Mishkin, Chapters 6, 26. See *Module Content* on Blackboard.

Derived two curves. With price flexibility, Y remains at potential Y^* when S rises. Higher S reduces r, and there is more I and less C in equilibrium. The equilibrium relationship is

$$S(r, Y^*) = I(r, Y^*)$$

where the burden of adjustment falls on r. Formally, the natural interest rate clears capital market (and goods market by Walras Law).

Compare to Keynesian analysis where Y is endogenous

$$S(r, Y) = I(r, Y)$$

Extensions

- Twin deficits (real exchange rate, $\frac{eP}{P*}$).
- Global Saving Glut.

Long-run rates. By arbitrage

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

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

More generally

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

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

r_z natural rate and π_z is from money growth/Phillips curve.

Fisher effect: in long run, there is a one-for-one rise in nominal rate with rise in inflation (i.e., $\frac{di}{d\pi} = 1$).

Budget deficits: raise future natural rates and long rates *today*.

Future money growth: would raise long rates today.

Future Growth: e.g., higher expected investment demand would raise future natural rates and hence long rates today. Inflationary expectations might also rise, esp. if there is no *nominal anchor*.

TIPS (indexed bonds).

Say real rate on Tip is 3%.

Nominal rate on same maturity nominal bond is 5%.

Expected inflation is $5 - 3 = 2\%$. This is *breakeven* inflation.

Recall: 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.

Recall *Expectations Theory (ET)*, which pins down long yields by arbitrage:

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

But this implicity assumes investors are indifferent to bonds of different maturity.

Market Segmentation Theory (MST): markets are segmented, so supply and demand in each market determines yields at each maturity. E.g., short-run bonds might be highly demanded due to their role as collateral (in, say, repo agreements). In this case, movements in short bond yields would be independent of long bonds (which themselves might be highly demanded by pension funds).

Overall: while the expectations theory is dominant (since arbitrage incentives are *strong*), there is truth to the segmented markets view.

Combine both theories to get the *Liquidity Premium Theory*

$$i_{nl} = \underbrace{\frac{\sum_{z=1}^{z=n} E(r_z + \pi_z)}{n}}_{ET} + \underbrace{\rho_n}_{MST}$$

ρ_n refers to the term premium, which is related to supply and demand for bonds of maturity n. Note that it incorporates a risk premium (if, for example, there is inflation risk associated with n period bond, *demand* for those bonds will fall, pushing up yields). That is, one can view risk premia as endogenous responses to supply and demand for bonds.

So far we haven't discussed monetary policy.

Recall the condition for money demand

$$\frac{M^d}{P} = L(i, Y)$$

More intuitively

$$M^d = PL(i, Y)$$

Ignore inflation

$$M^d = PL(r, Y)$$

If money supply is $\bar{M}$, equilibrium in the money market is

$$\bar{M} = PL(r, Y)$$

With flexible prices, a doubling of M induces doubling of P. Money neutral in long run, where prices are flexible. Most importantly, there is no effect on r or Y.

Liquidity effect: if prices are sticky, then a rise in $\bar{M}$ reduces r and raises Y . This way, money is non-neutral is prices are fixed.

$$\bar{M} = PL(r, Y)$$

New Keynesian model gives rationale for this important result.

If we had

$$\bar{M} = PL(i, Y) = PL(r + \pi^e, Y)$$

then higher M reduces i (and r), assuming inflation expectations π^e are fixed.

A lot of empirical evidence for money-output relationship, suggesting causation from M to Y.

St Louis Regressions took the form

$$Y = \alpha + \beta M$$

but changes in Y can cause changes in M (due to interest rate targeting or procyclical rises in the money muliplier). So better to use *Narrative approach*; Friedman and Schwartz, "A Monetary History of the U.S."

VARS.

Volcker Recession (large contraction of the money supply following by large recession. Contraction of money supply largely from inflation aversion of Paul Volcker).

