Lecture Note on Classical Macroeconomic Theory

Econ 135 - Prof. Bohn

This course will examine the linkages between interest rates, money, output, and inflation in more detail than Mishkin’s book. While you have taken intermediate macro, most of Mishkin’s book is meant to be accessible to less prepared students. Interest rates interact with output and inflation. Our task is to understand the overall macro effects of monetary policy.

The class will proceed in two steps and examine Classical monetary theory first, then New-Keynesian theory. Most central bankers these days are New-Keynesians. However, Keynesian theory is more complicated and it provides new insights mainly about the short run and for economies with nominal frictions, so-called “sticky” prices and wages. Classical theory provides straightforward answers about the long run (once Keynesian frictions wear out) and for economies with sufficiently volatile prices and wages that nominal frictions are relatively unimportant (notably, high-inflation countries).

Different instructors in Principles and Intermediate Macro place different emphasis on Classical versus Keynesian theories. Abel-Bernanke-Croushore’s *Macroeconomics* provides a nicely balanced coverage. (An older edition is on reserve; ch.7+9 recommended.) Stephen Williamson’s *Macroeconomics* text, which is sometimes used in Econ 101, has mostly classical theory. (If you have the book, I recommend ch.10-11.) Jones’ *Macroeconomics* is mostly Keynesian. Mishkin also covers Keynesian theory in chapters 20-23. This lecture note is intended to supplement Mishkin and to establish common ground for discussing macroeconomic questions.

Suggestions: Study most whichever theory your previous instructors emphasized least. Try to reconcile any conflicts with what you have learned before (if any). Seemingly conflicting answers are usually due to differences in assumptions that can be clarified if you ask—don’t hesitate to ask me.

Nominal variables – incomes, consumption, sales, wages, etc denominated in a currency – can always be interpreted as real variables multiplied by a general price level (e.g., the CPI or GDP-deflator). Two fundamental assumptions of Classical macro theory are (1) that equilibrium values of most real variables can be determined without knowing the price level or the inflation rate; and (2) that the equilibrium value of the price level and the inflation rate are determined primarily by the central bank’s supply of money. Thus macro theory divides cleanly into real macro and monetary macro. They can be examined independently—which simplifies things. The notion that money has no real effects is known as **monetary neutrality**. Money is neutral in the classical model.
Motivation for Monetary Neutrality

Why should printing green pieces of paper (dollars) have an impact on production, consumption, and other real economic variables? After all, people care about real things like food, cars, or leisure. This reasoning motivates why Classical macroeconomic starts with examining real economic activity and assumes money has no impact on real variables. Even if money does have real effects in reality, imagining a world without money is a useful thought experiment; it helps clarify why and under which condition money matters.

The Classical Model of the Real Economy

Here is a basic model of the real economy—hopefully similar to what you studied in Econ 101. Output is produced with capital and labor. Labor is supplied by households who make tradeoffs between leisure and consumption, resulting in a labor supply function that depends on the real wage. Firms pay a real wage equal to the marginal product of labor. In equilibrium, labor demand equals labor supply at the market-clearing real wage. The labor force is full employed in the sense that everyone can find a job at prevailing wages, though workers may be unemployed while they are searching for new jobs. The output that can be produced with the available capital stock and the equilibrium labor inputs defines the aggregate supply on the goods market.

Demand for goods comes from households (for consumption), firms (for capital investment), the government (exogenous), and foreigners (here assumed exogenous). Because consumers have a choice to consume or to save and earn interest, consumption and savings naturally depend on the interest rate—specifically, on the real interest rate, because they care about real consumption. Because capital investment yields returns with delay and must be financed, investment also depends on the interest rate—again, on the real interest rate, because real investment produces real output. Higher real interest rates unambiguously reduce investment, but they have conflicting income and substitution effects on consumption: the income effect of higher interest income encourages consumption; the substitution effect encourages savings. The ambiguity is theoretical, however; empirically the aggregate demand for goods depends negatively on the real interest rate \( r \). To remember this dependence, we write aggregate demand \( Y^d \) as function \( Y = Y^d(r) \) with negative slope.

