Monetary Policy and Stabilization

**Background** - Phillips curve suggests (incorrectly) we can trade higher \( \pi \) for lower \( u \); Okin's Law gives us the benefit (increase \( Y \) by 2% for each 1% less \( u \)); only thing we know about cost of higher \( \pi \) is decreased real money balances \((M/P)\); need to compare gains \((\Delta Y)\) with cost \((\Delta(M/P))\)

**Optimum Quantity of Money** - article by Friedman (1969); real title should be optimal inflation rate; looked at costs and benefits for higher or lower inflation rate to determine the best rate

**Assumption** - initial assumption to make numbers easier is that there is no growth, no inflation, and no securities (i.e., money is the only asset)

**Benefits of Holding Money** - \( \rho \) measures rate of return on services of money

- **Pecuniary Services** - "shoe leather costs"; higher money balance yields return (less time getting it out of the vault; could use it to produce something)

- **Non-Pecuniary Service** - "utility"; holding more money allows person to withstand bad times (emergency spending) without diminishing lifestyle

**Diminishing Returns** - \((M/P)\uparrow \Rightarrow \rho \downarrow\)

**Cost of Holding Money** - consume less now (don’t worry about interest because we assumed money is the only asset and there’s no inflation); \( \delta \) is discount rate of consumption (measure of impatience, how hard it is to hold money to next period); will be different for each consumer, but can look at as average in aggregate

**Adding Inflation** - increases cost of holding money so cost is now \( \delta + \pi \)

**Private Optimal** - with no inflation, should have \( \rho = \delta \) adding inflation means \( \rho = \delta + \pi \)

**Social Optimal** - Friedman argued that there is a positive externality to money holding; if people want to hold more money they do so at no social cost; first they postpone or reduce consumption to increase their demand for money \((L \uparrow \Rightarrow LM \downarrow)\), eventually prices will fall increasing real money balances \((P \downarrow \Rightarrow LM \uparrow)\); problem occurs if only one person does this; everyone else benefits from the higher \( M/P \), but the individual suffers less consumption without making it up completely; since there is zero social cost, the optimal amount of money occurs at \( \rho = 0 \Rightarrow \pi = -\delta \) (Friedman was saying the government should induce negative inflation to subsidize money holding)

**Being Away from Optimal** - cost of being away from optimal \( M/P \) is area under the curve

**Numerical Example** - using Baumol model (transactions demand for money... note: this will overestimate the cost of inflation): \( L = L_0 Y^{1/2} i^{-1/2} \) which allows us to calculate money demand, \( L \), which we substitute for real money balances \( M/P \); given current \( M/P = $1200B \), \( i = 5\% \), \( \pi = 2\% \), we know \( r = i - \pi = 3\% \); this allows us to find \( i \) for different levels of \( \pi \), which then lets us calculate \((M/P)t = 1200/\sqrt{it/5\%})\); \( i \) is the benefit of holding money so \( \rho = i \) (for this example); create table and find \( \delta \) by using \( \pi = 0 \) (looking for \( \rho = \delta \) so in this case, \( \delta = 3\% \)); the cost of inflation is the area under the curve, which equals \( i(M/P) \); not that the current situation \((\pi = 2\%) \) costs \$60B... in an economy with \( Y = $10000B \), this is less than 1 percent so cost of higher in inflation is fairly low; much lower than the gains that resulting from lower unemployment
Cost = \pi \rho \frac{M}{P} \frac{i(M/P)}{i(M/P)}

<table>
<thead>
<tr>
<th>\pi</th>
<th>i</th>
<th>M/P</th>
<th>\rho</th>
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<tbody>
<tr>
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<tr>
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<td>3%</td>
<td>1549</td>
<td>3%</td>
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<tr>
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<td>5%</td>
<td>1200</td>
<td>5%</td>
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<td>9%</td>
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<td>11%</td>
<td>809</td>
<td>11%</td>
</tr>
<tr>
<td>10%</td>
<td>13%</td>
<td>744</td>
<td>13%</td>
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Additional Benefit - higher inflation also forces higher I (if constant \( r \)) so it helps prevent a liquidity trap, so having a modest amount (2-4%) is good.

Real World - the fact that economies with 50% inflation function suggests costs of high inflation aren't so great when compared to having 50% unemployment, but there can be too much inflation...

**Hyperinflation (Inflationary Finance)**

*Cagan* - "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)

*Inflationary Finance* - print currency to finance government purchases; very inflationary

*U.S. System* - Federal Reserve's assets include bonds; liabilities are cash in circulation; inflationary finance would involve government issuing new bonds for $xB and the Fed then buying $xB in bonds (by printing money)

*Example* - assume government wants to purchase some real amount of goods each year

**Borrowing** - \( G \uparrow \Rightarrow IS \uparrow \Rightarrow W \uparrow \Rightarrow LM \downarrow \); end result is \( i \uparrow \), but it's a 1 time \( \Delta i \) and it's not that significant based on real world experience (e.g., $400B deficit right now and \( \pi = 2\% \))

**Printing** - running the numbers shows very high inflation in first period (32%) and then inflation stays at 10% every year after; considering $60B is such a small % of GDP, it seems odd that inflation would be so high

*Money-Balance Tax* - effect of inflationary finance is basically a tax on money-balances; people essentially have less money because of inflation;

**Money Raised** - \( \Delta M/P = \) effective amount of money raised by printing \( \Delta M \)

**Tax** - multiply \( \Delta M/P \) by \( M/M \) to get \( (\Delta M/M)(M/P) \); the "inflation tax rate is \( \Delta M/M \) and the "tax base" (i.e., real money balances) is \( M/P \)

**Good** - no forms to fill out; people can't evade it

**Bad** - money balances are low (compared to income tax based on \( Y \)) so the "tax" (i.e., inflation) has to be high; people can avoid it by not holding cash (which makes money balances even lower, raising inflation, causing more avoidance... etc.)

