MA Advanced Macroeconomics: 12. Default Risk, Collateral and Credit Rationing

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Moving Beyond Risk-Free Interest Rates

- We spent the last few weeks talking about how monetary policy sets something called "the interest rate."
- However, in reality, monetary policy sets a very particular targeted short-term risk-free interest rate, usually the overnight interest rate that banks charge each other for very short-term loans.
- But these interest rates are not very important for the economy. Most of the important borrowing that takes place involved some element of risk.
- This risk, and how it operates and how it changes over time, is very important for understanding the way the financial sector interacts with modern economies.
- A lot of borrowing also operates via financial intermediaries such as banks and these are very special institutions worth examining closely.
- In discussing risky lending, I'm going to focus first on three elements:
    1. Default risk and collateral.
    2. Credit rationing by banks.
    3. Sovereign default.

Part I

Default Risk and Collateral

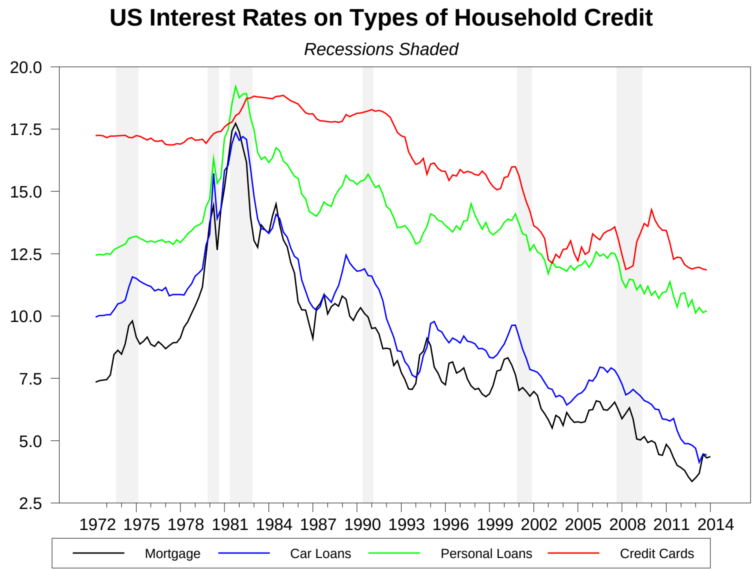
Default Risk, Collateral and Borrowing Rates

- An alternative to investing in (essentially) risk-free government bonds is to lend to households and businesses.
- Because there is some risk that these loans will be defaulted on, these types of loans need to have higher interest rates.
- Suppose the interest rate on risk-free bonds is r percent. Now consider a loan with interest rate R but a probability of default of p.
- This loan has
  1. A probability $1-p$ of a return of R.
  2. A probability p of a return of -1: Losing all your money.
  3. So, the expected return is $R - Rp - p$. Rp will be small so the expected return is approximately $R - p$.
- To deliver the same expected return as the risk-free bond, this loan has to have $R - p = r$, so its interest rate needs to be $R = r + p$.
- If the loan has some collateral, so default implies a return of $c - 1 < 0$, then the loan needs to have a return of approximately $R = r + (1-c)p$, so collateralized loans have lower interest rates.

Four Types of Household Borrowing

- To assess whether this framework helps to explain interest rates, consider four different types of loans to households:
  1. **Credit Cards**: No collateral. Can be used for any purpose (e.g. shopping for clothes). No set schedule for repayments apart from a small minimum monthly payment. Attractive to irresponsible borrowers who may not pay back.
  2. **Personal Loans**: No collateral. Usually screened by a bank manager as being for a particular purpose. Generally, a set schedule for repayments.
  3. **Car Loans**: The car can be used as collateral. But it's not great collateral: Cars lose value quickly. Set schedule for repayments.
  4. **Mortgages**: House used as collateral and usually it's pretty good collateral. Set schedule for repayments and people are generally very reluctant to default and lose their house.
- This suggests interest rates on credit cards should be the highest, then personal loans, then car loans, then mortgages.
- The chart on the next page confirms that this is indeed the case.

