Credit Cycles and Debt-Deflation[1]

The goal of this topic is to write down a macroeconomic model that will provide insight into financial crises. Unfortunately, the best models that the profession has for this purpose, extended New Keynesian models, are extremely complex and are beyond the scope of this class. The simplest models that provide some insight, IS/LM models, miss too many aspects of the story to be useful. So my goal is to take a New Keynesian model, make some heroic simplifications, and hope for the best. I think the resulting model describes some important features of the Great Recession pretty well.

This is essentially the same model that I use in ECO 270. I try to minimize overlap between that course and this one, but we need this background before going through the events of the financial panic and recession. Depending on the composition of the class, I may move quickly through this material.

The Supply Side

The supply side of the economy is represented by a New Keynesian Phillips Curve:

$$\pi_t = \pi^e_{t+1} + \kappa \tilde{y}_t + \mu_t \tag{1}$$

The derivation of this equation is a tad complicated. It takes about three hours of class time. It results from solving a firm's profit maximization problem in a setting where they can only change their price each period with some probability. This requires that firms think about the future when choosing their current price. So if they expect inflation to be 5% in the next period, they will, all else equal, increase their current prices by 5% in order to keep up.

The term, $\tilde{y}_t$, is not output. Instead it is the difference between actual output and potential (full employment) output. A negative value therefore indicates that there is excess unemployment and too little output. This term affects the demand for the firm's output. If demand is depressed, then the firm responds by lowering prices and inflation falls, all else equal.

The term, μ_t, represents a random supply shock that, on average, equals zero. An increase in oil prices is an example of a positive value.

The Demand Side

The demand side of the economy is represented by an Euler Equation:

[1] These are undergraduate lecture notes. They do not represent academic work. Expect typos, sloppy formatting, and occasional (possibly stupefying) errors.

$$\tilde{y}_t = \tilde{y}^e_{t+1} - \sigma^{-1}(i_t - \pi^e_{t+1}) + g_t \tag{2}$$

The term inside parentheses represents the real interest rate. Recall the standard intuition from ECO 103 and 270. As real interest rates increase, so does the cost of borrowing. Consumers reduce their consumption and firms may also reduce their investment. Both effects depress aggregate demand. The presence of expected output (which equals consumption because there is no capital) indicates that households wish to smooth their consumption. This is the standard result from the Life Cycle Hypothesis.

Finally the term g_t represents random shocks to demand that average zero. Positive shocks may include tax decreases or increases in government spending.

Monetary Policy

We will assume that the Central Bank sets a target inflation rate, $\bar{\pi}$. In the United States, for example, this target is 2%. The Central Bank then tries to set interest rates using the following policy rule:

$$i_t = \bar{\pi} + \phi_1 \tilde{y}_t + \phi_2(\pi_t - \bar{\pi}) \tag{3}$$

By assuming that $\phi_1, \phi_2 > 0$, the Fed lowers interest rates in response to depressed output or lower inflation. This is standard.

Solving the Model

Dealing with the expectational terms makes solving the model under rational expectations beyond the scope of this class. So we will rely on the following heroic assumptions:

$$\tilde{y}^e_{t+1} = 0 \tag{4}$$

$$\pi^e_t = \bar{\pi} \tag{5}$$

We are thus assuming that agents always expect output to go back to potential output in the next period and inflation to go back to its target. Agents are thus naive. This is not ideal. But it does allow us to illustrate the model's most important points without making the model too complex.

Inserting (3)-(5) into (1) and (2) and rearranging yields:

$$\pi_t = \bar{\pi} + \kappa \tilde{y}_t + \mu_t \tag{6}$$

$$\pi_t = \bar{\pi} - \frac{\sigma^{-1} + \phi_1}{\phi_2} \tilde{y}_t + \frac{\sigma g_t}{\phi_2} \tag{7}$$

If we define the former equation as aggregate supply and the latter as aggregate supply, then we can plot the model in inflation/output gap space:

Graph: Equilibrium in NK model

Notice that if $g_t = \mu_t = 0$, then equilibrium occurs where $\tilde{y}_t = 0$, and $\pi_t = \bar{\pi}$. Supply shocks where $\mu_t > 0$ increase inflation and reduce output. Demand shocks where $g_t > 0$ increase both inflation and the output gap.

The model as it currently stands makes fairly standard predictions. It does not tell us much about financial crises. To allow it to do so, we will add credit spreads into the model.

