Lack of substitutability

- What are the effects of anticipated inflation on interest rates, capital, and output when fiat money and other assets are not substitutes?

- Suppose the rate of return of other assets exceed that of fiat money (realism).

- Why would people hold (value) money?

- Let’s assume that by law they are required to hold money balances worth $q^*$ goods.

- This assumption will allow us to look at the effect of anticipated inflation when the rate of return of fiat money is dominated by that of other assets.
**Interest rates**

- Interest rates cited in the press are *nominal interest rates*, $R_t$, the number of dollars paid for each dollar borrowed.

- In times of inflation, these differ from *real interest rates*, $r_t$, the number of goods paid for each good borrowed.

- Let $d$ be the loan size:

  $$r_t = \frac{R_t d}{p_{t+1}} = \frac{R_t p_t}{p_{t+1}}.$$

  $$R_t = r_t \left( \frac{p_{t+1}}{p_t} \right) = r_t \left( \frac{z}{n} \right).$$

  $$R_t - 1 = (r_t - 1) + \left( \frac{p_{t+1}}{p_t} - 1 \right) + (r_t - 1) \left( \frac{p_{t+1}}{p_t} - 1 \right).$$
1. Suppose that $M_t = 1.5M_{t-1}$ and $N_t = 1.25N_{t-1}$. Let the gross real interest rate be 1.1

a. Compute the gross and net inflation rates.

b. Compute the gross and net rates of return of fiat money.

c. Compute the gross and net nominal interest rates.

d. Compute the nominal interest rate using the approximation $R - 1 = (r - 1) + \left(\frac{p_{t+1}}{p_t} - 1\right)$. 
Anticipated inflation and nominal rates

- Let $x$ be the rate of return on capital. By rate-of-return equality:

$$x = r_t = \frac{R_t p_t}{p_{t+1}} = \frac{R_t v_{t+1}}{v_t} = \frac{R_t n}{z}.$$

$$R_t = x \left( \frac{z}{n} \right).$$

- Since fiat money and capital are not substitutes changes to inflation do not affect $x$.

- Therefore, the rate of return on loans is not affected either by rate of return equality (loans and capital are substitutes.)

- The nominal interest rate rises with anticipated inflation to keep the real interest rate constant at $x$.

- This full adjustment of the nominal interest rate to anticipated inflation is known as the \textit{Fisher effect}. 
Anticipated inflation and real interest rates

Suppose now that fiat money and capital are substitutes and capital exhibits decreasing marginal product.

An increase in the anticipated inflation makes people save more in the form of capital (and less in the form of money), leading to a decrease in capital’s rate of return.

Since capital and loans are substitutes, this in turn leads to a decrease in the real interest rate by rate-of-return equality.
So far we have assumed that assets (loans) pay a known rate of return with certainty.

If there is risk of default, for example, then the rate of return becomes uncertain.

If people are risk neutral, they decide only based on the expected rate of return.

If an asset returns $r_i$ in a state that occurs with probability $p_i$, the expected rate of return is given by:

$$E(r) = \pi_1 r_1 + \pi_2 r_2 + \cdots + \pi_n r_n.$$
People are **risk averse** when they will only buy lotteries with strictly positive expected value.

Risk averse people only hold risky assets whose expected return exceeds the risk-free rate of return.

That extra expected return is known as the risk premium:

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\text{risk premium} = E(r_{\text{risky}}) - r_{\text{safe}}.
\]
Risky examples

1. Suppose two things can occur. With probability 0.9 a loan pays 15% otherwise the borrower loses half the money. Calculate this loan’s expected rate of return?

2. Suppose some farm machinery costs 10 goods but produces 18 goods in normal weather, 8 goods in rainy weather, and 5 goods in a drought. If the probability of rainy weather is one forth and the probability of drought is 10% what is the expected return on the machinery?