1. Draw a budget-constraint/indifference-curve diagram to illustrate each of the following situations with current consumption (C_1) on the horizontal axis and future consumption (C_2) on the vertical axis. You should assume that the person is approximately a consumption smoother, so that whether she is initially a saver or dissaver (borrower) is determined mainly by her endowment point. Be sure to identify clearly the endowment point, the budget constraints before and after the change, and the amounts saved or dissaved before and after the change.
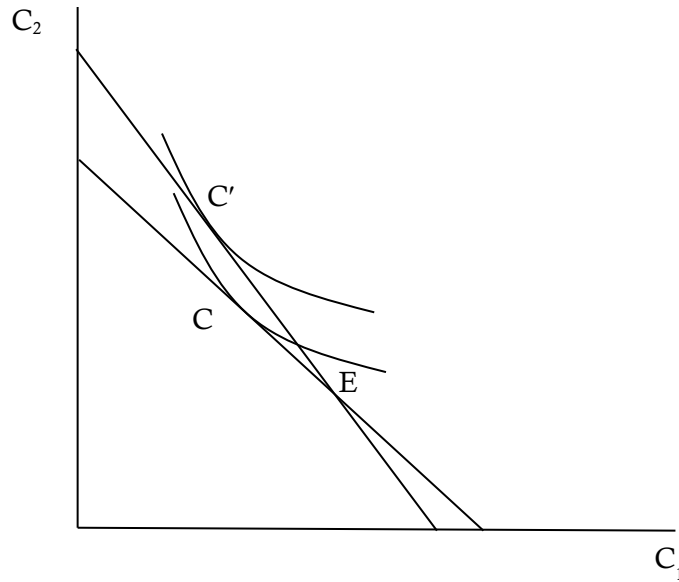
   a. A person who is initially a saver in period 1 and who responds to an increase in the real interest rate by decreasing saving.

       Graph should look something like this. The key points are that the endowment point E lies below the consumption points and that the new consumption point C' lies to the right of the original consumption point C. The horizontal distance from E to C is saving at the lower interest rate. The (smaller) horizontal distance from E to C' is saving at the higher interest rate.
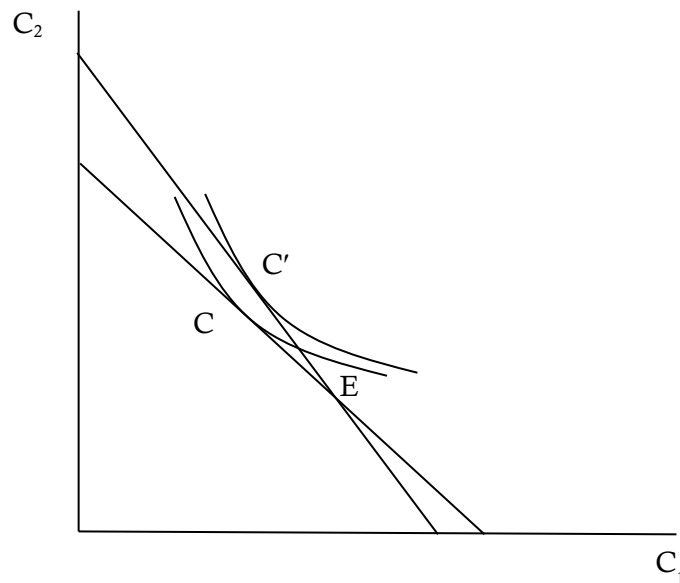

   b. A person who is initially a saver in period 1 and who responds to an increase in the real interest rate by increasing saving.

The only difference here is that C' lies to the left of C, showing an increase in saving (decrease in period one consumption) rather than a decrease.

c. A person who is initially a dissaver (borrower) in period 1 and who responds to an increase in the real interest rate by increasing saving (reducing dissaving).

Here the endowment point E lies above and to the left of the consumption points, making the agent a borrower rather than a lender. Consumption changes from C to C', which must lie below and to the left of C, showing a decrease in borrowing due to the rise in the interest rate.
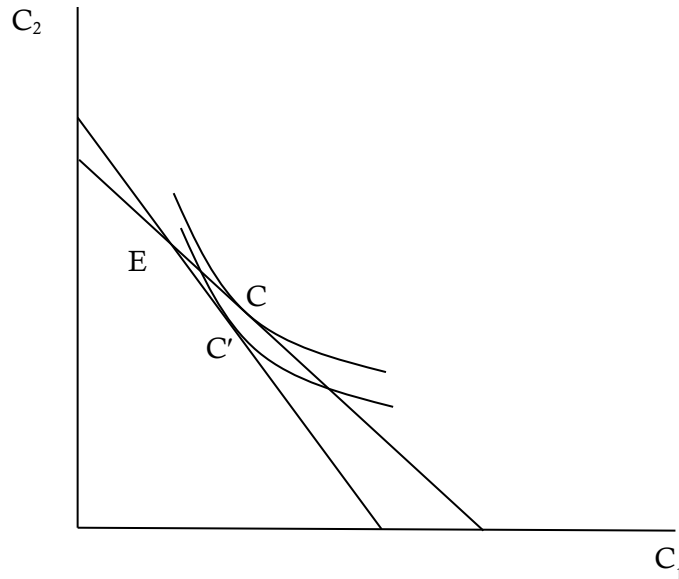
d. Explain (based on substitution and income effects) why the fourth case (dissaver who increases dissaving when the real interest rate rises) is impossible.