The supply of goods—aggregate output—may depend positively on the real interest rate, namely if a higher interest rate encourages workers to supply more labor. We will sometimes ignore this effect for simplicity and assume and exogenous supply is essentially exogenous. Thus aggregate supply \( (Y^s) \) as function of \( r \) has steep positive or vertical slope,
An output-interest rate diagram helps to illustrate how output and the real interest rate are determined: Aggregate demand is a downward sloping line that determines the real interest rate at which supply equals demand, \( Y^*(r) = Y^d(r) \). In Keynesian macro, the \( Y^d \)-curve is commonly called the IS-curve (e.g. Mishkin ch.20), and the classical supply is called potential output, \( Y^p \). Mishkin ch.21-23 uses the Keynesian notation; I introduce the same notation here to prepare you and show you how the theories relate.

The IS-curve is motivated by the following: By definition, personal savings are disposable income minus consumption, \( S^h = Y - T - C \). Government savings equal the budget surplus \( S_g = T - G \) (deficit if negative), the difference between taxes (T) and government spending (G). Negative net exports (net imports) can be interpreted as savings of foreigners in the U.S., \( S_f = -NX \). If one takes the demand identity \( Y = Y^d = C + I + G + NX \) and rearranges, one finds \( I = Y - C - G + NX = (Y - T - C) + (T - G) + S_f = S^h + S_g + S_f = S \). Investment equals total savings (S). The equality of savings and investment whenever \( Y = Y^d \) motivates the IS label. (Mishkin ch.20 provides more details—optional.)

The savings-investment motivation for \( Y^d \) is closely related to the demand-supply analysis on financial markets. Savings provide a supply of funds to financial markets, a demand for bonds and other financial assets. Borrowing for real investment creates a demand for financial funds, a supply of new securities such as stocks and bonds. One may interpret \( S = S(r) \) as the supply curve for funds, and \( I = I(r) \) as the demand curve for funds. In this macro perspective, demand and supply on financial markets must be interpreted broadly, in aggregate sense, as encompassing the demands and supplies on all financial markets (bonds, loans, equity issues, etc.). Goods market equilibrium and aggregate-level financial market equilibrium are two perspectives on the same phenomenon. We will revisit this in Mishkin ch.5.
The real economy is subject to several types of disturbances. First, aggregate supply is subject to “supply shocks” that can make the supply curve jump left or right. Examples are oil shocks that disrupt production and make some of the capital stock obsolete, changes in tax policy that discourage labor supply, and technical innovations that increase productivity. Second, aggregate demand is subject to “demand shocks” that can make the demand curve jump left or right. Examples are discoveries of profitable investment opportunities that trigger capital investment, changes in consumer tastes for foreign versus domestic goods, changes in government spending, and changes in tax policy that encourage or discourage savings. Some of these shocks affect both demand and supply.

**Money and Prices**

How then does money enter? Money in the classical model is an add-on, a convenience that people like to carry around to facilitate transactions. Real money demand depends on the real volume of transactions (represented by real income $Y$), the price at which the transactions take place ($P$), and the opportunity cost, which is the *nominal* interest rate that could be earned on bonds ($i$). If the same real transactions are done at higher prices, the nominal need for money would increase proportionally. This is important enough to formalize in algebraic terms:

1. **Assumption 1:** Nominal money demand is a product of real money demand and price level:
   \[ M^d_{\text{nominal}} = L(i, Y) \cdot P, \]
   where the money demand function $L$ is decreasing in $i$ and increasing in $Y$.

2. **Assumption 2:** Nominal money supply is controlled by the Fed: $M^s_{\text{nominal}} = M$.
   (Note: This is actually a questionable assumption, but so standard that we will adopt it for now. The analysis of money multipliers later in the course will show under what condition this a good assumption and how to modify it as needed.)

