. First, assume that consumer is unconstrained.

For this utility function, $MU_1 = \frac{1}{C_1}$, and $MU_2 = \beta \frac{1}{C_2}$. The Euler equation tells us that $\frac{1}{C_1} = \beta(1+r)\frac{1}{C_2}$, or $C_2^* = \beta(1+r)C_1^*$. Plug this result into the budget constraint to obtain,
$C_1 + \frac{\beta(1+r)C_1^*}{1+r} = Y_1 + \frac{Y_2}{1+r}$, or
$C_1^* = \frac{1}{1+\beta}\left[Y_1 + \frac{Y_2}{1+r}\right] = \frac{1}{1.90}(40 + 80/(1.05)) \approx 61$. Thus,
$C_2^* = 0.90 * (1.05) * 61 \approx 57.8$.

If consumer is constrained this implies that $C_{1,bc}^* < Y_1$, and $C_{1,bc}^* = \min\{61, 40\} = 40$. Also, $C_{2,bc}^* = 80$. You can also show that the liquidity constrained consumer will be worse off.

The Life-Cycle Hypothesis

- Idea: want to smooth consumption over the life cycle. Thus, need to save during the working life to support consumption during retirement.

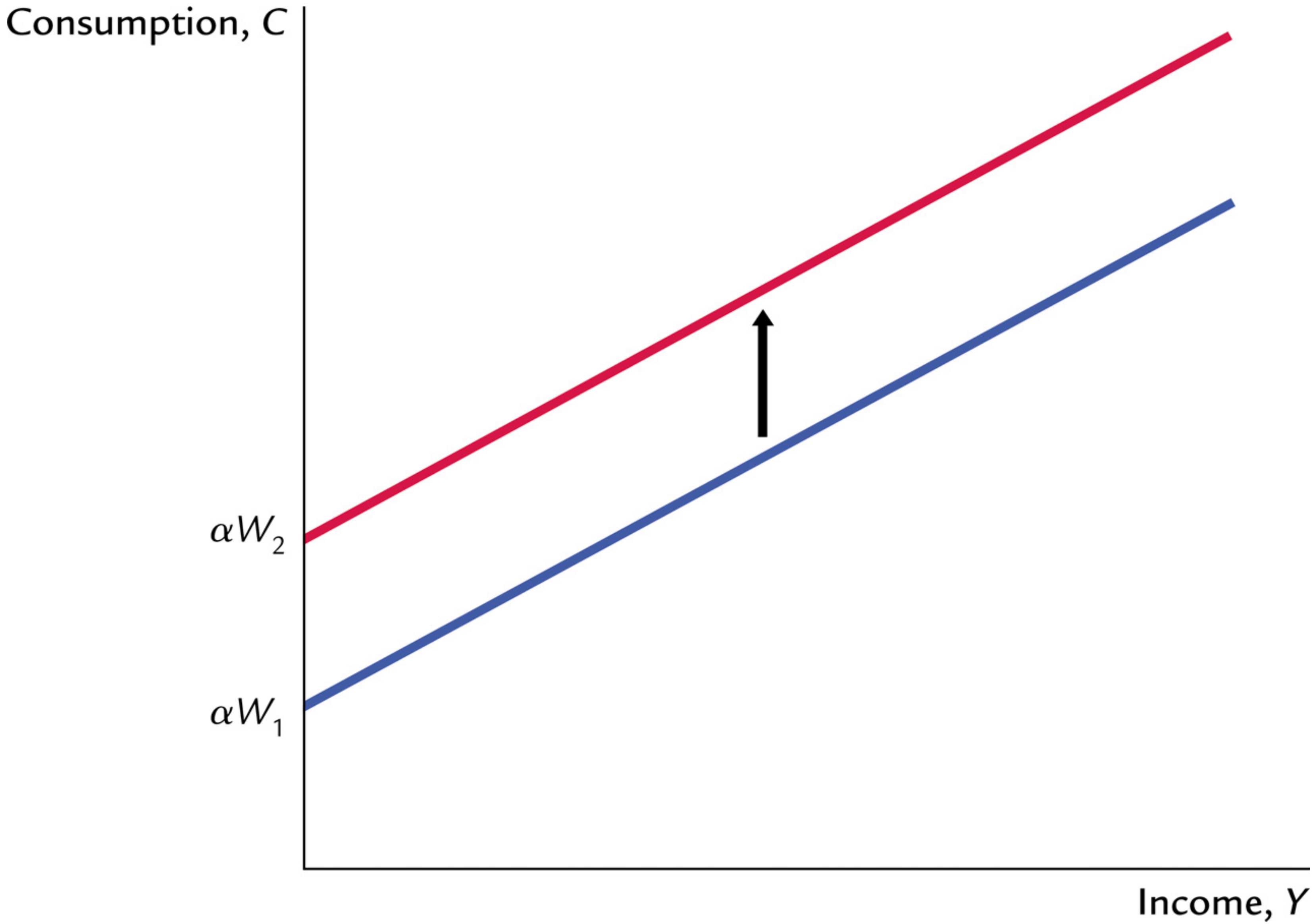
Assume consumer prefers a smooth consumption path; will live T more years; will work for another R years; has wealth of W; and will receive a sure income Y during the working years.

The lifetime wealth is $W + R \times Y$. Then,

$$C = (W + R \times Y)/T = W/T + (R/T) \times Y = \alpha \times W + \beta \times Y.$$

Thus, $\frac{C}{Y} = \alpha \times (W/Y) + \beta$.

In the short run, for a fixed W, an increases in Y leads to a falling APC; in the long run, W and Y grow together, and C/Y is stable.



Consumption, C
αW_2
αW_1
Income, Y

Milton Friedman's Permanent Income Hypothesis

Milton Friedman postulated the following model of consumption:

$$Income: \quad Y = Y^T + Y^P,$$

$$Consumption: \quad C = Y^P.$$

Y^P is *the permanent income* (the component of income that persists over time); Y^T is *the transitory income* (short-lived components of income such as bonuses, overtime, windfalls from lottery etc.)

The Permanent Income Hypothesis (PIH)

Implications:

- Consumption changes by the magnitude of a change in *permanent income*. Transitory changes in income are predominantly saved.
- $APC = \frac{C}{Y} = \frac{Y^P}{Y}$. In the household studies, most of variation in $\frac{Y^P}{Y}$ comes from the transitory variation in income. Thus, if $Y > Y^P$, $C < Y$, and the APC is falling.
- In the long time series, most of variation in Y comes from the variation in Y^P, and so APC will be stable.

Hall's Formulation of the PIH

PIH: consumption depends on Y^P, and therefore on expectations of the lifetime resources.

Robert Hall: if the *PIH* holds, and consumers form rational expectations, then *changes in consumption* are *unpredictable*. I.e., (the level of) consumption is a *martingale*, and consumption responds only to the 'news' in income.

Importantly, under the *PIH* only *unexpected* changes in policy influence consumption.