Review

Topics & Authors
Final exam is not cumulative, but still need to know IS-LM (no multipliers)

**Shifts in IS** - IS↑ (i.e., curve shifts to the right) if T↓ (C↑), or πe↑ (I↑), or G↑; results in larger output (Y) for given interest rate (i)

**Shifts in LM** - LM↑ (i.e., curve shifts to the right) if M↑, P↓, or L↓; results in larger output (Y) for given interest rate (i)

**Investment**
- **Modigliani & Miller** - "The Cost of Capital, Corporation Finance and the Theory of Investment"; if firms have same expected stream of income and same variance (risk), then market value of equity plus debt is constant (e.g., firm 1 has no debt and firm 2 has debt D₂: V₁ = V₂ + D₂)

**Time Series Models**

**Money Demand**
- **Baumol** - "The Transactions Demand for Cash: An Inventory Theoretic Approach"; based on transaction demand for money; looks at keeping money like stocking inventory; short on intuition, but empirically testable
- **Tobin** - "The Interest Elasticity of the Transactions Demand for Cash"; similar to Baumol's model, but more intuitive (didn't come up with specific equation)
- **Meltzer** - "The Demand for Money: Evidence From the Time Series"; empirical work trying to estimate parameters from Baumol & Tobin's money demand models
- **Sweeney & Sweeney** - "Monetary Theory and the Great Capitol Hill Baby Sitting Co-op Crisis"; administration's budget surplus took "money" (scrip) out of circulation; solution was to have administrators redistribute the "surplus" (monetary policy)
- **Goldfield** - "The Case of the Missing Money"; Goldfield argued that money demand may adjust slowly because there are two components to the cost of reaching equilibrium: holding cost (for not holding proper amount) and adjustment cost (to get to proper amount); end result: overestimating real money balances is equivalent to underestimating inflation; problem wasn't missing money, but too much inflation

**Inflation & Unemployment**
- **Phillips** - "The Relationship Between Unemployment and the Rate of Change of Money Wages in the U.K. 1861-1957"; plotted rate of change of money wage rates vs. unemployment (data from Brittan, 1861 to 1913) and concluded that there's a trade off between inflation and unemployment; higher inflation means lower unemployment
- **Friedman** - "The Role of Monetary Policy"; explained why Phillips curve does fit U.S data; came up with long-run Phillip's Curve; multiple short-run curves each at different π'; equilibrium at natural rate of unemployment; only time we trade off π for u is when it's unexpected (π ≠ π'); also examined 3 possible roles for monetary policy: "pegging" u, I, or π... concluded that π is the only thing we can control in long-run with monetary policy
- **Lilien** - "Sectoral Shifts and Cyclical Unemployment"; empirical work trying to measure impact of shocks on unemployment;
- **Tobin** - "Inflation and Unemployment"; argued that long-run Phillips curve is not vertical because wages are sticky downward; ∴ as i↓ below a certain level, u↑
Monetary Policy and Stabilization

Friedman - "The Optimum Quantity of Money"; looked at costs and benefits for higher or lower inflation rate to determine the best rate; also said there's a positive externality to money holding; government should induce negative inflation to subsidize money holding

Cagan - "The Monetary Dynamics of Hyperinflation"; studied classic example of hyperinflation; post-World War I Germany; unpopular government couldn't increase taxes; it borrowed until creditors wouldn't lend anymore; then it printed money to cover spending

Lucas - "Some International Evidence on Output Inflation Tradeoffs"; tried to explain why some countries experience swings in prices ($\pi$) and other in output ($Y$) in response to demand shocks ($\Delta x$); said more price stable (i.e., predictable $Y$) countries confuse relative demand shocks with aggregate demand shocks so $Y$ (and $u$) are more likely to be adjusted the $P$

Ball, Mankiw & Romer - "The New Keynesian Economics and the Output-Inflation Tradeoff"; alternative explanation for swings in prices vs. output using menu costs (costly for firms to change prices so firms respond slowly to shocks; they rather change output than prices so inflation looks more like a step function)

Old Exam Questions

1. Recently, the possibility that developed economies may find themselves in a liquidity trap seems to have increased. How does a liquidity trap alter the degree to which a recession can be ended by:
   (a) monetary policy?
   (b) fiscal policy?
   (c) a 'laissez faire’ recovery?

