Part IIB

Supervision 8 - International Economics II

Daniel Wales

29 Apr, 2020, University of Cambridge

This Class

- Problem 1: Debt Crises.
- Problem 2: Debt Relief and Debt Overhang.
- Essay 1: The Costs of Incomplete Monetary Union.
- Essay 2: International Financial Institutions.

Problem 1: Debt Crises.

Problem 1 - Set Up I

- *Consider the simple model of debt crises. Agents can invest in either an international asset at the price* $Q_t^* = \frac{1}{R_t^{World}}$ *or in one-period domestic public debt at the market price* Q_t*, which may differ from* Q_t^* *because of expectations of default. For simplicity, assume the following:*

  - All investors are risk neutral with $R_t^{\text{World}} = 1$;
  - Domestic public debt $\mathcal{B}_t$ is only short term (one period);
  - If default occurs, the haircut on government bond holders is 50%, that is, the "recovery rate" is 50%;
  - The existence of a debt threshold, $\mathcal{B}_{t+1}^{\text{Max}}$, is common knowledge. Whenever public debt is above $\mathcal{B}_{t+1}^{\text{Max}}$ and the economy enters a "bad state of the world" (say, a deep recession or political instability), the government will default.

Problem 1 - Set Up II

- *continued:*
  - In all periods $\mathcal{B}_{s+1}^{\text{Max}} = 115$.
  - In the initial period t the government starts with financing needs $FN_t = 100$.
  - In periods $t+1$, $t+2$, ... etc the economy will enter the "bad state of the world" with a probability $p = 0.2$.

Problem 1 (a) - Bond Price Schedule

- *(a) Calculate the equilibrium price at which the government issues bonds in period t. Is the equilibrium unique? How much debt, $\mathcal{B}_{t+1}$, does the government issue?*

- Default occurs iff $\mathcal{B}_{t+1} > \mathcal{B}_t^{\text{Max}}$, **and** the economy is in a "bad" state of the world

- This state occurs with probability, $p = 0.2$.

- Even then investors recover 50% of the value of their bonds.

- If investors are **risk neutral**, bond prices equal the expected cash flow (discounted at $R = 1$):

$$Q_t = \begin{cases} 1 & \text{if} \quad \mathcal{B}_{t+1} \leq 115, \\ 0.8 \times 1 + 0.2 \times 0.5 = 0.9 & \text{if} \quad \mathcal{B}_{t+1} > 115. \end{cases}$$

Problem 1 (a) - Uniqueness

- Suppose investors **believe** the country will be at **risk** of default, hence $Q_t^{\text{Risky}} = 0.9$.

- Given $FN_t = 100$, how much debt is issued?

$$FN_t = Q_t \mathcal{B}_{t+1}, \quad \rightarrow \quad \mathcal{B}_{t+1}^{\text{Risky}} = \frac{FN_t}{Q_t^{\text{Risky}}} = \frac{100}{0.9} = 111.11,$$

$$\mathcal{B}_{t+1}^{\text{Risky}} = 111.11 < 115 = \mathcal{B}_{t+1}^{\text{Max}}.$$

- Thus, even if $Q_t^{\text{Risky}} = 0.9$, debt remains **below** $\mathcal{B}_{t+1}^{\text{Max}}$.