3. **Conclusion:** Equilibrium in the market for money requires
   \[ M = L(i, Y) \cdot P. \]  
   (1)

Divided by $P$, equilibrium can also be written as $M/P = L(i, Y)$, equating real money supply to real money demand. To emphasize the distinction between nominal and real variables, one may also write money market equilibrium as $M = L(r + \pi^e, Y) \cdot P$.

Recall that real output and the real interest rate are already determined from the conditions for equilibrium in the market for goods. Equilibrium output and the real interest rate also determine real investment, real consumption, real savings, and all other real variables. Money cannot affect any of these real variables: *Money is neutral* in this model.

A Money-Price Diagram helps illustrate the money market equilibrium. Money supply is a vertical line at $M$. Money demand is a line through the origin with slope $1/L(i, Y)$. The slope depends on real output, the real interest rate, and expected inflation.
The Money-Price Diagram

The diagram shows that for given output, real interest rate, and expected inflation, higher money supply raises the price level proportionally. Reduced money supply reduces price level proportionally.

Note: If you studied Keynesian economics in previous classes, you may have seen condition (1) with a different interpretation (holding P fixed), and a diagram with money and interest rate. We will cover that later when we discuss the liquidity preference section of Mishkin’s ch.5; for now, P is variable and the real interest rate is given.

The equilibrium condition and diagram also provide answers to questions of what will happen if output or the real interest change exogenously (in response to real disturbances) or if there are shifts in the money demand function or in expected inflation. A limitation of the diagram is that expected inflation is taken as given.

Inflation and Expected Inflation

Taking expected inflation as given is acceptable if one considers one-time changes in money supply or other variables that don’t have a lasting effect on actual inflation. A more general analysis is needed for monetary and other changes that might change the rate inflation. By definition, inflation is the rate of change in the price level, a growth rate. Because the level of prices is linked to the level of money supply, growth in prices requires growth in money supply.

The problem can be illustrated in the money-price diagram. Money growth can be represented as a gradual but persistent shift of the $M^s$-line to the right. For a given $M^d$-line, the price level increases in proportion. The complication is that as prices keep increasing, individuals will likely expect inflation to continue; expected inflation rises. Given the real interest rate, higher expected inflation raises nominal interest rates and reduces real money demand. In the diagram, the $M^d$-line becomes steeper, which means that P must increase further and is no longer strictly proportional to M.
Here is a systematic way to answer questions that involve changes in the inflation rate. It’s a three-step approach, and we will go through it twice, first in a basic setting with money growth only, then in more realistic setting with output growth and other complications.

Step 1: consider money demand and supply at the initial rate of money growth. Whatever the slope of the $M_d$-line, prices will increase in proportion to money supply. The inflation rate equals the money growth rate (subject to some adjustments discussed below).

Step 2: consider money growth after a change in monetary policy. In the long run, the $M_d$-line will have stabilized at some (new) slope. Hence prices will again increase in proportion to money supply, which means that the new inflation rate equals the new money growth rate. If the scenario involves an increase in money growth, inflation will be higher, and individuals reduce their real money demand. The $M_d$-line will be steeper than before. Conversely, if the scenario involves a decrease in money growth, inflation will be reduced, real money demand will increase, and the $M_d$-line will be flatter. The steeper or flatter $M_d$-line causes an upward or downward shift in the prices level beyond the usual proportional change. Bottom line: Whenever the rate of money growth changes, the price level responds somewhat more than proportionally to the change in money supply.

Step 3: consider the transition process from one money growth rate to another. Expected inflation initially matches actual inflation. Expected inflation will also match actual inflation in the long run, after all adjustments are complete. In between, individuals must learn about the changes and may have inflationary expectations that differ from actual inflation. The dynamics of this learning process depend on how much information individuals have in a particular application. Good information should trigger a quick adjustment of expectations, whereas a lack of information may yield a slow adjustment. Thus there are no general answers about the transition.