   (a) $M^\uparrow \Rightarrow LM^\uparrow$ (shift right); goal is to get $i^\downarrow \Rightarrow I^\uparrow \Rightarrow Y^\uparrow$, but doesn't work because $i$ can't be $< 0$ (graph on left)
   (b) $G^\uparrow \Rightarrow IS^\uparrow$ (shift right); this is not only effective ($IS_1$), but if government waits to act or uses monetary policy in conjunction ($LM_1$), the economy moves to potential output without impacting interest rates ($LM_2$; no crowding out) (graph on right)
   (c) $P^\downarrow \Rightarrow M/P^\uparrow$ (i.e., $LM^\uparrow$) $\Rightarrow i^\downarrow \Rightarrow I^\uparrow \Rightarrow Y^\uparrow$; doesn't work for same reason as monetary policy (graph on left)

Which economy is in more danger of slipping into a liquidity trap? An economy with a
   (d) high saving rate or low saving rate?
   (e) high inflation rate or low inflation rate?

   (d) high saving rate means less consumption so IS curve is lower ($IS_1$ vs. $IS_2$ for low saving rate) $\therefore$ high saving rate is in more danger
   (e) high inflation rate means higher $i$ so IS curve is higher ($IS_2$ vs. $IS_1$ for low inflation rate) $\therefore$ low inflation rate is in more danger
2. We have examined the work of three sets of authors on the effects of a sustained decrease in the inflation rate: Ball, Mankiw and Romer, Friedman, and Tobin. The models deal with the effect of lower inflation on: (1) the level of real money balances, (2) the position on the long-run Phillips Curve, (3) the slope of the short-run Phillips curve.

(a) which author deals with which issue? (b) in each case what is the effect of lower inflation and is it beneficial or not? (c) Explain the reasoning in each case.

Ball, Mankiw & Romer - did (3); argued that $\pi \downarrow \Rightarrow P \text{ adjusted less frequently so demand shocks goes into } Y \text{ and } u... \text{ bad}

Friedman - did (1); argued that $\pi \downarrow \Rightarrow M/P \uparrow \text{ which is good because of the benefits of higher money balances (pecuniary services [shoe-leather costs] and non-pecuniary services [utility])}

Tobin - did (2); argued that $\pi \downarrow \Rightarrow u \uparrow \text{ because short-run Phillips curve is curved from sticky wages; said low } \pi \text{ is bad (higher } \pi \text{ allows wages to respond quicker)}

3. Suppose interest rate rise permanently.

(a) According to the "accelerator" specification of the investment function, will the initial decline in investment be larger than, smaller than, or of the same magnitude as the eventual decline in investment? Explain.

$$I_t = K_t - K_{t-1} + \delta K_{t-1} \text{ (05 p.2)}$$

If optimal level of capital doesn't change, investment = $\delta K$ (i.e., just making up for depreciation); if the interest rates rise, the optimal level of capital will decline. In this case, investment will drop as firms let depreciation reduce the capital stock to the new optimal level. Eventually investment will pick up again to cover the depreciation of the new (lower) capital stock. initial decline will be larger than eventual decline in $I$.

(b) According to the "partial adjustment" specification commonly used in empirical work, will the initial decline in the demand for real money balances be larger than, smaller than or of the same magnitude as the eventual decline in the demand for real money balances? Explain.

$$\ln(M/P)_t = b_0 + b_1 \ln(Y)_t + b_2 \ln(i)_t + ... + c \ln(M/P)_{t-1} \text{ (06 p.7)}$$

If $L$ changes, there are costs for not being at $L$, but also for changing too quickly. People will adjust $M/P$ slowly assuming there’s some adjustment cost. initial $\Delta M/P$ will be smaller than the total change in $M/P$.

4. Currently the fraction of income American’s save is low. Suppose this saving rate increases. Describe the short-run and long-run effects on:

(a) output, (b) investment, (c) interest rates, (d) exports

$S \uparrow \Rightarrow C \downarrow \Rightarrow IS \downarrow \text{ (shift left); short-run: } Y \downarrow \text{ & } i \downarrow \Rightarrow I \uparrow \text{; also looking at exchange rate from point of view as U.S. as home country, the $ depreciates because interest rates are lower so capital flows move away from U.S.; dollar worth less so it takes more $ to buy foreign currency: } E \uparrow \text{ (alternatively, fewer units of foreign currency to buy $) } \Rightarrow EX \uparrow \text{ (Note: basically E and EX always move opposite the interest rate)}$

Long-run: $W \downarrow \Rightarrow LM \uparrow \text{ (shift right) } \Rightarrow Y \uparrow \text{ (net change is 0) and } i \downarrow$
5. Use the expectations augmented Phillips Curve, developed by Milton Friedman and others, to describe the short-run and long-run effect of a sustained increase in the rate of money growth on (a) unemployment, (b) interest rates, (c) the inflation rate, (d) real interest rates

\[ \mu \uparrow \Rightarrow \text{LM shifts right} \Rightarrow \text{short-run } u \downarrow, i \downarrow, \pi \uparrow, r \downarrow \ldots \text{long-run } \pi \uparrow \Rightarrow \text{IS shifts right}, u \uparrow \text{ (back to original)} \]  
also \[ P \Rightarrow \text{LM shifts left} \Rightarrow i \uparrow, r \uparrow \text{ (back to original)} \]

