Lower bound problem.

Delong/Summers: hysteresis (Phelps).

Krugman/Eggertson ($r = i - \pi = 0 - \pi$).

Liquidity constraints.

Financial system.

Richard Koo and Balance Sheet Recession (pay down debt).

Mian and Sufi.

Labour Market.

Housing.

Mulligan argument.

Evidence.

Talk.

Example: Retirement implicit tax.

Tax smoothing.

Labour Tax.

Capital Tax (Incidence; very mobile).

Consumption (Effcient, doesn't distort production; tax what you "take out"; regressive).

Long Run. Economy closed; think of US. Determine the natural interest rate (Wicksell) in general equilibrium. Bond market. For now, ignore monetary authority "setting" rates.

The natural interest rate is an important benchmark in monetary economics (e.g., Taylor rule). Suppose everyone wants to save; though all take interest rate as given, in aggregate it's endogenous. There is a representative agent and firm, prices are one, and real interest rate is what matters (but real and nominal rates the same here). There is a perfect capital market, no risk, no uncertainty. Only interested in period 1.

Income stream Y_1, Y_2. Y_1 is an endowment.

$$u(C_1, C_2) = u(C_1) + \beta u(C_2)$$

$$C_1 + S = Y_1$$

$$C_2 = Y_2 + (1 + r)S$$

(Can also explicitly model bonds).

Intertemporal Budget Constraint:

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

Take r as given and maximize. Two equations, 2 unknowns. Get Euler equation:

$$u'(C_1) = \beta(1 + r)u'(C_2)$$

E.g., Log utility (we can show that this corresponds to $\theta = 1$)

$$\frac{C_2}{C_1} = \beta(1 + r)$$

Combine with budget constraint to get

$$C_1(1 + \beta) = Y_1 + \frac{Y_2}{1 + r}$$

$$C_1 = \frac{1}{1 + \beta}\left(Y_1 + \frac{Y_2}{1 + r}\right)$$

Three effects; income, substitution, wealth.

$$S_1 = Y_1 - C_1$$

$$S_1 = Y_1 - \frac{1}{1 + \beta}\left(Y_1 + \frac{Y_2}{1 + r}\right)$$

β shifts curve; slope depends on IES and θ.

The firm has concave production, $AF(K) = AK^{\alpha}$, $0 < \alpha < 1$; $F'' < 0$. Capital useless at end. No initial capital. Invest in period 1 and produce in period 2.

Firm borrows I in period 1 to finance investment, which will yield profits next period. Must pay back $(1+r)K$ in period 2. PDV of profits is

$$\frac{AF(K) - (1+r)K}{1+r}$$

But $K = I$. Investment demand given implicitly by

$$AF'(I) = 1 + r$$

High r implies low I.

A shifts curve.

At potential.

$$S = I$$

$$Y_1 - C = I \Longrightarrow Y_1 = C + I$$

Natural interest rate clears goods market.

Interest rate in general equilibrium depends on structural "deep" parameters.

MPK of capital, savings propensities, curvatures of production/utility functions.

Extensions. Other sources of (dis)savings: Gov, world.

At potential.

$$S = I$$

$$Y_1 - C = I \Longrightarrow Y_1 = C + I$$

Natural interest rate clears goods market.

Long-run theory: Prices flexible and economy is always at potential

$$Y = C(Y, r) + I(r) + G$$

$$Y = \bar{Y}$$

where $\bar{Y}$ denotes potential. If C falls, S rises and r_n falls, causing I to rise.

Changes in natural interest rate ensure we are always at potential.

Keynesian theory is different: prices are sticky, so a rise in the savings rate s leads to a fall in production Y, so savings stock, $S = sY$ will not necessarily rise.

So far, have developed a simple model illustrating forces impinging on all interest rates at any point in time. But have only derived the real rate, not nominal one.

Inflation premium. Recall the quantity theory

$$\pi = g_m - g_y$$

Equilibrium *nominal* interest rate under certainty

$$i = r_n + \pi$$

High money growth *raises* nominal rates. Fisher effect.

Natural nominal rate.

In practice, there is uncertainty re inflation. So the Fisher equation is

$$i = r_n + \pi^e$$

where π^e denotes expected inflation.

But with risk aversion, we would also add a risk premium ρ

$$i = r_n + \pi^e + \rho$$

Observe that a high ρ would raise real rates (in expectation).

Long-run bonds.

Expectations Theory of the Term Structure.

Option 1. Invest today in a one-year bond, and next year use proceeds to invest in another one-year bond:

$$(1 + i_1)(1 + Ei_2)$$

Option 2: invest today in a 2 year bond:

$$(1 + i_{2l})(1 + i_{2l})$$

By arbitrage

$$(1 + i_1)(1 + Ei_2) = (1 + i_{2l})(1 + i_{2l})$$

Taking logs and noting $log(1 + x) \approx x$:

$$i_{2l} = \frac{i_1 + Ei_2}{2}$$

More generally

$$i_{nl} = \frac{\sum_{z=1}^{z=n} E i_z}{n}$$

$$i_{nl} = \frac{\sum_{z=1}^{z=n} E(r_z + \pi_z)}{n} + \rho$$

ρ is a risk premium; sometimes called the term premium or liquidity premium.

Important insight: expectations of future affect long-run rates *today*.

Budget deficits/Future money growth/Debt monetization (risk premium).

But not only theory. Market Segmentation Hypothesis: This says that markets for bonds of different maturities are segmented. In this case, bond yields of different maturities are not necessarily related, as in previous theory.

For instance, Asian governments purchase long bonds and are not concerned with profits (other motives such as currency intervention). In this case, long yields could be low, and would not necessarily reflect expectations of low short rates in the future. A "flight to quality" to long bonds would have a similar effect. Generally, this theory emphasizes that bonds might have valuable characteristics – such as usefulness as collateral – aside from monetary ones.

In general, economists use former theory and *not* this one. But both theories confer useful insights.

Bonds prices and yields: inverse relationship.

E.g., buy for 80, get back 100. 25% return.

But if interest rates rise to 50%, bond only worth 66 now. Make a capital loss.

In practice this is a big issue if you don't hold bond to maturity.