LECTURE 6
Does Monetary Policy Matter?

February 7, 2013
Announcements

• Problem Set 1 is being distributed. It is due a week from today.

• You may work together on the problems, provided that:
  – You try each question yourself first.
  – You must write up your answers yourself, in your own words.
DOES MONETARY POLICY MATTER?

I. MONEY-OUTPUT REGRESSIONS
A Simple Model of GDP Growth – in Words

GDP growth depends on the growth rate of the money supply and on other factors.
Aside: Growth Rates and Changes in Logs

• Useful fact: When the percent change in a variable is small, the change in its natural log is approximately 0.01 times its percent change.
  – For example: If $x$ rises by 1%, the change in $\ln x$ is $\ln 1.01$, which is 0.00995.
  – Another example: If $x$ rises by 10%, the change in $\ln x$ is $\ln 1.1$, which is 0.0953.

• Partly for that reason, economists often use the change in the natural log of a variable rather than its percent change.
Simple Model of GDP Growth – equation version

\[ \Delta \ln Y_t = a + b \Delta \ln M_t + e_t, \]

where:
- \( Y \) is real GDP;
- \( M \) is the money stock;
- \( e_t \) reflects all other factors affecting growth;
- \( a \) and \( b \) are parameters;
- \( \Delta \) denotes change;
- \( \ln \) denotes natural log.
Estimating the Parameters of the Model Using a Regression

\[ \Delta \ln Y_t = a + b \Delta \ln M_t + e_t. \]

- Choose \( a \) and \( b \) to fit the data as well as possible.
- That is, so \( a + b \Delta \ln M_t \) is on average as close as possible to \( \Delta \ln Y_t \).
- This is an “ordinary least squares” (or “OLS”) regression.
The Results of a Typical Money–Output Regression

Specification:

$$\Delta \ln Y_t = a + b_0 \Delta \ln M_t + b_1 \Delta \ln M_{t-1}$$

$$+ b_2 \Delta \ln M_{t-2} + b_3 \Delta \ln M_{t-3}$$

$$+ b_4 \Delta \ln M_{t-4} + c t + e_t$$
Results:
Quarterly data, 1960:Q2 – 2008:Q4, money measured by M2

$$\Delta \ln Y_t = 0.0046 - 0.09 \Delta \ln m_t + 0.18 \Delta \ln m_{t-1} + 0.16 \Delta \ln m_{t-2}$$

$$+ 0.02 \Delta \ln m_{t-3} - 0.02 \Delta \ln m_{t-4} - 0.000010 t,$$

$$R^2 = 0.056, \quad D.W. = 1.51, \quad \text{s.e.e.} = 0.008,$$

The estimate of $b_0 + b_1 + b_2 + b_3 + b_4$ is 0.25 (with a standard error of 0.10).
What Do You Think?

(It may help to recall our simple model:

$$\Delta \ln Y_t = a + b \Delta \ln M_t + e_t.$$ )
Examples of Confounding Factors that Could Affect the Correlation between Money Growth and GDP Growth

Recall: $\Delta \ln Y_t = a + b \Delta \ln M_t + e_t$.

- **Endogenous policy:** The Federal Reserve chooses $\Delta \ln M_t$ to offset $e_t$.
- **Endogenous money:** A high value of $e_t$ causes $\Delta \ln M_t$ to be high.
- **Coordinated policies:** Fiscal policy (one part of $e_t$) is expansionary when $\Delta \ln M_t$ is high.
Omitted Variable Bias

Recall: $\Delta \ln Y_t = a + b \Delta \ln M_t + e_t$.

Correlation between the factors left out of the regression (here, $e_t$) and the variables in the regression (here, $\Delta \ln M_t$) causes the regression estimate of $b$ to not be a good estimate of the true $b$. 
The correlation between money growth and GDP growth doesn’t establish the effect of money growth on GDP growth.
I used to think correlation implied causation.

Then I took a statistics class. Now I don't.

Sounds like the class helped. Well, maybe.
II. TAKING “IDENTIFICATION” SERIOUSLY
Types of “Experiments”

• Controlled experiments
• Random assignment
• Natural experiments
FRIEDMAN AND SCHWARTZ’S CRUCIAL EPISODES

• January–June 1920
• October 1931
• July 1936–January 1937
• “[T]he actions of the Reserve System in 1929–33 ..., even during the early phase of the contraction, from 1929 to 1931”
A Simple Version of F&S’s Model

(1) \[ \Delta \ln Y_t = a + b \Delta \ln M_t + e_t, \]

(2) \[ \Delta \ln M_t = c + d Z_t + u_t, \]

where \( Z \) is some variable measuring “unusual monetary developments” that is not correlated with \( e \) or with \( u \).
Now substitute eq. (2) into eq. (1):

\[ \Delta \ln Y_t = a + b[c + d Z_t + u_t] + e_t \]

\[ = (a + bc) + (bd) Z_t + (b u_t + e_t) \]

\[ \equiv \alpha + bdZ_t + \varepsilon_t. \]
\[ \Delta \ln Y_t = \alpha + bdZ_t + \varepsilon_t. \]

So:

- Run a regression of \( \Delta \ln Y_t \) on \( Z_t \).

Or

- Estimate \( d \), and then run a regression of \( \Delta \ln Y_t \) on \( dZ_t \).
How Do Friedman and Schwartz Assess the Evidence from Their Four Crucial Episodes?
What Do You Think?
Suppose $\Delta \ln Y_t = a + b \Delta \ln M_t + e_t$, and that the $\Delta \ln M_t$’s are from a random experiment.
3 Numbers that Come out of Estimating the Regression

• Coefficient estimate: An estimate of true $b$.

• Standard error: an estimate of the standard deviation of the coefficient estimate that would arise just from chance.

• t-statistic: ratio of coefficient estimate to standard error.
Examples
(Still assuming the $\Delta \ln M_t$’s are from a random experiment)

<table>
<thead>
<tr>
<th>Coeff. est.</th>
<th>Standard error</th>
<th>t-stat</th>
</tr>
</thead>
<tbody>
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<td>#1 0.01</td>
<td>0.001</td>
<td>10.0</td>
</tr>
<tr>
<td>#2 0.001</td>
<td>0.01</td>
<td>0.1</td>
</tr>
<tr>
<td>#3 3.0</td>
<td>6.0</td>
<td>0.5</td>
</tr>
<tr>
<td>#4 3.0</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>#5 3.0</td>
<td>0.5</td>
<td>6.0</td>
</tr>
</tbody>
</table>
Interpreting the Examples
(Still assuming a random experiment)

• #1: Strong evidence that money growth affects GDP – but that the effect is small.
• #2: Strong evidence that the effects of money growth are not large.
• #3: No useful evidence.
• #4: Moderate evidence that money growth affects GDP growth; not much evidence about the size of the effect.
• #5: Strong evidence that money growth has large effects on GDP growth.
Messages

• Look at coefficients and standard errors, not just t-statistics.
• And don’t forget about the possibility of omitted variable bias!