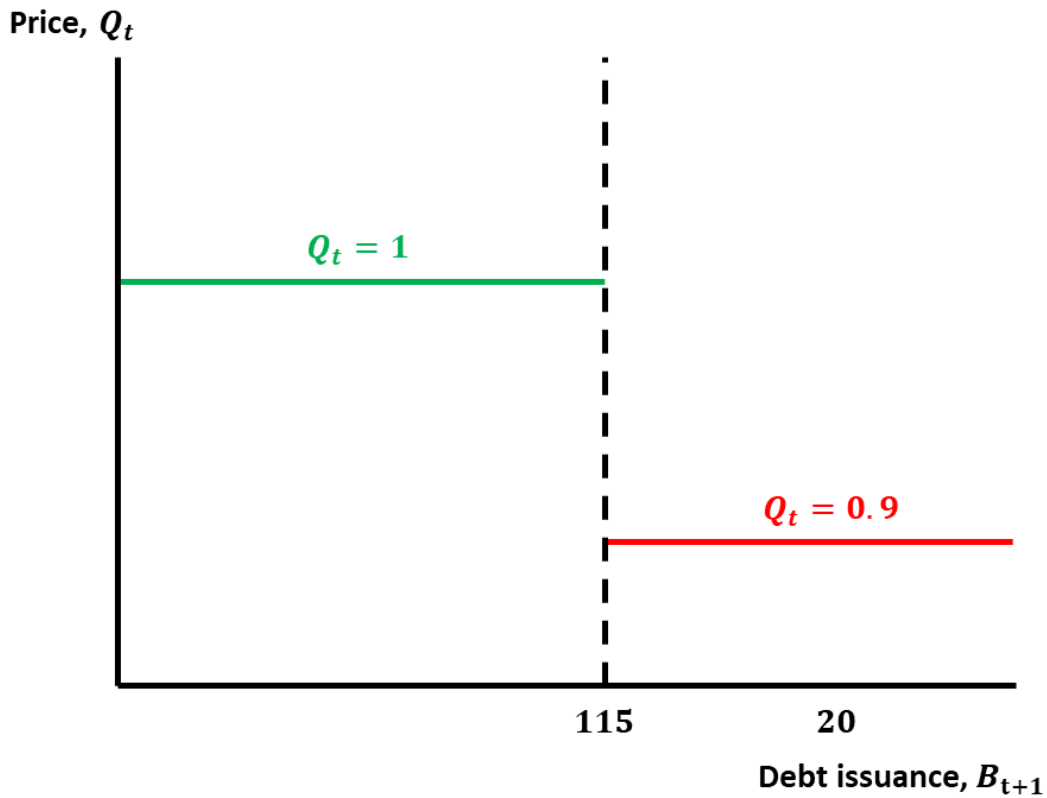
- Hence no default will occur in period $t+1$ and $Q_t^{\text{Risky}} = 0.9$ cannot be an equilibrium price (rational expectations).

- The **unique** equilibrium price is therefore $Q = 1$, with $\mathcal{B}_{t+1} = 100$.

Problem 1 (a) - Bond Price Schedule

- A discontinuity exists in the bond price schedule due to possibility of default.