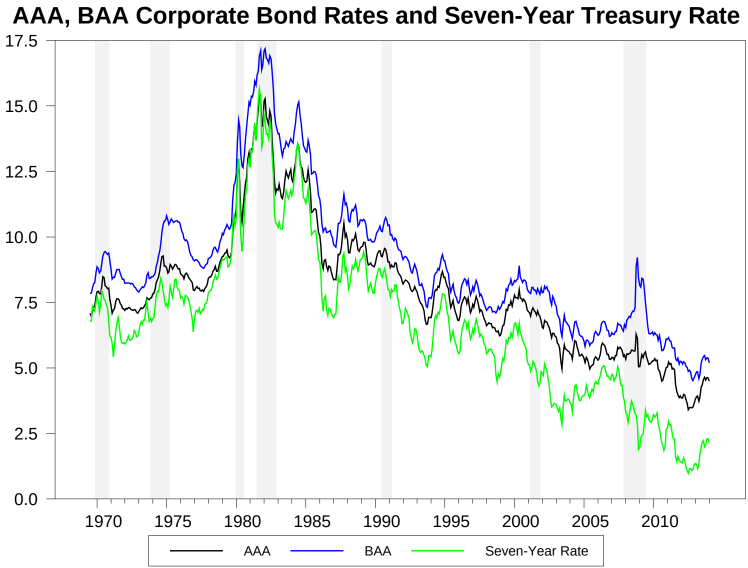
Default Risk and Collateral Affect Borrowing Rates



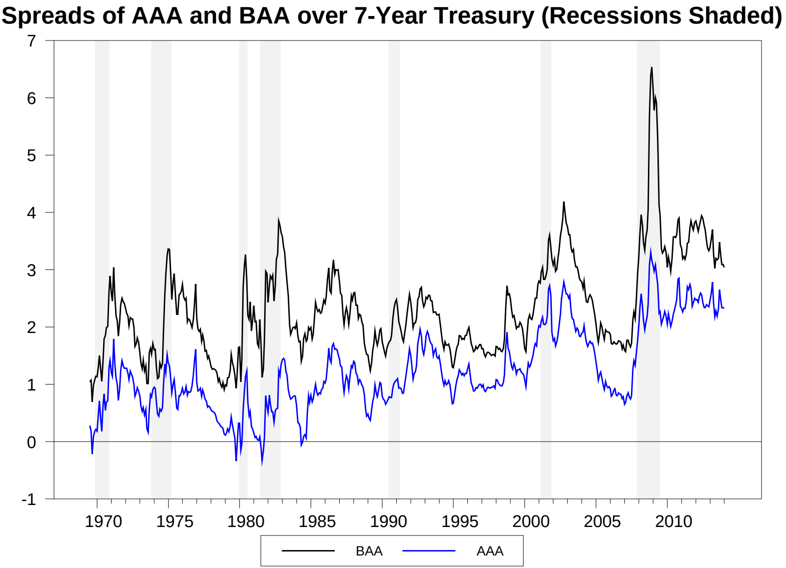
Corporate Bond Rates

- Large public corporations have their credit-worthiness rated by independent ratings agencies such as Moody's and S&P.
- The highest-rated firms get an AAA rating.
- Firms with that are an "adequate" credit risk are given a BAA rating by Moody's.
- Corporate bonds tend to move in line with rates on Treasuries of similar maturities, usually around seven years.
- But BAA bond rates are higher than AAA rates. This reflects higher perceived default rates.
- Because default risk goes up and down over the cycle, the "risk spreads" associated with these bonds tend to display a cyclical pattern, rising during and after recessions, when corporate default risks are high.
- These risk spreads spiked upwards to all-time highs during the period after the Lehmans bankruptcy. They have come back down now but are still high by historical standards.