Devaluations: countries that devalue – and emerge from monetary straitjacket – typically see large increases in output. E.g., Countries that left the gold standard during the Great Depression recovered quickly (and in order in which they left).

Monetary Policy.

Suppose fed rate is i^*. Then, by arbitrage (or expectations theory), 2 night rate is

$$(1 + i_2)(i + i_2) = (i + i^*)(1 + i^*)$$

Clearly $i_2 = i^*$. So if FED sets i^* for months or a year, say, FED has a lot of control over short-run rates.

In ten years time, though, the best guess of i^* is $r + \pi$, where r is the natural rate and π the in ation target. (See this from Taylor rule below).

FED sets i^* in accord with Taylor rule

$$i^* = r_n + \pi + .5(\pi - \pi^*) + .5(y - y^*)$$

$$\frac{\partial i^*}{\partial \pi} = 1.5$$

Taylor principle; e.g. if $i = 3$ and inflation rises from 0 to 1, then, cet par, real rate falls from 3 to 2. In response raise nominal rate by more than 1, by 1.5. So fed raises rates to 4.5, raising real rates.

$$r^* = r_n + .5(\pi - \pi^*) + .5(y - y^*)$$

Interest Rate Smoothing.

Overall theory of long-run rates

$$i_{nl} = \frac{\sum_{z=1}^{z=n} Ei_z}{n} + \rho_n$$

For the short end of the yield curve, best to think of i_z as coming from the Taylor rule and monetary policy. After that, best to think of $i_z = r_n + \pi$, where r_n is the natural rate and π is the bank's inflation target.

FED tries to affect long rates through forward guidance or *open mouth operations* E.g.,

"weak economic conditions are likely to warrant exceptionally low levels of the federal funds rate for some time."

Idea is, try to affect expectations of future shorts and thereby bring down the more important long rates.

Transmission Mechanisms

1. Interest rate channel: lower interest rates reduce the cost of capital, raising investment. Consumer durables also are quite responsive to interest rate changes.

2. Asset prices : $P = \sum \frac{D_t}{(1+r_t+\rho)^t}$. Lower r raises asset prices, which induces wealth effects: your wealth is now higher, so you spend more (by PIH logic).

3. Tobin's Q: Lower interest rates raise asset prices, thereby raising the market value to replacement value of equipment (i.e., Tobin's Q), which in turn spurs investment.

4. When asset prices rise, households have more liquid wealth, so they may buy more illiquid assets (like cars).

5. Exchange rate: lower interest rates lower demand for domestic assets, thereby lowering demand for the currency. This weakens the currency and improves the current account balance (more export demand, lower import demand).

6. Credit Channel for households/banks. There are two aspects to the credit channel:

   - *Balance Sheet effects*: if asset prices (i.e., stocks, real estate) rise as a result of monetary policy, then borrowers have more collateral to offer banks, which raises the incentive to lend. In turn, this raises the money multiplier and broad money supply. The fact that asset prices are procyclical therefore induces a what Bernanke calls a *financial accelerator*.

- *The Lending Channel*. There are two aspects to this. First, if banks have more reserves (as a result, say, of open market operations), they are "awash with funds" and would be willing to lend more. This would be especially important for small firms who rely on banks for funding (by contrast, large corporations can go to the debt/equity markets themselves). Another aspect refers to the balance sheet positions of banks. See next slide.

7. As price rises, real value of debt falls, improving debtors' balance sheets.

8. Cash flow: lower interest rates mean that debtor firms have more cash on hand, which can lead to more investment (empirically, investment is quite responsive to internal funds of firms).

Balance Sheet of Bank

Assets

Loans: 100

Liabilities

Capital: 10

Debt: 90

Leverage Ratio is $\frac{Assets}{Capital} = \frac{100}{10}$.

In this case, if the assets of the bank fall by 10% in value, it loses all its capital (or *buffer* against losses). Any further losses render the bank *insolvent*. In this case, a bank will be very reluctant to lend, and the money muliplier will fall. That is, there will be a *credit crunch*.