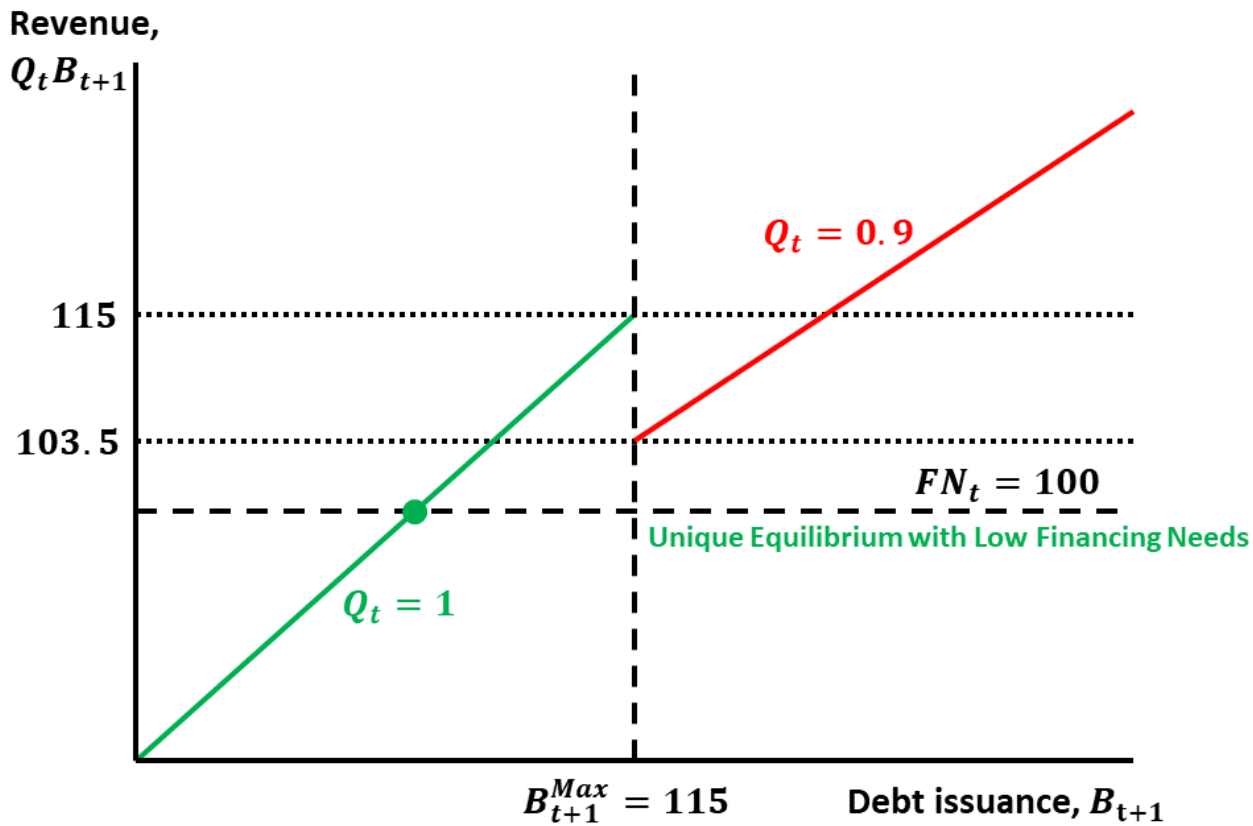
Bond Price Schedule



Problem 1 (a) - Bond Revenue Function

- FN_t always remain below the debt threshold, ensuring a **unique** equilibrium.

Bond Revenue Function



Problem 1 (b) - FN_{t+1}

- *(b) Given $\mathcal{B}_{t+1}$, focus now on the financing problem during period $t+1$. Assume that in that period the government runs a primary deficit equal to 5. At which price will the government be able to borrow?*

- In period $t+1$, government FN now comprises (i) the debt issued in the previous period, $\mathcal{B}_{t+1} = 100$, and (ii) the new primary deficit which we are told is $G_{t+1} - T_{t+1} = 5$.

$$FN_{t+1} = Q_{t+1}\mathcal{B}_{t+2} = G_{t+1} - T_{t+1} + \mathcal{B}_{t+1} = 100 + 5 = 105.$$

Problem 1 (b) - Uniqueness

- Repeating the exercise above we observe that now:

$$FN_{t+1} = Q_{t+1}\mathcal{B}_{t+2}, \quad \rightarrow \quad \mathcal{B}_{t+2}^{\text{Risky}} = \frac{FN_{t+1}}{Q_{t+1}^{\text{Risky}}} = \frac{105}{0.9} = 116,$$

$$\mathcal{B}_{t+2}^{\text{Risky}} = 116 > 115 = \mathcal{B}_{t+2}^{\text{Max}}.$$

- In period $t+1$, because of the primary deficit, if investors set $Q_{t+1}^{\text{Risky}} = 0.9$, debt rises above the default threshold.