Relationship Between Treasury and Corporate Bonds



Risk Spreads are Cyclical



Part II

The Financial Accelerator

Collateral Feedback Effects: The Financial Accelerator

- We have seen how the value of collateral pledged by a borrower can affect the interest rate at which they borrow.
- Because assets values go up and down with the state of the economy, this suggests that a mechanism by which the financial sector can propagate business cycle shocks: A shock that produces a recession leads to higher interest rate spreads for borrowers and thus a deeper recession.
- There are a number of ways to model the link between interest rates and collateral formally. Bernanke and Gertler (1989) was a famous paper that introduced collateral-based risk spreads into an otherwise-standard real business cycle model and showed how it produced more substantial impulse responses to shocks. This mechanism became known as the *financial accelerator*.
- Bernanke, Gertler and Gilchrist (1999) adds the financial accelerator to a fairly standard New Keynesian model.
- The next few slides are borrowed from lecture notes in which Mark Gertler explains the log-linearised version of the model.

Mark Gertler's Description of the BGG Model

Aggregate demand

$$y_t = \frac{C}{Y}c_t + \frac{I}{Y}inv_t + \frac{G}{Y}g_t + \frac{C^e}{Y}c_t^e + ...$$

$$c_t = -\sigma r_{t+1} + E_t c_{t+1}$$

$$c_t^e = \frac{1-\phi}{\phi}n_{t+1}$$

Mark Gertler's Description of the BGG Model

$$(inv_t - k_t) = \varphi q_t$$

$$E_t r_{kt+1} = (1-\vartheta) E_t (p_{wt+1} - p_{t+1} + y_{t+1} - k_{t+1}) + \vartheta E_t q_{t+1} - q_t$$

$$E_t r_{kt+1} - r_{t+1} = -v(n_t - q_t - k_{t+1})$$

Mark Gertler's Description of the BGG Model

Aggregate supply

$$y_t = a_t + \alpha k_t + (1 - \alpha) l_t$$

$$y_t - l_t = \mu_t + \gamma_l l_t + c_t$$

$$\pi_t = \kappa(p_{wt} - p_t) + \beta E_t \pi_{t+1}$$

Mark Gertler's Description of the BGG Model

Evolution of state variables

$$k_{t+1} = \delta inv_t + (1-\delta)k_t$$

$$n_t = \frac{\theta RK}{N}[r_t^k - r_t] + \theta R(r_t + n_{t-1})$$

with

$$r_r = i_{t-1} - \pi_{t-1}$$

Mark Gertler's Description of the BGG Model

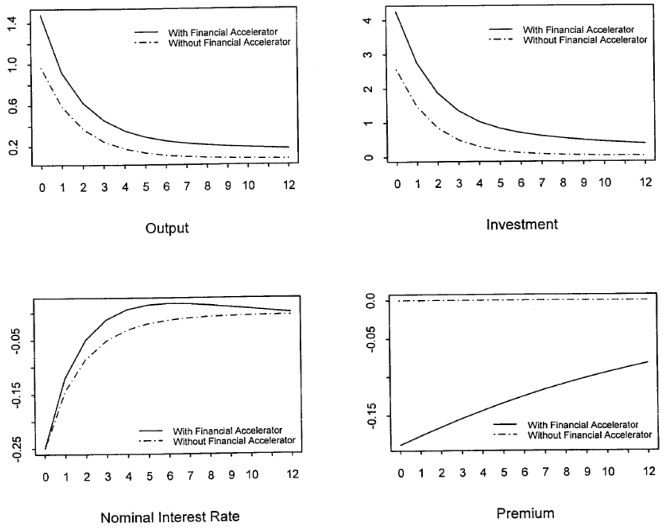
Monetary Policy Rule

$$i_t = \rho i_{t-1} + (1-\rho)[\gamma_\pi \pi_t + \gamma_y (y_t - y_t^n)] + \varepsilon_t^{rn}$$