In a test, you are typically told what to assume about expectations, or what information is available. Some textbooks assume perfect foresight even during the adjustment process. By substituting expected by actual inflation in $M = L(r + \pi, Y) \cdot P$ one obtains a differential equation that can be solved for prices as function of time. In this course, we do not assume perfect foresight.

This three-step approach takes for granted that inflation will eventually stabilize. This is a reasonable assumption for countries with low or moderate inflation, but requires caution when hyperinflation is a concern. Hyperinflation arises if money growth triggers a vicious cycle of expected inflation reducing real money demand and raising prices further, leading to a collapse of money demand and to an emergence of barter trade or substitute media of exchange; we disregard this case.
Money Growth in a Growing Economy

The answers above are valid if one abstracts from real growth. Because most real-world economies are growing, adjustments are needed for realistic applications. The main insight will be that output growth increases money demand and therefore dampens inflation. Additional adjustments are needed if there are structural changes in a country’s payment system, e.g., financial innovations.

If an economy grows, people need more money to do more transactions. Specifically, suppose the nominal money stock \( M \) is used to execute transactions with nominal value \( P \cdot Y \). Then each dollar must be used \( V = (Y \cdot P) / M \) times. The proportionality factor \( V \) is known as the velocity of money. When real output grows or the price level changes, but people use the same payment system and don’t change their payment habits, velocity should stay unchanged. Writing \( M = (Y \cdot P) / V = P \cdot (Y / V) \), the real demand for money should be \( M^d / P = L(i,Y) = \frac{1}{V} \cdot Y \), i.e., proportional to output. Because money demand depends negatively on the interest rate, velocity should depend positively on the interest rate, i.e., \( V = V(i) \). That is, money circulates faster when it’s more costly to hold money—a reasonable assumption.

With money demand written as \( L(i,Y) = \frac{1}{V(i)} \cdot Y \), equilibrium in the money market can be written as

\[
M \cdot V(i) = Y \cdot P
\]

This equation is known as the Quantity Equation, one of the most famous relationships in monetary economics. To remember: Nominal output equals money supply times velocity.

Mishkin ch.19 provides more details. This Note presents a streamlined version. Mishkin associates quantity theory with Monetarism and Monetarism with the notion that velocity and money demand don’t depend on interest rates. In his Keynesian version, \( V \) is a function of both interest rates and output. This Note recognizes the interest rate dependence without making the output effect too complicated. Mishkin ch.19 is not required reading because Mishkin’s treatment is more complicated than we need, but it’s a reasonable alternate reading if you have trouble with this note.

The quantity equation is particularly useful in a growing economy because of a math fact: If two variables are multiplied, the growth rate of the product is the sum of the growth rates. To apply this, we need a notation for growth rates: let \( \% \Delta x \) stands for growth rate of any variable \( x \) (bit clunky, but follows Mishkin). Inflation is the growth rate of prices, \( \pi = \% \Delta P \); money growth is \( \% \Delta (M) \); velocity growth is \( \% \Delta V \); and real output growth is \( \% \Delta Y \). Then the quantity equation, implies that money growth plus velocity growth must equal real output growth plus inflation: In algebraic terms, \( \% \Delta M + \% \Delta V = \% \Delta Y + \pi \), which implies

\[
\pi = \% \Delta M + \% \Delta V - \% \Delta Y
\]

Thus the quantity equation in growth rates implies a simple formula for inflation. To remember:

Inflation equals money growth plus velocity growth minus real output growth.
For given V and Y, the growth rate equation (3) confirms the “basic” analysis: A change in money growth translates into an equal change in the inflation rate. The equation is also consistent with additional inflation during transitions: When money growth increases, expected inflation and interest rates rise, hence velocity rises and triggers an additional burst of inflation.

