Monetary Economics

A longstanding problem in macroeconomics is to formally incorporate money into the analytical framework. One reason why this is not so easily done in a convincing way is that modern currencies closely resemble fiat money (i.e. unbacked and intrinsically worthless objects that function as money). Thus, explaining why such objects have value often puts the level of analysis way above the undergraduate level.
Methodology

Economists are strong believers that in most areas of economics it is useful to construct model economies (agents with preferences, firms with production technologies and some rules of exchange) to figure out how policies work within model economies. Model economies are our laboratories. This part of the course will construct formal model economies to only a very limited extent due to the difficulty of constructing tractable models of monetary economies.
Objects Serving as Money

1. Gold, silver, copper, salt, oxen, sea shells.

2. Certificates to gold or tobacco.


1 and 2 are commodity monies, whereas 3 is fiat money (unback and intrinsically worthless objects).
Functions of Money

1. Medium of exchange.

2. Medium of account.

3. Store of value.


[US dollars - serve in all four functions]
Physical Properties of Objects

1. Portability
2. Divisibility
3. Recognizability
4. Durability
Objects that have these properties to a large degree are often viewed as promising candidates for a useful media of exchange to be used in decentralized exchange.

Aguably, US dollars or certificates to some underlying commodities could be made to be display these properties to a large degree.

See Stanley Jevons (1875) "Money and the Mechanism of Exchange" for historical monies, functions and properties of money. Jevons also had a detailed discussion of some of the physical properties of gold.
John Law (1705):

“He who had more Goods than he had use for, would choose to barter them for Silver, though he had no use for it; Because, Silver was certain in its Quality.”

Upshot: Pattern of exchange features indirect trade with a special role for a medium of exchange. The medium of exchange being highly recognizable is key.
Questions about Money

1. Are there potential welfare gains to replacing a commodity money with fiat money?

2. Is there an arbitrage opportunity between T-bills and dollar bills?

3. Is money simply a creation of the State?

Tentative answers: 1. yes, 2. yes and 3. no
Welfare Gains

A commodity money, such as gold, has an alternative use. If it is not tied up in its use as a medium of exchange, then it can be used in jewelry and other uses. As a fiat money may be produced at low cost (paper money) then it potentially can substitute for gold as a medium of exchange.

While economists buy this argument at some level, the actual management of the money supply during the fiat money era in many countries has been quite poor. Many countries have had episodes of hyperinflation (Germany, Argentina and Zimbabwe to name a few).
**Arbitrage**

There is a straight-forward scheme that, at least in principle, can make large amounts of money off the fact that T-bills pay interest but dollar bills do not.

1. Print the "Huggett Dollar" the $H$.

2. Exchange $H$ for US $ one for one.

3. Use US $ to buy T-bills to back each $H$.

4. Enjoy life on Aruba using the interest payments.
Economic Organization of a POW Camp

1200- 2500 prisoners per camp

Red Cross Pkg: Cigarettes, Milk, Chocolate, ...

Economic Organization: free decentralized exchange

Issues: How is exchange transacted?

Upshot: Money is NOT just a creation of the State
Price Level: Theory and Empirics

David Hume and John Stuart Mill among others are credited with developing a theory of the price level, now called the Quantity Theory of Money. They probably saw some version of the British price series data contained on the next slide. They developed an explanation for the data pattern.
A 20th-century blip?
British consumer prices
1300=100, log scale

Source: Roger Bootle
Quantity Theory

\[ MV = PY \]

Assume: \( V \) constant

\( M \) and \( V \) - money and velocity

\( P \) and \( Y \) - price and output
Quantity Theory: Implications

(1) $P$ is proportional to $M/Y$ since $P = \frac{MV}{Y}$

(2) $\frac{\Delta M}{M} = \frac{\Delta P}{P} + \frac{\Delta Y}{Y}$

Both equations offer straightforward tests of the quantity theory simply by means of a scatter plot.
Chart 1

Money Growth and Inflation:
A High, Positive Correlation

Average Annual Rates of Growth in M2 and in Consumer Prices
During 1960–90 in 110 Countries

Source: International Monetary Fund
Measuring Velocity

Given an empirical measure of money $M$, output $Y$ and the price level $P$, then one can “back out” velocity.

$$V = \frac{PY}{M}$$

How does such an empirical velocity measure move?
Figure 1: $\Delta P/P$ vs. $\Delta M/M - \Delta Y/Y$

45 degree line
M1- velocity

Year

Nominal GDP/M1

Questions

Q1: What explains the upward trend in velocity?