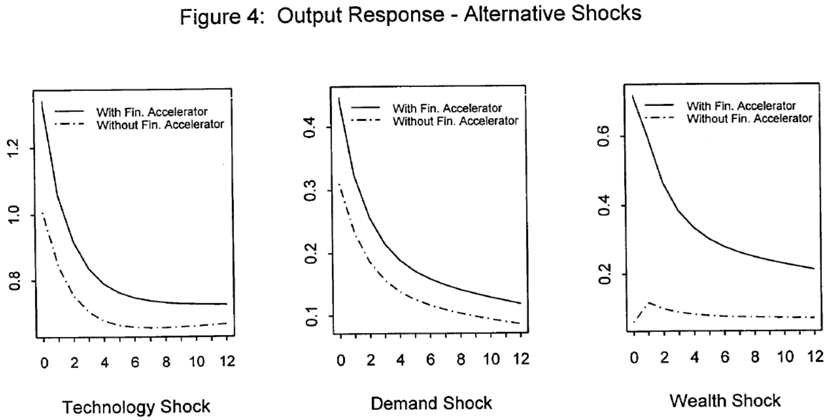
$$i_t = r_{t+1} - E_t \pi_{t+1}$$

Impulse Responses with the Financial Accelerator

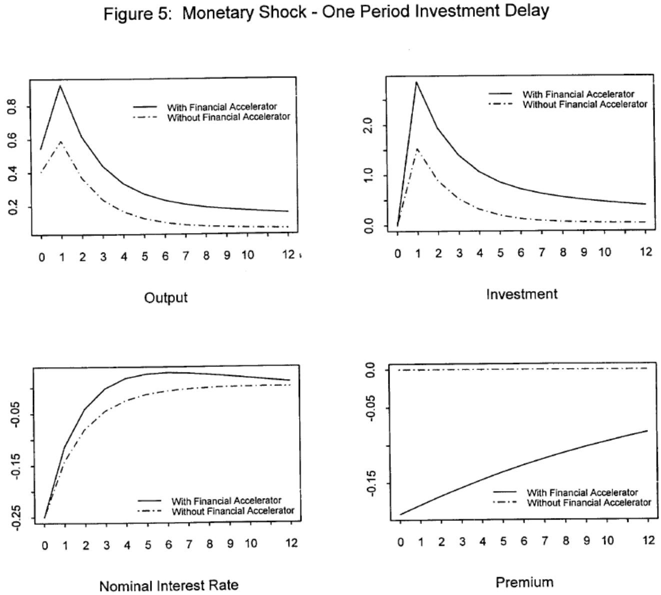
Figure 3: Monetary Shock - No Investment Delay



Impulse Responses with the Financial Accelerator



Impulse Responses with the Financial Accelerator



Part III

Credit Rationing

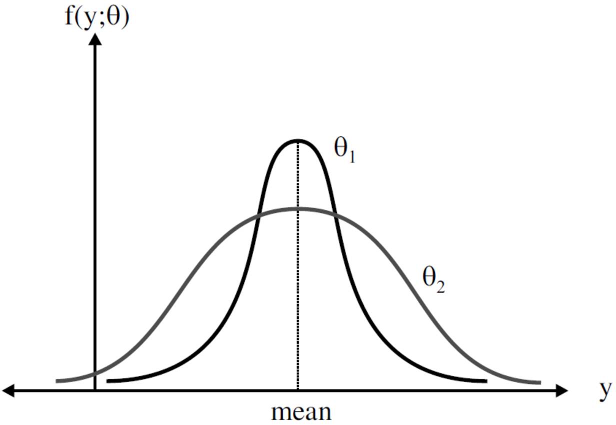
Beyond Interest Rate Spreads: Credit Rationing

- We have seen that borrowers with higher risk tend to pay higher interest rates.
- However, we assumed that there would always be someone willing to lend to these high risk borrowers, once the interest rate was high enough.
- In practice, we don't necessarily see this. Suppliers of credit like banks often simply refuse to make loans rather than try to make up potential losses by raising the interest rate.
- And this credit rationing can often be quite severe: Borrowers who appear to be good credits may get turned down.
- There are a number of models in which there is credit rationing, i.e. lenders provide a smaller amount of loans than is demanded at the market interest rate.
- The reason for this asymmetric information. Banks can't always tell good borrowers from bad and is that the pool of borrowers worsens (from the bank's point of view) as the interest rate rises.
- Here, I present the classic Stiglitz and Weiss (1981) model of credit rationing.

