Outline

• Recap: IS-LM equations
• Recap: Solution and multipliers
• What determines policy efficacy?
## Recap: Real Side

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<tr>
<th>Eq.No.</th>
<th>Equation</th>
<th>Description</th>
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<tbody>
<tr>
<td>(1)</td>
<td>$Y = AD$</td>
<td>Output equals aggregate demand, an equilibrium condition</td>
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<tr>
<td>(2)</td>
<td>$AD = C + I + G + X$</td>
<td>Definition of aggregate demand</td>
</tr>
<tr>
<td>(3)</td>
<td>$C = a_o + bY_d$</td>
<td>Consumption function, $b$ is the mpc</td>
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<td>(4)</td>
<td>$Y_d = Y - T$</td>
<td>Definition of disposable income</td>
</tr>
<tr>
<td>(5)</td>
<td>$T = TA_0 + tY$</td>
<td>Tax function; $TA_0$ is lump sum taxes, $t$ is marginal tax rate.</td>
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<td>(6)</td>
<td>$I = e_o - dR$</td>
<td>Investment function <em>(revised)</em></td>
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<td>(7)</td>
<td>$G = GO_o$</td>
<td>Government spending on goods and services, exogenous</td>
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<td>(8)</td>
<td>$X = g_o - mY - \tilde{h}R$</td>
<td>Net Exports <em>(revised)</em></td>
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Recap: Financial Side

<table>
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<th>Eq.No. Equation</th>
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<tr>
<td>(14) ( \frac{M^d}{P} = \frac{M^z}{P} )</td>
<td>Equilibrium condition</td>
</tr>
<tr>
<td>(15) ( \frac{M^z}{P} = \frac{M_0}{P} )</td>
<td>Money supply</td>
</tr>
<tr>
<td>(16) ( \frac{M^d}{P} = \mu_0 + kY - hR )</td>
<td>Money demand</td>
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Recap: IS-LM equations

(13) \[ R = - \left( \frac{1 - b(1-t) + m}{d + \bar{\eta}} \right) Y + \left( \frac{1}{d + \bar{\eta}} \right) A_0 \]  \text{<IS curve>}

(17) \[ R = \left( \frac{\mu_0}{h} \right) - \left( \frac{1}{h} \right) \left( \frac{M_0}{P} \right) + \left( \frac{k}{h} \right) Y \]  \text{<LM curve>
Figure 2: Equilibrium in IS-LM
Solving for Equilibrium (I)

One way to solve this system is to substitute $R$ in for $R$ in (12).

\begin{equation}
Y = \left( \frac{1}{1-b(1-t)+m} \right) \left[ A_0 - (d + \tilde{n}) \left( \frac{\mu_0}{h} - \frac{1}{h} \frac{M_0}{P} + \frac{k}{h} Y \right) \right]
\end{equation}

Notice that this can be solved for $Y$, by bringing the term in the (.) to the left hand side.

\begin{equation}
Y(1-b(1-t)+m) = A_0 - (d + \tilde{n}) \left( \frac{\mu_0}{h} - \frac{1}{h} \frac{M_0}{P} \right) - (d + \tilde{n}) \frac{k}{h} Y
\end{equation}

Collect up the last term on the right hand side involving "$Y" to the left hand side:

\begin{equation}
Y[1-b(1-t)+m + \frac{(d + \tilde{n})k}{h}] = A_0 + (d + \tilde{n}) \left( \frac{1}{h} \frac{M_0}{P} - \frac{\mu_0}{h} \right)
\end{equation}

Dividing both sides by the term in [.] to obtain:

\begin{equation}
Y = \hat{\alpha} \left[ A_0 + \frac{(d + \tilde{n})}{h} \left( \frac{M_0}{P} \right) - \frac{(d + \tilde{n})}{h} \mu_0 \right] \quad <\text{equilibrium income}>
\end{equation}

Where

\begin{equation}
\hat{\alpha} \equiv \frac{1}{1-b(1-t)+m + \frac{(d + \tilde{n})k}{h}}
\end{equation}
The “Multiplier”

- A “multiplier” is a parameter which summarizes the change in one variable for a one unit change in another (typically exogenous) variable. Hence, as the model changes, the “multiplier” for fiscal policy changes.

\[
\frac{1}{1 - b(1-t) + m + \frac{(d + \tilde{n})k}{h}} \equiv \hat{\alpha} \leq \bar{\alpha} \equiv \frac{1}{1 - b(1-t) + m}
\]
Solving for Multipliers, in general

\[ Y_0 = \hat{\alpha} \left[ A_0 + \left( \frac{d + \bar{n}}{h} \right) \left( \frac{\bar{M}}{P} \right) - \left( \frac{d + \bar{n}}{h} \right) \mu \right] \]  \hspace{1cm} (<equilibrium income>)

\[ \Delta Y = \hat{\alpha} \left[ \Delta A + \left( \frac{d + \bar{n}}{h} \right) \Delta \left( \frac{\bar{M}}{P} \right) - \left( \frac{d + \bar{n}}{h} \right) \Delta \mu \right] \]

\[ \Delta Y = \hat{\alpha} \Delta GO \Rightarrow \frac{\Delta Y}{\Delta GO} = \hat{\alpha} \]

If it is lump sum taxes:

\[ \Delta Y = -\hat{\alpha} b \Delta TA \Rightarrow \frac{\Delta Y}{\Delta TA} = -\hat{\alpha} b \]
Graphical Depiction of Fiscal Policy

Figure 3: Fiscal (Govt. spending) Policy
Monetary Policy

If monetary policy is being used, the $\Delta A = 0$, so:

$$\Delta Y = \hat{\alpha}\left(\frac{d + \bar{\gamma}}{h}\right) \Delta\left(\frac{M}{P}\right) \Rightarrow \frac{\Delta Y}{\Delta(M / P)} = \hat{\alpha}\left(\frac{d + \bar{\gamma}}{h}\right)$$

- Notice this is a new “multiplier”: the change in real GDP for a one unit change in the price-deflated money stock (or “real money stock” for short).
- Critical to understand how monetary policy works.
Graphical Depiction of Monetary Policy

Figure 4: Monetary Policy
What Determines Policy Efficacy?

- Sometimes fiscal policy is relatively effective, sometimes monetary policy is relatively effective.
- There are (at least) two ways of thinking about this problem; both are aids to thinking about the economics.
- The first is algebraic.
- The second is graphical.
Fiscal (LM steep vs. flat)

\[ \hat{\alpha} = \frac{1}{1 - \beta (1 - t) + m + \frac{(d + \bar{n})k}{h}} \]
Fiscal (IS steep vs. flat)
Monetary (LM flat vs. steep)

\[ \frac{\Delta Y}{\Delta (M/P)} = \hat{\alpha} \left( \frac{d + \tilde{n}}{h} \right) \]
Monetary (IS steep vs. flat)