Q2: What explains the fall in velocity in the 1980’s?
Quantity Theory: A Simple Foundation

1. Each student is given $M$ tokens.

2. Put candy ($Y = 10$ units) into vending machines and set price.

3. All students purchase candy with tokens.

4. End of day: collect tokens from own machine and remove rotten candy.
Clarification:

It is understood that all students love candy and that acquiring tokens is the only way to get candy. This is one way for worthless tokens to have value. It is also understood that the sequence of events 2, 3 and 4 is repeated each day forever.
Question:

How should student’s set the price of candy bars on their own vending machine?

Clearly, if a student sets the lowest price then that student sells out first. The highest price student will sell out last but may not sell all the candy.

Equilibrium: set price optimally, given others prices.
Equilibrium:

An equilibrium occurs when each student chooses the same price and the price satisfies the equation below:

\[ P = \frac{M}{Y} = \frac{M}{10} \]

\( M \) - number tokens per student

\( Y = 10 \) - number candy bars per student
Two Questions:

1. What happens in this economy if Georgetown University doubles the number of tokens given to each student?

2. What happens if Georgetown University allows students to remove tokens twice per day - after lunch and after dinner?
Is Money A Veil?:

Money is largely a veil in the vending-machine economy.

There is a long line of thought that views money as somewhat unimportant and as hiding the real workings of the economy. At the most extreme, some view money as neutral. When money is neutral, changes in money or in the mechanism by which money works do not affect real quantities (e.g. GDP, real interest rates and real wage rates) but do affect nominal quantities.
Real and Nominal Interest Rates:

The gross nominal interest rate measures the number of units of money one receives next period for giving up 1 unit of money now.

The gross real interest rate measures the number of baskets of goods one receives next period for giving up 1 basket of goods now.
Real and Nominal Interest Rates:

How to figure out the real interest rate, if we live in a nominal world?

1. Start with 1 basket of goods.

2. Covert basket into $p_t$ dollars - use CPI.

3. Convert $p_t$ into $p_t(1 + i_{t+1})$ dollars tomorrow.

4. Convert $p_t(1 + i_{t+1})$ into $\frac{p_t(1+i_{t+1})}{p_{t+1}}$ goods!
Conclusion: real interest rate is given by equation 1. Fisher equation is equation 2.

1. \textit{Gross real interest rate} = 1 + r_{t+1} = \frac{p_t(1+i_{t+1})}{p_{t+1}}

2. \(1 + i_{t+1}) = (1 + r_{t+1})(1 + \pi_{t+1})

3. \(1 + \pi_{t+1}) = p_{t+1}/p_t = \text{gross inflation rate}

Economists say that the real (not the nominal) interest rate is key for decision making
GOAL: We want to figure out whether or not money is a veil in the candy bar economy by “seeing” how changes in money impact the real and nominal interest rates.

Economy 1: Agents receive $Y = 10$ candy bars every period. Agents start out with $M$ units of money per person. No additional money is added to the economy.

Economy 2: Agents receive $Y = 10$ candy bars every period. Agents start out with $M$ units of money per person. Georgetown doubles the money every every period.
Economy 1: Analysis

1. Prices: \( P_t = \frac{M_t}{Y} = \frac{M}{10} \) all periods

2. Consumption: \( C_t = 10 \) all periods

3. MRS: \( MRSt,t + 1 = \frac{U_t}{U_{t+1}} = \frac{\beta^{t-1}}{ct} \)
   \( \beta \) is a "discount factor" \( 0 < \beta < 1 \)

Utility: \( U(c_1, c_2, ..., c_T) = \sum_{t=1}^{T} \beta^{t-1} \log(c_t) \)

Period \( t \) Marginal Utility: \( U_t(c_1, c_2, ..., c_T) = \frac{\beta^{t-1}}{ct} \)
Economy 1: Analysis

At the beginning of the day, some students discuss the idea of loaning tokens. What should the nominal interest rate be? What should the real interest rate be?

Presumably, these rates should not end up changing the consumption of anyone. We are assuming that preferences for candy bars over time are the same for all students!
Economy 1: Analysis

Claim: If the gross nominal interest rate is $1 + i_{t+1} = \frac{1}{\beta}$, then there is no gain for anyone either to take out a loan or to give out a loan. Moreover, the real interest rate and the nominal interest rate are the same as inflation is zero.

Proof: The budget line between two periods is just tangent to the agents indifference curve that runs through the candy bar endowment.