Assumptions of the Model

- There are a number of borrowers, each of whom have a project to undertake.
- All borrowers look to borrow B and put up collateral C.
- Projects deliver a sum of R but this is uncertain and the distribution of outcomes varies across borrowers: Borrowers of type θ have a return distribution of given by probability density function $f(R, \theta)$. The mean of these distributions are identical across borrowers but greater values of θ correspond to greater riskiness.
- Specifically, high values of θ induce a *mean-preserving spread* in the distribution of project payoffs.
- The probability density function for θ is $g(\theta)$. (The cdf is $G(\theta)$)
- Borrowers are observably identical to banks: They don't observe an individual's value of θ.
- The interest rate on bank loans is r and this is determined endogenously.
- We first examine at the relationship between loan demand and interest rates, then by looking at loan supply and interest rates and finally considering the joint determination of loan quantities and interest rates.

A Mean Preserving Spread



The Firm's Decision

- The return to the firm is $P(R, r) = \text{Max}(R - (1 + r) B, -C)$
- The worst the firm can do if it gets a really bad return is default on the loan and lose its collateral.
- After that the return increases one for one with the outcome R.
- The return also depends negatively on the borrowing rate r.
- We assume that not all firms decide to go ahead and borrow. In other words, not all firms have positive expected value from this uncertain outcome.
- Who borrows and who doesn't? You borrow if

$$E[P(R, r)] = \int_0^\infty P(R, r) f(R, \theta) dR > 0$$

- Borrowers only differ according to their θ so the question is: How does $E[P(R, r)]$ vary with θ?

The Payoff for the Firm

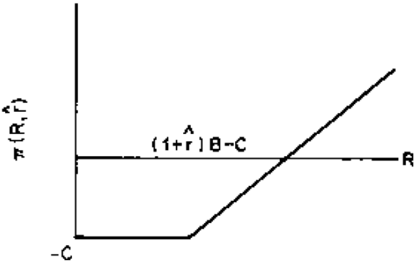


FIGURE 2a. FIRM PROFITS ARE A CONVEX FUNCTION OF THE RETURN ON THE PROJECT

Changes in the Pool of Borrowers

- Only those with a value of θ above some critical value $\hat{\theta}(r)$ decide to borrow.
- Explanation: Recall basic utility theory. If the function $U(C)$ is concave, then a mean-preserving spread in the distribution of C reduces expected utility because people are risk averse. In this case, the outcome is a *convex* function of R, so more uncertainty *increases* the expected return.
- Intuition: In bad cases, the outcome is still $-C$ but increased risk raises the chance of a really good outcome.
- How does an increase in r affect loan demand? Project returns depend negatively on r, so an increase in r reduces everyone's expected project returns.
- But expected project returns also depend positively on θ, so some firms will still have positive expected value for going ahead with borrowing and doing the project. The increase in r raises the cut-off $\hat{\theta}(r)$ for potential borrowers.
- In other words, as the interest rate for the bank rises, the pool of borrowers changes so that it increasingly consists of those people with risky projects. This is an example of adverse selection.

Bank Profits

- The payoff to the bank is $\text{Min}\left(R+C,(1+r)\,B\right)$
- If the bank knew that it was lending to type θ, then its expected return would be
$$\rho\left(\theta,r\right)=\int_0^{\infty}\left[\text{Min}\left(R+C,(1+r)\,B\right)\right]f\left(R,\theta\right)dR$$
- The bank's payoff is a concave function of R, so increases in θ reduce the bank's expected return: In the best case scenarios, the bank just gets its principal and interest but in the worst cases it only gets the collateral. So more risk is bad for the bank.
- But the bank can't tell who is risky or not. Its expected payoff can be calculated by averaging across all types that look for loans at interest rate r:
$$E\left[\rho\left(\theta,r\right)\right]=\frac{\int_{\hat{\theta}(r)}^{\infty}\rho\left(\theta,r\right)g\left(\theta\right)d\theta}{1-G\left(\hat{\theta}(r)\right)}$$