Long Version (with #s): assume we start at \( i = 8\%, u = 6\% \text{ and } \pi = \pi^e = 5\% \) (∴ \( r = i - \pi^e = 3\% \)), \( \mu \uparrow \) by 3% \( \pi \uparrow 3\% \) (and \( \pi^e \) unchanged so \( \pi > \pi^e \) so we move along Phillips Curve and \( u \) ↓); also from \( \mu \uparrow \), LM curve shifts right lowering interest to say 7% (exact amount doesn't matter in short-run); note this means \( r = i - \pi^e = 7 - 5 = 2\%; r \downarrow \) eventually \( \pi \uparrow 3\% \) to match \( \pi^e \); this moves us to new short-run Phillips Curve and brings \( u \) back to original level; \( \pi \uparrow \) also shifts IS curve to right which combined with LM shift left from \( P \uparrow \) results in \( i \uparrow \); final \( \Delta i = \Delta \pi = \Delta \mu \) is unchanged

6. (a) In his article on inflation and unemployment, James Tobin presented a model which implies that the central bank should aim an inflation rate which is greater than zero. Explain his reasoning.

(b) In his article "The Optimum Quantity of Money", Milton Friedman presented a model in which the optimal inflation rate is less than zero. Explain his reasoning.

For a & b see #2

(c) Suppose that Tobin is right that there is a benefit to having a positive inflation rate but Friedman is also right that there is a separate benefit to the proper amount of deflation. Explain which benefit is likely to be most important.

Lower \( u \) better than lower \( \pi \) ... estimated benefit of 0 vs 5\% \( \pi \) to be $60B... but by Okin's law 1\%↓ in \( u \) results in 2\%↑ in \( Y \)... that's more significant

7. According to estimates by Phillip Cagan, the spending which can be supported on a sustained basis by printing money reaches a maximum when money and price increase about 50% per year and the amount of spending which is thus financed is not very large as a portion of GDP.

(a) Why does so little spending lead to so much inflation?

(b) Why can't governments raise more revenue by increasing the money supply at an even faster rate?

(c) If this is the case, why do governments often produce inflation rates much higher than 50% per year?

(a) Inflationary finance is effectively a tax on real money balances; in real terms government prints \( \Delta M/P \) multiply by \( M/P \) and we get \( \Delta M/M \). That is \( \mu = \Delta M/M \) (money growth rate) is the "tax rate" and \( M/P \) (real money balances) is tax base. End up with large inflation because large \( \Delta \mu \) is needed since \( M/P \) (tax base) is small relative to GDP.

(b) As "tax rate" \( \Delta M/M \) ↑, tax base \( M/P \) ↓... people try to avoid tax by holding less money.

(c) Trying to collect more money and can only do it if people don't expect \( \pi \)
8. Recently, government purchases have risen in the U.S. Describe the short-run and long-run effects of this increase on: (a) output, (b) prices, (c) investment, (d) the exchange rate, (e) exports.

\[ G \uparrow \Rightarrow IS \uparrow \text{(shift right); short-run: } Y \uparrow \text{ & } i \uparrow; \text{ from AS-AD (graph not shown) } P \uparrow; \text{ because of } i \uparrow, I, E, \text{ and EX} \downarrow \text{ (see #4; Note: if asking about real exchange rate, } e \downarrow \text{ because } e = E/P)\]

Long-run: \( W \uparrow \text{ LM} \downarrow \text{(shift left) } \Rightarrow Y \downarrow \text{(net change is 0) and } i \uparrow\)

How would your (short-run and long-run) answers change if the Federal Reserve were using monetary policy to keep prices from changing?

To counter \( P \uparrow \), Fed would \( M \downarrow \Rightarrow LM \downarrow \text{(shift left)... basically automatically goes to long-run equilibrium (same as before except no change in } P)\)

Long-run: already at long-run equilibrium

### ARIMA

2. Suppose that the rate of output \( (y_t) \) is defined as the change in the log of output \( (Y_t) \). That is, \( y_t = Y_t - Y_{t-1} \). Suppose further than growth is described by the process:

\[ y_t = 3 + e, \text{ where } e_t = u_t + 0.5u_{t-1} \text{ and } u \text{ is a "white noise" error.} \]

(a) If \( y_t \) is described as an ARIMA(\( P,D,Q \)), what are the values for \( P,D, \text{ and } Q? \)
(b) If \( Y_{2001} = 1000 \text{ and } u_{2001} = -2 \), what is the optimal forecast for \( Y_{2002}, Y_{2003}, \text{ and } Y_{2020}? \)