Comment: Real and nominal interest rates coincide and these rates are DETERMINED by the preference parameter $\beta$. 
Economy 1: Analysis

One might argue that the vending machine economy does not really change the allocation of candy bars. The same allocation of candy bars would occur if Georgetown University just did no impose these crazy rules. Therefore, the same real interest rate would have to occur without these crazy vending machines.

Upshot: Money is a veil. Real interest rates are NOT determined by the use of money in this economy.
Economy 2: Analysis

1. Prices: \( P_t = \frac{M_t}{Y} = \frac{2^{t-1}M}{10} \) all periods \( t \geq 1 \)

2. Money \( M_t = 2^{t-1}M \) - money doubles every period

3. Consumption: \( c_t = 10 \) all periods

4. MRS: \( MRS_{t,t+1} = \frac{U_t}{U_{t+1}} = \frac{\beta^{t-1}}{\beta^t} = \frac{c_t}{\beta c_{t+1}} = \frac{1}{\beta} \) when \( c_t = 10 \)

What should the nominal and real interest rate be?
Economy 2: Analysis

A good guess of the nominal interest rate is

\[(1 + i_{t+1}) = (1 + r_{t+1})(1 + \pi_{t+1}) = \frac{1}{\beta} \times 2\]

This nominal interest rate will imply that there is no gain for anyone either to take out a loan or to give out a loan. Why?
The budget line is tangent to the indifference curve as the implied real interest rate is \(\frac{1}{\beta}\)!
Conclusion for Economy 1 and 2:

1. Changing the money supply changes prices and the nominal interest rate BUT does not change the real interest rate or GDP. The real interest rate is determined by preferences and the amount of candy bars.

2. Thus, money is a veil in this simple world. The quantity theory holds and the Fisher equation holds.

3. How could we change this simple model so that money matters?
Some Monetary Facts - McCandless and Weber

Goal: Document correlations between growth rates of money, prices and GDP.

Motivation:

1. Federal Reserve System established in 1913 to provide an "elastic currency and to supervise the banking system".


Looking at some "long-run" correlations is a first step towards developing an opinion of whether or not the Fed has the tools to do all of these things.
Some Monetary Facts - McCandless and Weber

1. 110 countries 1960-90

2. Geometric mean growth rate

3. Money: M0, M1, M2

4. Subsamples: Latin America and OECD
Some Monetary Facts - McCandless and Weber

Main Findings:

1. $\text{Corr}(\Delta M/M, \Delta P/P) \doteq 1$ for all measures of $M$

2. $\text{Corr}(\Delta M/M, \Delta Y/Y) \doteq 0$ but NOT for OECD

3. $\text{Corr}(\Delta P/P, \Delta Y/Y) \doteq 0$ all countries
Table 1
Correlation Coefficients for Money Growth and Inflation*
Based on Data From 1960 to 1990

<table>
<thead>
<tr>
<th>Sample</th>
<th>Coefficient for Each Definition of Money</th>
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<tbody>
<tr>
<td></td>
<td>M0</td>
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<tr>
<td>All 110 Countries</td>
<td>.925</td>
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<td>Subsamples</td>
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<td>21 OECD Countries</td>
<td>.894</td>
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<tr>
<td>14 Latin American Countries</td>
<td>.973</td>
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</table>

*Inflation is defined as changes in a measure of consumer prices.
Source of basic data: International Monetary Fund
Chart 1

Money Growth and Inflation:
A High, Positive Correlation

Average Annual Rates of Growth in M2 and in Consumer Prices
During 1960–90 in 110 Countries

Source: International Monetary Fund
<table>
<thead>
<tr>
<th>Sample</th>
<th>M0</th>
<th>M1</th>
<th>M2</th>
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<tbody>
<tr>
<td>All 110 Countries</td>
<td>-.027</td>
<td>-.050</td>
<td>-.014</td>
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<td>Subsamples</td>
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<tr>
<td>21 OECD Countries</td>
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<td>.511</td>
<td>.518</td>
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<td>14 Latin American Countries</td>
<td>-.171</td>
<td>-.239</td>
<td>-.243</td>
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*Real output growth is calculated by subtracting changes in a measure of consumer prices from changes in nominal gross domestic product.
Source of basic data: International Monetary Fund
<table>
<thead>
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<th>Sample</th>
<th>Coefficient With Outlier**</th>
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<tr>
<td>All 110 Countries</td>
<td>−.243</td>
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<tr>
<td>Subsamples</td>
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<td>21 OECD Countries</td>
<td>.390</td>
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<tr>
<td>14 Latin American Countries</td>
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</tbody>
</table>

*Inflation is defined as changes in a measure of consumer prices. Real output growth is calculated by subtracting those inflation rates from changes in nominal gross domestic product.