The Payoff for the Bank

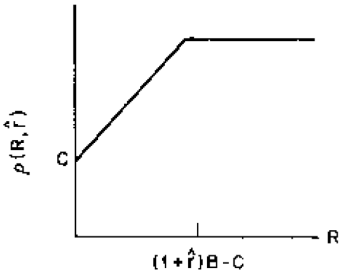
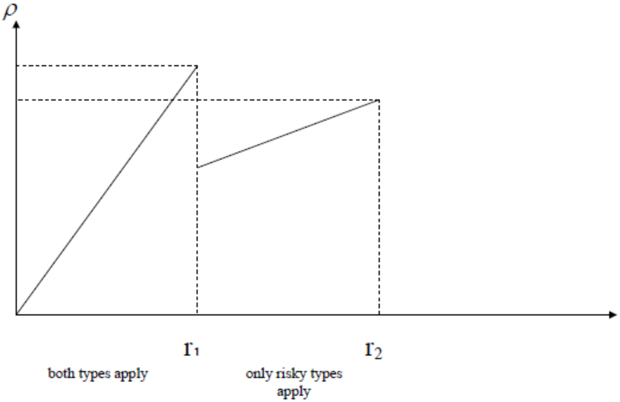


FIGURE 2b. THE RETURN TO THE BANK IS A CONCAVE FUNCTION OF THE RETURN ON THE PROJECT

Interest Rates and Expected Profits

- An increase in interest rates has two effects on the bank's payoff:
  1. A positive effect due to higher interest revenues from each project that pays off.
  2. A negative effect due to adverse selection. As interest rates rise, the pool of borrowers changes so that only riskier borrowers remain and this lowers the expected return.
- At some point the second effect dominates, so bank profits rise as the interest rate goes up, reach a maximum and then decline.
- One way to see this is to assume there are only two types of borrowers, low and high risk. Profits drop at the point where the "'low-risk" types drop out.
- Extended to a continuous number of types, this implies a particular interest rate, call it r^*, which is consistent with a maximum level of profits.
- We assume that loan supply depends positively on the expected payoff.
- Note, however, that banks can't simply choose the interest rate r^*, simply because they'd like this outcome. If there isn't sufficient demand to meet this supply, then this can't be an equilbrium: Banks would be chasing customers offering them r^* and lots of people would be turning them down.

The Bank's Expected Return With Two Types



The Bank's Expected Return

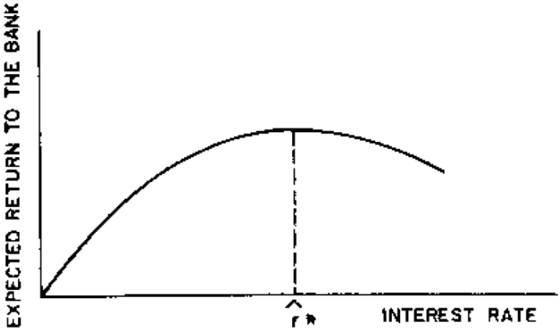
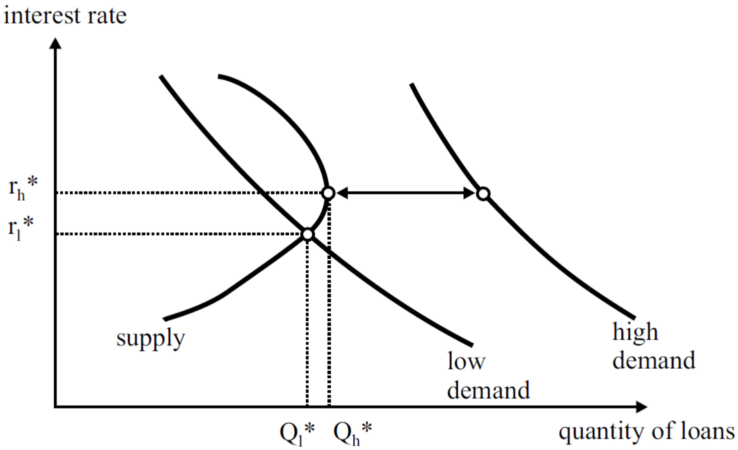