1 difference term \( (Y_t \text{ and } Y_{t-1}) \) \( : \) \( D = 1 \)
1 moving average term \( (u_{t-1}) \) \( : \) \( Q = 1 \)
0 autoregressive terms \( (no \text{ lagged } e) \) \( : \) \( P = 0 \)

Combine equations:

\[ Y_t = Y_{t-1} + 3 + u_t + 0.5u_{t-1} \]

Remember that \( E(u_t) \) is 0 at time \( t \) because it’s "white noise"

\[ Y_{2002} = Y_{2001} + 3 + E(u_{2002}) + 0.5u_{2001} = 1000 + 3 + 0 + 0.5(-2) = 1002 \]

Any period after 2002 will have \( E(u_t) \) and \( E(u_{t-1}) \) = 0 (those periods haven't occurred)

\[ Y_{2003} = Y_{2002} + 3 + E(u_{2003}) + 0.5u_{2002} = 1002 + 3 + 0 + 0 = 1005 \]

So every period, \( y \) will increase by 3 2020 is 17 years from 2003 \( : \) \( Y_{2020} = 1005 + 17(3) = 1056 \)
3. Suppose that output grows, on average at 3% per year with deviations above and below that trend:

\[ Y_t = Y_{t-1} + 0.03 + e_t \] (\( Y \) is the log of output).

Suppose further that deviations from trend fit the following pattern:

\[ e_t = u_t + 0.4e_{t-1} \] where \( u \) is a "white noise" error term.

Finally, suppose that recent values of \( Y \) are \( Y_{2000} = 1, Y_{2001} = 1.05, Y_{2002} = 1.06 \)

(a) In the ARIMA classification this is an ARIMA(P,D,Q). What are the values for P, D, and Q?

What is optimal conditional forecast for next year's \( Y \): \( E(Y_{2003})_{2002} \)? \( E(Y_{2004})_{2002} \)? \( E(Y_{2005})_{2002} \)?

1 difference term (\( Y \) and \( Y_{t-1} \)) \( D = 1 \)
0 moving average term (No lagged \( u_t \)) \( Q = 0 \)
1 autoregressive term (\( e_{t-1} \)) \( P = 1 \)

Use data we have to find error terms

\[ Y_{2001} = Y_{2000} + 0.03 + e_{2001} \Rightarrow e_{2001} = 1.05 - 1 - 0.03 = 0.02 \]
\[ Y_{2002} = Y_{2001} + 0.03 + e_{2002} \Rightarrow e_{2002} = 1.06 - 1.05 - 0.03 = -0.02 \]

Remember that \( E(u_t) = 0 \) at time \( t \) because it's "white noise"
\[ E(e_{2003})_{2002} = E(u_{2003})_{2002} + 0.4e_{2002} = 0 + 0.4(-0.02) = -0.008 \]
\[ E(Y_{2003})_{2002} = Y_{2002} + 0.03 + E(e_{2003})_{2002} = 1.06 + 0.03 -0.008 = 1.082 \]

Find next error term, then find \( Y_t \)
\[ E(e_{2004})_{2002} = E(u_{2004})_{2002} + 0.4e_{2003} = 0 + 0.4(-0.008) = -0.0032 \]
\[ E(Y_{2004})_{2002} = Y_{2003} + 0.03 + E(e_{2004})_{2002} = 1.082 + 0.03 -0.0032 = 1.1088 \]
\[ E(e_{2005})_{2002} = E(u_{2005})_{2002} + 0.4e_{2004} = 0 + 0.4(-0.0032) = -0.00128 \]
\[ E(Y_{2005})_{2002} = Y_{2004} + 0.03 + E(e_{2005})_{2002} = 1.1088 + 0.03 -0.00128 = 1.13752 \]

(b) Suppose instead \( Y_t = Y_{t-1} + 0.03 + u_t \), where \( u \) is a "white noise" error term. How would your answers change?

1 difference term (\( Y \) and \( Y_{t-1} \)) \( D = 1 \)
0 moving average term (No lagged \( u_t \)) \( Q = 0 \)
0 autoregressive terms (No lagged \( e_t \)) \( P = 0 \)

Remember that \( E(u_t) = 0 \) at time \( t \) because it's "white noise"
\[ E(Y_{2003})_{2002} = Y_{2002} + 0.03 + E(u_{2003})_{2002} = 1.06 + 0.03 + 0 = 1.09 \]
\[ E(Y_{2004})_{2002} = Y_{2003} + 0.03 + E(u_{2004})_{2002} = 1.09 + 0.03 + 0 = 1.12 \]
\[ E(Y_{2005})_{2002} = Y_{2004} + 0.03 + E(u_{2005})_{2002} = 1.12 + 0.03 + 0 = 1.15 \]