**Avoidance** - people can't evade the tax if they hold money, but they can avoid it by not holding money; if \( \Delta M/M \uparrow \), then \( M/P \downarrow \)

**Maximize Tax Revenue** - in order to find maximum of Laffer Curve, we need to know the demand for money \( (M/P) \)

**Demand for Money** - Cagan figured out demand for money for Germany...
**Functional Form** - \( \ln(M/P) = \alpha_0 - \alpha_1 i \), this wouldn't work in Germany because credit markets collapsed; the opportunity cost of money was the decrease in value (i.e., inflation), so Cagan used \( \ln(M/P) = \alpha_0 - \alpha_1 \pi^e \)

**Adaptive Expectations** - model for estimating expected inflation: \( \pi^e = \beta \pi_t + (1 - \beta) \pi_{t-1} \), so this period's expectation of next period's inflation is a weighted average of this period's inflation (\( \pi_t \)) and last period's expectation of this period's inflation (\( \pi_{t-1} \))

**Results** - Cagan computed for various values of \( \beta \) (0, 0.1, 0.2, etc... no computers back then); best fit was \( \beta = 0.2 \) resulting in \( \alpha = 5.46 \) (\( R^2 = 0.992 \))

**Max Tax Revenue** - revenue = \( \pi \cdot M/P = \pi(m_0\pi^{\alpha_0}) \Rightarrow \pi^e = 1/\alpha = 0.183 \) (per month!) with max revenue of 5.7M; note: Germany was trying to raise more than this at 20% inflation and increased to 40%... revenue dropped from 3.1M to 1.9M; they should've printed less money to get inflation down and real revenue from printing less money would've been more

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**More Phillips Curves**

(Trying to explain effect of unexpected inflation)

**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 (\( \Delta x \))

**Aggregate Demand Shock** - demand changes for all goods (up or down); people spend less (or more) on everything... tend to be temporary

**Relative Demand Shock** - people aren't spending less or more overall, but less or more in a specific industry (e.g., less beer and more wine)... tend to be permanent

**Problem** - Lucas argued that in the short-run, firms can't tell the difference between an aggregate demand shock and a relative demand shock; their response to a demand shock depends on the country's stability; more stable economies (i.e., more predictable \( Y \)) tend to mistake aggregate demand shocks for relative demand shocks; they change output first so shock is evidenced in output (which affects unemployment); firm's in countries were \( Y \) is unpredictable uses prices first to deal with shocks

**Result** - stable economies have flatter Phillips Curve (i.e., slopes different)... this should be testable which is what Lucas did

**Model** - \( Y_t = \text{constant} + \alpha \Delta x_t + \beta Y_{t-1} \) (\( \Delta x \) is demand shock)

- **U.S.** - \( \alpha = 0.91 \)... 91% of demand shock goes to increased output
- **Argentina** - \( \alpha = 0.01 \)... only 1% of demand shock goes to output

**Ball, Mankiw & Romer** - "The New Keynesian Economics and the Output-Inflation Tradeoff"; alternative explanation for swings in prices vs. output

**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

**Actual Prices** - tend to fall below ideal prices, then firms adjust by looking at \( \pi^e \); they overshoot because they know they won't adjust prices again for a while

**Unexpected Inflation** - if \( \pi \neq \pi^e \) there are problems

- \( \pi > \pi^e \) - prices higher than anticipated so firm is undercharging; sales skyrocket and output increases; firm has to hire more workers (\( u \downarrow \))
\[ \pi < \pi' \] - prices lower than anticipated so firm is overcharging; sales plummet and output falls; firm has to fire workers \((u^\uparrow)\)

**Note:** This is same conclusion as Fischer with labor contracts, just different reasoning

"Cheaper" Menu Costs - firms would change prices more often; in that case firm adjusts prices quicker to \(P\) adjusts rather than \(u\)... i.e., don't deviate from \(u\) as much and return quicker... that means Phillips Curve is steeper

**Testing Theory** - collected time-series data to get money demand:

<table>
<thead>
<tr>
<th>Country</th>
<th>(\sigma)</th>
<th>(\pi)</th>
<th>(\alpha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>0.02</td>
<td>0.04</td>
<td>0.61</td>
</tr>
<tr>
<td>Italy</td>
<td>0.06</td>
<td>0.08</td>
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</tr>
<tr>
<td>Argentina</td>
<td>0.42</td>
<td>0.54</td>
<td>-0.005</td>
</tr>
</tbody>
</table>

**Notes:** \(\sigma\) = standard deviation of \(\Delta x\) (demand shock); \(\alpha\) = coefficient for money demand (similar to Cagan's model)

**Cross-Section** - next used cross-section of data to look at relationship of \(\alpha\) (Lucas expected \(\sigma^\uparrow \Rightarrow \alpha^\downarrow\))

**Version 1** - \(\alpha = \text{constant} - 4.2\sigma + 7.5\sigma^2\)

\[ R^2 = 0.24 \]

\[ (1.5) \quad (4.1) \]

**Version 2** - \(\alpha = \text{constant} - 4.2\pi + 7.1\pi^2\)

\[ R^2 = 0.34 \]

\[ (1.1) \quad (2.1) \]

**Result** - could argue second version is better (i.e., inflation is better fit than unpredictable demand... somewhat supports menu costs (Ball, Mankiw, Romer) over shock theory (Lucas)