The main new point is that real output growth reduces inflation. Money growth is not inflationary if it merely matches $\%\Delta Y$; then money supply merely accommodates the growing demand for money. If $\%\Delta M > \%\Delta Y$, only the excess $\%\Delta M - \%\Delta Y$ is inflationary. If $\%\Delta M < \%\Delta Y$, inflation is negative—a situation called deflation. Eq. (3) also captures structural changes in the financial system that may independently reduce or increase the demand for money. If the payment system becomes more efficient over time and allows money to circulate more quickly, velocity will grow (at any given i) and money demand will decline. Eq. (3) shows that velocity growth is inflationary unless it is offset by a reduced money growth rate.

Equation (3) also provides a straightforward and powerful recipe for central banks to control inflation. For any combination of output growth and velocity growth, a central bank can control the inflation rate by setting money growth appropriately. One might object that output growth fluctuates; that velocity may fluctuate in the short run in response to interest rate changes and disturbances in the banking system; and that money supply may be out of the Fed’s control in the short due to disturbances in the banking system (to be examined later). But all such fluctuations are observable and can be offset by adjustments in the central bank’s money supply target. This makes equation (3) a virtually foolproof way to control inflation in the longer run. Many successful central banks have used this approach. The flipside is that the equation gives central banks full responsibility for price stability and all the blame for excessive inflation. As Milton Friedman put it: “inflation is always and everywhere a monetary phenomenon.”

Finally, a note on growth trends: You may recall from the Solow model in Econ 101 that real output tends to grow over time because of a growing population and improvements in productivity. Consumption and investment grow at about the same rate (growth is “balanced”). In the output-real interest rate diagram, demand and supply are gradually drifting to the right. In the money-price diagram, the slope of the money demand line $V(i)/Y$ is gradually decreasing, and money supply either must increase proportionally to main P constant, or P will drift up or down. Long run growth trends are difficult to draw in diagrams because all the curves are shifting all the time. To solve problems, it’s usually best to separate growth trends from disturbances: Use growth rate equations to determine long run growth rates. Then think of disturbances as changes relative to trend; they can be illustrated in the
diagrams by omitting growth trends; then shift a curve whenever the behavior captured by the curve changes relative to the trend.

Let’s review the key findings for the classical, market-clearing model:
1. Money is neutral: it has no effects on real variables like output or real interest rates.
2. Money supply determines the price level. A one-time increase in M increases P proportionally.
3. Money growth determines the inflation rate. If money growth increases, inflation and expected inflation increase by the same percentage in the long run. Because information about the change is often imperfect, expected inflation may differ from actual inflation during a transition period. As expected inflation adjusts, real money demand declines and causes an extra increase in the price level beyond the normal proportional increase. Output growth reduces inflation whereas velocity growth increases inflation.
4. The key relationships to remember are: Money market equilibrium (1), the quantity equation (2), and the quantity equation in growth rates (3).

Examples
A few numerical examples are useful to practice working with growth rates, and to distinguish temporary from permanent changes. For all four policy scenarios, assume real output grows by 3% per year (say, due to improved productivity) and velocity increases by 1% per year (say, because of improved payment technology). Assume the real interest rate is 2.5%.

a. Suppose the money supply grows at a constant rate of 4%/year. What is the inflation rate? What’s the nominal interest rate? What would be different if money growth were higher or lower (say, 2% or 10%)?
Answer: Inflation is \( \pi = 4\% + 1\% - 3\% = 2\% \). With expected inflation matching actual inflation, the nominal interest rate is 4.5%. If the money supply were growing at a constant rate higher or lower than 4%, inflation and nominal interest rates would be higher or lower by the same amount. For example, 2% money growth would yield zero inflation and i=2.5%; 10% money growth would yield 8% inflation and i=10.5%.

b. Consider a one-time increase in the money stock by 3% relative to trend. Money supply initially grows at a constant rate of 2% per year. For one year, the money stock grows by 5% instead of 2%, and then returns to 2% growth. We may call this a temporary increase in the growth rate or equivalently a permanent shift in the level. How will inflation respond?
Answer: The price level is initially constant, because \( \pi = 2\% + 1\% - 3\% = 0\% \). In the long run, money supply growth is again 2% per year, so inflation is zero. Prices must stabilize at some (new) level. All changes in inflation are therefore temporary. The temporary effects on the price level can be inferred
from money market equilibrium (either the M-P diagram or eq. (1)): The extra 3% boost in the money stock must raise the price level by an extra 3%. No change in inflation implies no change in nominal interest rates, so velocity and real money demand are unchanged.