Credit Spreads

So far, we have assumed that agents can borrow at the risk free interest rate. In reality, however, lenders must pay a credit spread (also known as a risk premium) on top of the risk free interest rate. The data show that, most of the time, these are fairly small (about 0.1%). So our model, as it currently stands, is acceptable for most macroeconomic conditions. During financial crises, however, credit spreads may become very important and much larger. We thus assume that lenders borrow at the rate $i_t + cs_t$. The credit spread is determined by:

$$cs_t = \left\{ \begin{array}{lll} 0 & if & \pi_t + \omega_1 \tilde{y}_t - \omega_2 i_t \geq \bar{c} \\ \tau & if & \pi_t + \omega_1 \tilde{y}_t - \omega_2 i_t < \bar{c} \end{array} \right\}$$

where $\tau > 0$, and $\omega_1, \omega_2 > 0$. We are thus assuming that three factors result in potentially significant credit spreads:

1. Deflationary pressures. Most debt in the United States is tied to fixed interest rates that do not automatically adjust for inflation. Suppose that a potential borrower has an existing level of debt. When deflation occurs, the real value of their outstanding debt decreases. They thus become less likely to make their payments and the chances of default increase. Lenders thus demand a higher credit spread to compensate them for this heightened risk.

2. Lower output. As income declines and unemployment increases, default risk also increases.

3. Higher (risk free) interest rates. As i_t increases, so do the associated finance charges and the risk of default.

Many macroeconomists believe that deflation is the most important of these three factors. *Debt-Deflation* is the cycle where reduced demand lowers prices, which increase real debt burdens, which increase credit spreads and reduce aggregate demand. This reduced demand further lowers prices and the cycle repeats itself. Debt-deflation remains the best explanation for the severity of the Great Depression where cumulative deflation peaked at about 33%. Ben Bernanke has written extensively on the Great Depression and has clearly been quite concerned about a repeat of debt-deflation during the current downtown.

This assumption also illustrates the *credit channel* of monetary policy which is especially important during financial crises. By lowering i_t, a Central Bank is able to apply downward pressure on credit spreads.

If the economy is in a financial crisis, then aggregate demand may be rewritten as:

$$\pi_t = \bar{\pi} - \frac{\sigma^{-1} + \phi_1}{\phi_2} \tilde{y}_t + \frac{\sigma g_t - \tau}{\phi_2} \tag{8}$$

A Demand Induced Crisis

Consider the following example. An asset pricing bubble bursts. This is represented in our model as a negative value of g_t. This reduces aggregate demand.

In our graph, the region of crisis lies at the lower left of the space. If the shock to demand is large enough, then it may push the model into this region changing the nature of aggregate demand from (5) to (8). Large credit spreads kick in resulting in a larger reduction of output and inflation than occurs in the model without credit effects. The effects of the demand shock are thus *amplified*.

Graph: Equilibrium in NK model, with Credit Effects

Liquidity Traps

There is one additional complication that makes the situation worse still. So far, we have assumed that i_t is unbounded from below. In reality, however, nominal interest rates must be positive. In our example, inflation and the output gap are especially low. It is thus possible (as is currently the case) that (3) suggests that $i_t < 0$. This is known as a *liquidity trap*. If this occurs, we can further modify our aggregate demand equation by imposing that $i_t = 0$. This yields a third aggregate demand equation:

$$\tilde{y}_t = -\sigma^{-1}(\tau - \bar{\pi}) \tag{9}$$

Plotting this scenario:

Graph: Equilibrium in NK model, Liquidity Trap

The liquidity trap limits the Central Bank's ability to respond to the financial crisis through conventional monetary policy. The reduction in output and potential deflation are thus made worse still.

Conclusions

This model is obviously not intended to capture every aspect of the recent macroeconomic downturn. But I hope that it does yield insight into how imperfect financial (credit) markets can lead to a cycle where negative shocks are amplified. It also illustrates issues that we will encounter later in the course:

The Central Bank's job becomes much more complicated than simply lowering short term interest rates in response to the downturn. First, it must worry about how macroeconomic variables, especially deflation, can lead to a tightening of private credit in the economy. Second, once i_t nears zero, it must come up non-conventional ways to stabilize the economy. Both of these complications will be important when discussing non conventional monetary policies such as TARP, and quantitative easing.