FIGURE 1. THERE EXISTS AN INTEREST RATE WHICH MAXIMIZES THE EXPECTED RETURN TO THE BANK

Loan Supply and Credit Rationing

- Ultimately, it is the interaction of supply and demand that will determine an equilibrium outcome.
- This can be written as a backward-bending supply curve. However, this is a bit misleading. The interest rates are not being set by a Walrasian auctioneer but by banks. And no bank will choose to set an interest rate above r^*.
- The chart on the next page shows two different potential outcomes:
    1. Low Demand for Loans: The demand curve for loans intersects with the part of the loan supply curve below r^*. The market functions normally and all who request a loan receive one.
    2. High Demand for Loans: In this case, the supply and demand curves don't intersect. Banks can pick their optimal interest rate r^*. At this point there will be more demand than banks are willing to supply so there will be credit rationing.
- During recessions, the demand for credit may be high and credit rationing more likely. Reductions in the value of collateral that occur during a recession also reduces bank expected profits and will increase the extent of credit rationing.

Sometimes Credit is Rationed, Sometimes Not



Part IV

Sovereign Default

Sovereign Default Risk

- The examples so far have focused on households and businesses. However, governments can also default on their obligations.
- This issue has come to the fore in Europe recent years as Greece has already had a sovereign default and markets worry that other countries (Spain, Italy, Portugal, Ireland) may also default.
- The website links to a paper by Charles Goodhart that discusses, among other things, how central banks had often been called on to finance governments as a last resort.
- The euro area has a prohibition on central banks directly purchasing government bonds. This means that if financial markets don't want to purchase a government's bonds, then it may not be able to raise the money to pay off old bonds. The result is a sovereign default.
- Fear of default has led to high interest rates on goverment bonds for countries with high debt in the euro area. In contrast, countries with high debt but central banks willing to buy government bonds (UK, US) have had low government bond yields.

Goodhart's Warnings About the Euro

- "Historically, the nation states have been able, in extremis, (whether in the course of war or other—often self-induced—crisis) to call upon the assistance of the money-creating institutions, whether the mint via debasement of the currency, a Treasury printing press, or the Central Bank. Whenever states (as in USA or Austrailia), provinces (as in Canada), cantons, lander etc. have joined together in a larger federal unity, both the main political, the main fiscal and the monetary powers and competencies have similarly emigrated to the federal level. The Euro area will not be like that.
- "In particular, the participating nations will continue to have the main fiscal responsibilities; but in the monetary field, their status will have changed to a subsidiary level, in the sense that they can no longer, at a pinch, call upon the monetary authority to create money to finance their national debt. There is to be an unprecedented divorce between the main monetary and fiscal authorities."

Why Sovereign Bond Markets Can Close

- Suppose investors perceive a ten percent chance that a government will default over the next year, leading to a 50 percent default on its outstanding debts.
- This means that they will need to pay a five percent premium on their debt relative to safe assets.
- What happens, however, if this interest cost imposes too large a burden on a government, i.e. if they do not have access to enough funds to make the interest payments associated with these high costs of funding?
- In this case, at some point, the market for these bonds may cease to operate. Given the risk, the required interest rate is too high for a country to be able to afford and default goes from being unlikely to being likely.
- This closing of the bond market can often be an abrupt event, a crisis that people did not see coming.
- In many cases, a default and a write-down of debts are required to restore the country to a point where its debts are sustainable.

Peter Boone's Graph on Italy

Limits to DSGE Modelling of Financial Factors

- After the global financial crisis, DSGE models were correctly criticised for generally having a very limited role for the financial system. The BGG model was a partial exception but this modelled only a very limited aspect of financial transmission mechanisms.
- There is more work underway now to add financial factors to DSGE models.
- The last couple of topics, however, provide an indication of why there may be limits to how far you can get with modelling financial factors with DSGE models.
- In the log-linearised forms in which they are simulated and estimated DSGE models can capture simple linear interactions between variables but they cannot capture highly nonlinear events. So, for example, they generally cannot capture the complete closure of a sovereign bond market. Credit rationing is another type of behaviour that linearised DSGE models would have great trouble capturing.
- So while DSGE models should be enchanced to incorporate how the financial system amplifies shocks in normal booms and recessions, it is probably too much to ask them to be useful tools to forecast or understand serious crises.