The above would be a perfect answer in a test. However, critical readers may notice that inflation is positive during the transition, and that’s where the argument can get messy. To start, one might think that inflation is 3% for one year. But this is exact only if the inflation is unexpected, say, if the boost in money growth was imposed secretly and not recognized by Fed watchers. If inflation were expected, borrowers and lenders would demand a higher nominal interest during the transition year, and this would reduce money demand (or raise the velocity of money). The M-P diagram would imply that the price level rises more than 3% in the short run (as $M^d$ is steeper). Bottom line: The basic answer is fine for the tests, but be aware that there are complications.

General hint: To analyze policy examples, it’s usually best to start with the initial position, then examine the long run, and leave the transition from short to long run for last.

c. Consider a **permanent increase** in the money growth rate. Assume money supply initially grows at a constant rate of 2% per year. Then starting at some date (“time t”), money supply growth is increased to 5% per year and stays at 5% indefinitely. We may also call this a repeated increase in the money stock. How will inflation and nominal interest rates respond?

**Answer:** This experiment involves long run changes: With 5% money supply growth, the growth rate equation implies $\pi = 5\% + 1\% - 3\% = 3\%$. Sooner or later, everyone will figure this out and adjust their expectations. So $\pi^e$ must adjust from 0% to 3%, and the nominal interest rate must eventually increase by the same 3 percentage points, from 2.5% to 5.5%. The increased nominal interest rate implies reduced money demand and an increase in velocity, so prices must increase a bit faster during the transition than in the long run.

d. Same scenario as before, but now assume money growth is 5% for one year, then -1% for one year, and then returns to 2%. In other words, the stock of money rises above trend for a year and then returns to the old trend. How will inflation respond?

**Answer:** There are no long run changes. Assuming expected inflation remain constant at zero, the impact is a 3% increase in the price level in year 1 followed by a 3% decrease in the price level in year 2 (i.e., deflation).

Scenarios (b-d) highlight distinctions between changes in **levels** versus changes in **growth rates**. Scenario (b) is about a one-time shift in the time path of the money stock, shifting the level up permanently by a fixed percentage, without changing long-run growth. Scenario (c) is about a break in the growth path, a shift to a steeper slope of the price trend over time. Scenario (d) describes a “blip” in the price level stock that leaves the longer run level of prices entirely unchanged.

Optional exercise: Draw time series for money, prices, inflation, and nominal interest rates in scenarios (a)-(d).

For more practice questions, see the “Examples” file on the class page.
**Expected Inflation: What do we know and when do we know it?**

The scenarios also help to illustrate why predicting inflation is difficult in practice but important. To see how difficult it is, note that money growth equals 5% for the first year in scenarios (b), (c), and (d). The scenarios all look alike at first! Suppose you observe an increase in money growth from 2% to 5%. How should you adjust your expectations about future inflation? The answer clearly depends on whether you think you are in scenario (b), (c), or (d), or some combination thereof. In other words, the answer depends on expectations about future Fed policy, something one cannot observe nor easily predict.

To see the importance of expected inflation, suppose you are investing in bonds. If inflationary expectations response slowly to money growth, nominal interest rates rise slowly in (c) and remain unchanged in (b) and (d). Then actual real returns on nominal bonds fall below the real rate during the transition, perhaps even turn negative (say, 2.5% nominal rate minus 3% inflation). If inflationary expectations respond quickly, however, nominal interest rates rise sharply even if the money growth turns out to be only temporary. Then real returns on nominal bonds remain close to the real interest rate in scenario (c), but rise far above the real rate in (b) and (d).