**The outlier is Nicaragua.

Source of basic data: International Monetary Fund
Money and Interest Rates - Monet and Weber

Central banks control money (e.g. Fed Funds) and often target interest rates (e.g. Fed Funds Rate). What is the relationship between money and interest rates?

1. Fisher Effect View: increased money growth leads to increased nominal interest rate.

2. Liquidity Effect View: increased money growth leads to decreased nominal interest rate.
Fisher Effect View:

a mechanism by which this view may hold is that money growth primarily affects inflation but not the real interest rate. Proponents of this view may say that the real interest rate is connected to the marginal rate of substitution of consumers, which may be little affected by inflation.
Money and Interest Rates - Monet and Weber

Liquidity Effect View:

a mechanism by which this view may hold is that surprise increases in money growth may have a short-lived decrease in interest rates if the demand curve for money is downward sloping in the interest rate.
Table 2

Measures of the Relationship Between Money and Interest Rates
Correlation Coefficients and Regression Slope Coefficients for Money Growth Rates†
and Interest Rates in Developed and Developing Countries
in Various Periods Between 1961 and 1998

<table>
<thead>
<tr>
<th>Type of Measure</th>
<th>Time Period</th>
<th>Type of Country</th>
<th>Short-Term: Money Market Rates</th>
<th>Long-Term: Government Bond Yields With Venezuela</th>
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</thead>
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<td>Coefficient for Interest Rate Sample</td>
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<tr>
<td>Correlation Coefficient</td>
<td>Long Run (1961–98)</td>
<td>All</td>
<td>.71</td>
<td>.79</td>
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<td></td>
<td></td>
<td>Developed</td>
<td>.81</td>
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<td>.62</td>
<td>.66</td>
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<tr>
<td>Short Run</td>
<td>5-Year Periods (1964–98)</td>
<td>All</td>
<td>.52</td>
<td>.59</td>
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<tr>
<td></td>
<td></td>
<td>Developed</td>
<td>.52</td>
<td>.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Developing</td>
<td>.49</td>
<td>.53</td>
</tr>
<tr>
<td></td>
<td>1-Year Periods (1961–98)</td>
<td>All</td>
<td>.24</td>
<td>.34</td>
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<tr>
<td></td>
<td></td>
<td>Developed</td>
<td>.22</td>
<td>.26</td>
</tr>
<tr>
<td>Regression Slope Coefficient</td>
<td>Long Run (1961–98)</td>
<td>All</td>
<td>.68**</td>
<td>.60**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Developed</td>
<td>.68**</td>
<td>.56**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Developing</td>
<td>.66*</td>
<td>.51**</td>
</tr>
<tr>
<td>Short Run</td>
<td>5-Year Periods (1964–98)</td>
<td>All</td>
<td>.63**</td>
<td>.44**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Developed</td>
<td>.38**</td>
<td>.35**</td>
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<tr>
<td></td>
<td></td>
<td>Developing</td>
<td>.56**</td>
<td>.44**</td>
</tr>
</tbody>
</table>

†Money growth is based on a series comparable to the U.S. M1 definition of the money supply.
*Statistic is significantly greater than zero, but not significantly less than one, at the 0.05 level.
**Statistic is significantly greater than zero and significantly less than one at the 0.05 level.
Charts 1–2

A Strong, Positive Relationship Across Countries in the Long Run

Money Growth Rates vs. Short- and Long-Term Interest Rates in Developed and Developing Countries, *1961–98 Averages

![Regression Line for All Countries (Slope = 0.68)](chart1)

Developed Countries: ●
Developing Countries: ■

Chart 1. Money Growth vs. Money Market Rates

![Regression Line for All Countries (Slope = 0.60)](chart2)

Chart 2. Money Growth vs. Government Bond Yields**
Chart 3

A Weaker, But Still Positive Relationship in the Shorter Run

Money Growth Rates vs. Money Market Interest Rates in 19 Developed Countries
1961–98 Averages and 5-Year Averages Over 1961–98

Source of basic data: IMF, various dates, lines 34, 60b

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Charts 4–5

A Similar Relationship in the United States

Money Growth Rates (M1) and Interest Rates (6-Month U.S. Treasury Bill Rates) in 1960–99

Chart 4  Strong and Positive in the Long Run
(Overlapping 10-Year Averages)

Chart 5  Weaker, But Still Positive in the Shorter Run

Sources of basic data: Federal Reserve Board of Governors, ERI-WFPA
What determines the exchange rate between two currencies?