For this to occur, point C' in part c would have to lie to the right of point C, which cannot happen if consumption in both periods is a normal good. Both the income and substitution effects cause the borrower to borrow less when the interest rate rises. The substitution effect because present consumption is more expensive in terms of future consumption and the income effect because the borrower is poorer, so she consumes less in both periods (and, in particular, in period one, which means borrowing less).

2. Explain why the real interest rate rather than the nominal interest rate is used in the budget constraint for consumers. Explain why the real interest rate rather than the nominal interest rate is relevant for firms deciding whether to invest in real capital.

People care about purchasing power, not money *per se*. The real interest rate measures the rate of return on borrowing in terms of purchasing power.

3. Explain the fallacy in the following statement: "Increases in the real interest rate will raise investment because households will find the higher rate of return more attractive."

The statement would be (probably) true if we substituted "saving" for "investment." But the real interest rate is the opportunity cost of investing in real capital goods, not the reward for doing so.

4. Consider a model in which individuals live for three periods, earning income of Y_1, Y_2, and Y_3 and consuming C_1, C_2, and C_3. You may assume that they receive and leave no bequests.

   a. Show the equation for the individual's lifetime budget constraint.

$$C_1 + \frac{C_2}{1+r} + \frac{C_3}{(1+r)^2} = Y_1 + \frac{Y_2}{1+r} + \frac{Y_3}{(1+r)^2}$$

   b. Solve for permanent income using an extension of equation (8.2) in the textbook.

$$Y^P + \frac{Y^P}{1+r} + \frac{Y^P}{(1+r)^2} = Y_1 + \frac{Y_2}{1+r} + \frac{Y_3}{(1+r)^2}$$

$$Y^P \left[1 + \frac{1}{1+r} + \frac{1}{(1+r)^2} \right] = Y_1 + \frac{Y_2}{1+r} + \frac{Y_3}{(1+r)^2}$$

$$Y^P = \frac{Y_1 + \frac{Y_2}{1+r} + \frac{Y_3}{(1+r)^2}}{1 + \frac{1}{1+r} + \frac{1}{(1+r)^2}}.$$

   c. Assuming for simplicity that the real interest rate is zero and that the consumer chooses perfectly smooth consumption, what consumption level will she choose in each year if Y_1 = $20,000, Y_2 = $100,000, and Y_3 = $0 and she has access to perfect capital markets? In an economy comprising many such consumers, what pattern of borrowing and lending will emerge among individuals of various ages?

   C = $40,000 in each period. She borrows $20,000 when young, repays it and saves an additional $40,000 in middle age, and consumes the $40,000 saved in middle age when old.

   d. How would her consumption in each period be different if the government had a program giving a $30,000 transfer payment to all young people, paid for by a $30,000 tax on all middle-aged people?

   No change in consumption, because lifetime income has not changed and she still smooths consumption. She now saves $10,000 when young, an additional $30,000 in middle age, and consumes her accumulated $40,000 when old.

   e. How would her consumption in each period be affected if the government had a Social Security program that paid old people $30,000 and taxed middle-aged people $30,000 to pay for it?

Again, no change in consumption for the same reason. The Social Security program would simply do the saving for her that she planned to do herself.

f. Re-do parts c through e under the assumption that young individuals are totally unable to borrow due to imperfections in the capital market.

In c, she cannot borrow when young, so the best option is $C_1 = Y_1 = \$20,000$. She then has $100,000 to smooth over the last two periods, and consumes $50,000 in each period.

In d, she can now smooth consumption because with the transfer she does not need to borrow.

In e, as in c, she cannot borrow when young, so she chooses $20,000, $50,000, and $50,000.

g. What implications does your analysis have for government transfer policies?

As long as people can borrow and lend freely in perfect capital markets, these programs do not alter people's consumption paths. However, they may change the volume of saving in particular periods. And when people are liquidity constrained, such programs may relieve the constraint and allow people to smooth consumption.

5. Read the very short article "Did the 2008 Tax Rebates Stimulate Spending?" *American Economic Review* 99 (2):374–379 (May 2009). (This is available through the Reed Library Web site. Search for the journal under "Print and E-Journals.") What are the authors' results? Are they consistent with modern consumption theory? Are they consistent with Keynes's consumption theory? Explain your conclusions.

Results are more consistent with modern consumption theory because people seemed to save a large fraction of the temporary change in income, either by adding to stocks of assets or by paying down stocks of debt. Keynes would have predicted a large MPC, even out of a temporary change in disposable income.