How quickly do inflationary expectations adjust? The best answer depends on how much information the public has about monetary policy. Sometimes changes in money growth are widely publicized and easily understood. Then analysts can figure out the implications: interest rates and bond prices respond within seconds when relevant news comes out. Sometimes changes are unannounced and are difficult to interpret.

Uncertainty about future policy has several implications: First, it explains why investors spend considerable time and effort collecting clues about the Fed’s intentions. This is the basic motivation for “Fed watching.” Second, it explains why smart investors often modify their inflationary expectations and charge higher or lower nominal interest rates whenever they see something that might indicate a permanent change in monetary policy—even if it turns out to be temporary blip, a false alarm. Uncertainty about future monetary policy is a major source of interest rate volatility. This also explains why textbook discussions along the lines of ‘how inflationary expectations would adjust if investors had perfect foresight’ are not very useful. Investors typically don’t know.

In summary, we have covered the effects of monetary policy on inflation and nominal interest rates in a model where money is neutral. As we consider economies with price rigidities, remember the distinctions between temporary and permanent policy changes, and between long run and transitional
effects. In most models where money has real effects, the real effects are temporary. Money remains neutral in the long run. Equation (1)-(3) above will continue to provide the right answers about the long run.

**Thinking Ahead: Optimal Monetary Policy**

This note is mainly about what monetary policy can do to the economy. Another question is what monetary policy should do.

Classical policy advice focuses on the medium of exchange function of money. Because printing money is virtually costless, the socially optimal policy is to provide the medium of exchange at a near-zero opportunity cost. Setting $i=0$ maximizes the real quantity of money in circulation and it maximizes the consumer surplus provided by money (the area under the money demand function). This is known as the Friedman Rule, or Milton Friedman’s optimal quantity of money. A zero nominal interest rate can be obtained by setting money growth low enough that inflation equals the negative of the real interest rate. Algebraically, setting $\pi = \pi^e = -r$ yields $i = r + \pi^e = 0$, and it requires a money growth rate of $\%\Delta M = \%\Delta Y - \%\Delta V - r$. Assuming the real interest rate is positive, optimal policy calls for deflation, a declining price level.

Friedman is also known for the idea that the money supply should grow at a fixed rate. The zero-interest-rate rule is consistent with fixed money growth if $\%\Delta Y - \%\Delta V - r$ is constant, but not otherwise.

The Friedman rule implicitly assumes that the Fed knows the correct real rate and that the public has the right expectations. It becomes problematic if real interest rates and inflationary expectations vary: Then the expected rate of deflation ($-\pi^e$) might exceed the real interest rate required for a goods market equilibrium. Money would offer a higher marginal return than real investments, providing incentives for savers to hoard money—a phenomenon called a “liquidity trap.” How exact an economy would operate under such extreme conditions is still disputed among academics, but there is a risk of hugely negative consequences—a collapse in output and massive unemployment. (In the output-interest rate diagram, aggregate demand at $r=-\pi^e$ is less that aggregate supply.) A more practical interpretation of classical policy advice is therefore to keep inflation low, keeping the opportunity cost of holding money near zero but strictly positive.

How good is the classical policy advice? The practical version of Friedman’s rule—saying a central bank should commit to keeping inflation low and stable—has become universally accepted, not only in the U.S. but also around the world. In this sense, Classical thinking is the foundation of central banking.
Note what’s not mentioned here: Classical theory provides no justification for central bankers to worry about business cycles, countercyclical policy, and related issues. This is worth remembering as we return to Mishkin’s book: Developed countries with well-run central banks often take low inflation for granted and focus mostly on other effects of monetary policy, often using Keynesian theory. This is arguably appropriate for countries that can afford to be sophisticated—such as the U.S. and much of Europe. This should not distract, however, from the basic point that monetary policy has the power and responsibility to control inflation. Maintaining low inflation continues to be the central challenge for monetary policy in many less-developed countries.