Neil Wallace argues that the exchange rate can be any positive number or zero within a theoretical model where (i) both currencies are unbacked and intrinsically worthless and where (ii) governments do not act to support a currency or restrict its use.
Exchange Rates- Wallace

Wallace seems to conclude that

(1) exchange rates are only pinned down by government restrictions.

(2) Restrictions have taken the form of fixed exchange rates in some periods of time or speculation on future government intervention (e.g. US greenback after the Civil War and the British pound after WWI).
Thought Experiment: One Currency

If there is an economy with a constant amount of fiat money and this fiat money has value, then the same economy with ten times the fiat money should have the same real outcome but where the price level is ten times higher. Thus, the usefulness of fiat money only depends on its real value and not on its quantity.
Thought Experiment: Two Currencies

$M_1$ and $M_2$ - country 1 and 2 money.

$M = M_1 + eM_2$ - world money

If there is one constant exchange rate between the two currencies, then any other exchange rate simply changes the world money supply. Increasing the money supply results (according to the one currency thought experiment) in a proportional increase in prices.
Comment:

1. Wallace’s ideas can be restated to apply to the vending-machine economies.

2. We will now determine what exchange rates are possible in vending-machine economies.
Inflation Targeting - Bernanke

Background: Bernanke was a professor at Princeton, a governor of the Fed and is the current Fed Chairman. He was a proponent of inflation targeting long ago.

Monetary policy (since 2009) is often termed "unconventional monetary policy" because the zero lower bound on nominal interest rates is binding or close to binding on short-term funds. Nevertheless, we will consider the topic of Inflation Targeting. It has been widely adopted around the world and might be a good description of US policy in the near future.
Effective Federal Funds Rate (DFF)
Source: Board of Governors of the Federal Reserve System

Shaded areas indicate US recessions.
2009 research.stlouisfed.org
Consumer Price Index for All Urban Consumers: All Items (CPIAUCSL)

(Percent Change from Year Ago of Index 1982-84=100)

Shaded areas indicate US recessions.
2013 research.stlouisfed.org
Features of Inflation Targeting:

1. Framework for making policy choices

2. Strategy for communicating choices to the public
Features of Inflation Targeting:

1. Framework: "Constrained Discretion"

"Under constrained discretion, the central bank is free to do its best to stabilize output and employment in the face of short-run disturbances, with the appropriate caution born of our imperfect knowledge of the economy ... . However, a crucial proviso is that in conducting stabilization policy, the central bank must also maintain a strong commitment to keeping inflation ... firmly under control ... ."

“Although constrained discretion acknowledges the crucial role that monetary policy plays in stabilizing the real economy, this policy framework does place heavy weight on the proposition that maintainace of low and stable inflation is a key element – perhaps the key element – of successful monetary policy.”
Features of Inflation Targeting:

2. "Communication Strategy" - the central bank’s regular procedures for communicating with political authorities, the financial markets and the public

(i) Public announcement of policy objectives (e.g. inflation rate)

(ii) Time frame for achieving policy objectives

(iii) Public release of central bank forecasts
Inflation Targeting: Why Limit Discretion?

Since Kydland and Prescott (1977) economists have (better) understood from a theoretical perspective why "rules" (a form of commitment) can dominate "discretion".

“Examples”:

- Tie Ulysses to the mast
- Why Cortes burned his boats
- Rules on building in the flood plain
- US Inflation experience in the 1970's under "discretion"
Monetary Policy

Low and stable inflation and low nominal interest rates viewed as beneficial. How to achieve this?

1. Move closer to “Rules”: (i) independent central bank, (ii) make goals more explicit in central bank charter (iii) appoint people ideologically committed to low/stable inflation.

2. Evidence: central banks with more independence are associated with lower inflation rates.

3. Evidence: countries adopting “inflation targeting regimes” achieved lower inflation rates

Figure 1
Central Bank Independence vs. Average Rates of Inflation in 16 Countries, 1973–88

Figure 2
Examples of Inflation in Discretionary and Targeting Regimes, 1980–98

A. United Kingdom

Inflation rate (%)

B. New Zealand

Discretionary regime

Inflation targeting regime

Bands for the targets

C. Canada

D. Sweden

Discretionary regime

Inflation targeting regime

Bands for the targets

Source: Bernanke et al. (1999).