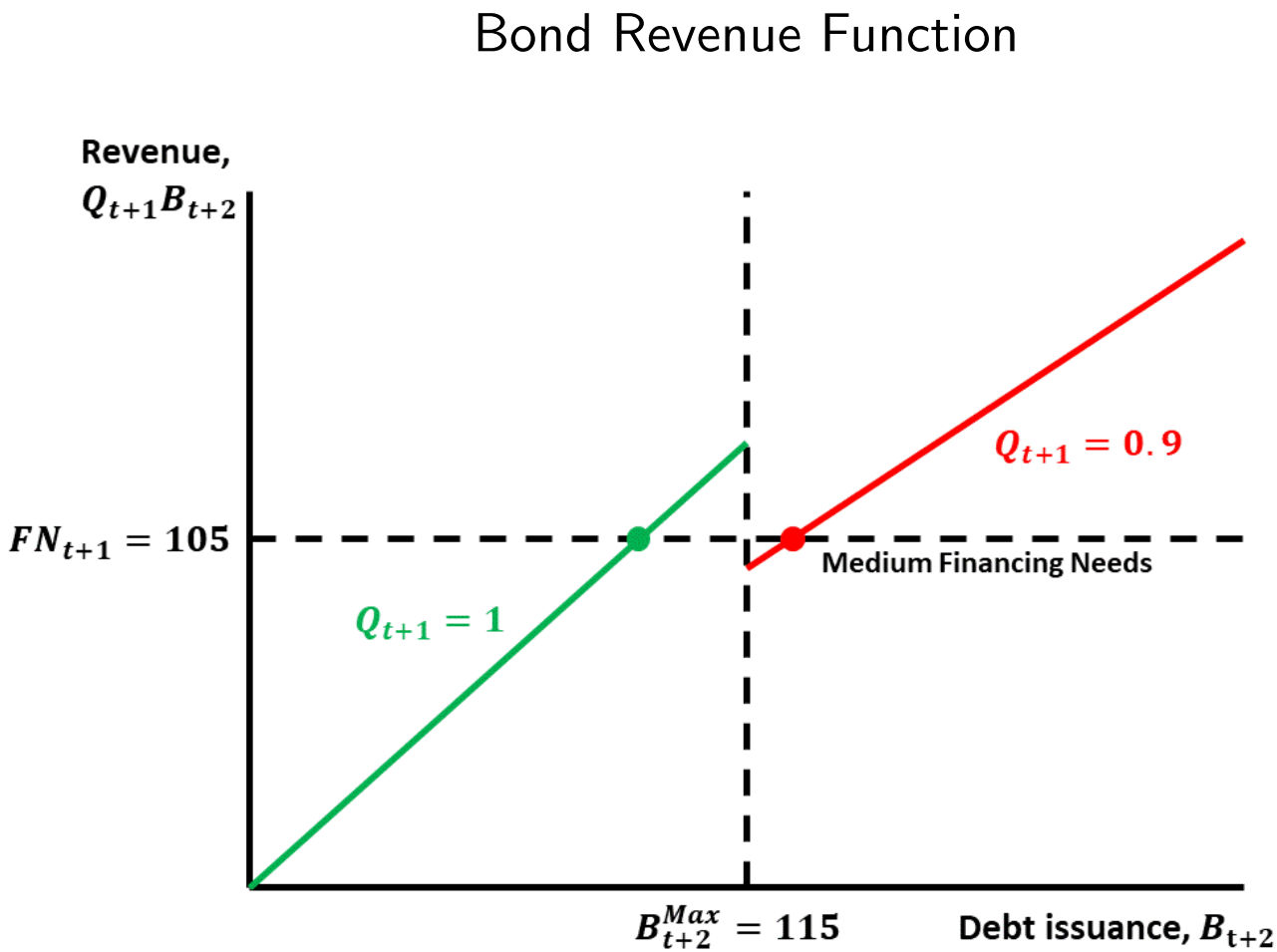
- Expectations of default can then become **self-fulfilling**. Note that, if market coordinates their expectations with $Q_{t+1}^{\text{Safe}} = 1$ these expectations would also be **self-fulfilling** since:

$$\mathcal{B}_{t+2} = \frac{105}{1} = 105 < 115 = \mathcal{B}_{t+2}^{\text{Max}}$$

- Therefore the equilibrium price is **no longer unique**.

Problem 1 (b) - Bond Revenue Function

- In period $t+1$ financing needs are higher, leading to multiple equilibria.



Problem 1 (c) - FN_{t+1} with IF

- *(c) Suppose that in each period an International Lender of Last Resort (IF) stands ready to buy* $\mathcal{B}^{IF}_{t+2} = 20$ *of government bonds at the price* $Q^{IF}_{t+1} = 1$*. How would your answer to point part (b) above change?*

- When the International Fund stands ready to buy $\mathcal{B}^{\text{IF}}_{t+2} = 20$ of government bonds the price $Q^{\text{IF}}_{t+1} = 1$, the government budget constraint may now be written as:

$$\begin{aligned} FN_{t+1} = 105 &= Q^{\text{Market}}_{t+1}\mathcal{B}^{\text{Market}}_{t+2} + Q^{\text{IF}}_{t+1}\mathcal{B}^{\text{IF}}_{t+2}, \\ &= Q^{\text{Market}}_{t+1}\mathcal{B}^{\text{Market}}_{t+2} + 20. \end{aligned}$$

Problem 1 (c) - Uniqueness with IF

- Suppose investors offer the risky price, $Q^{\text{Market}} = 0.9$:

$$\mathcal{B}_{t+2}^{\text{Market}} = \frac{105 - 20}{Q_{t+1}^{\text{Market}}} = \frac{85}{0.9} = 94.44.$$

- Market purchases 94.44 of debt to satisfy FN_{t+1}.

- Total **overall** debt stock also includes bonds purchased by IF:

$$\mathcal{B}_{t+2}^{\text{Market}} + \mathcal{B}_{t+2}^{\text{IF}} = 94.44 + 20 = 114.44 < 115 = \mathcal{B}_{t+2}^{\text{Max}}.$$

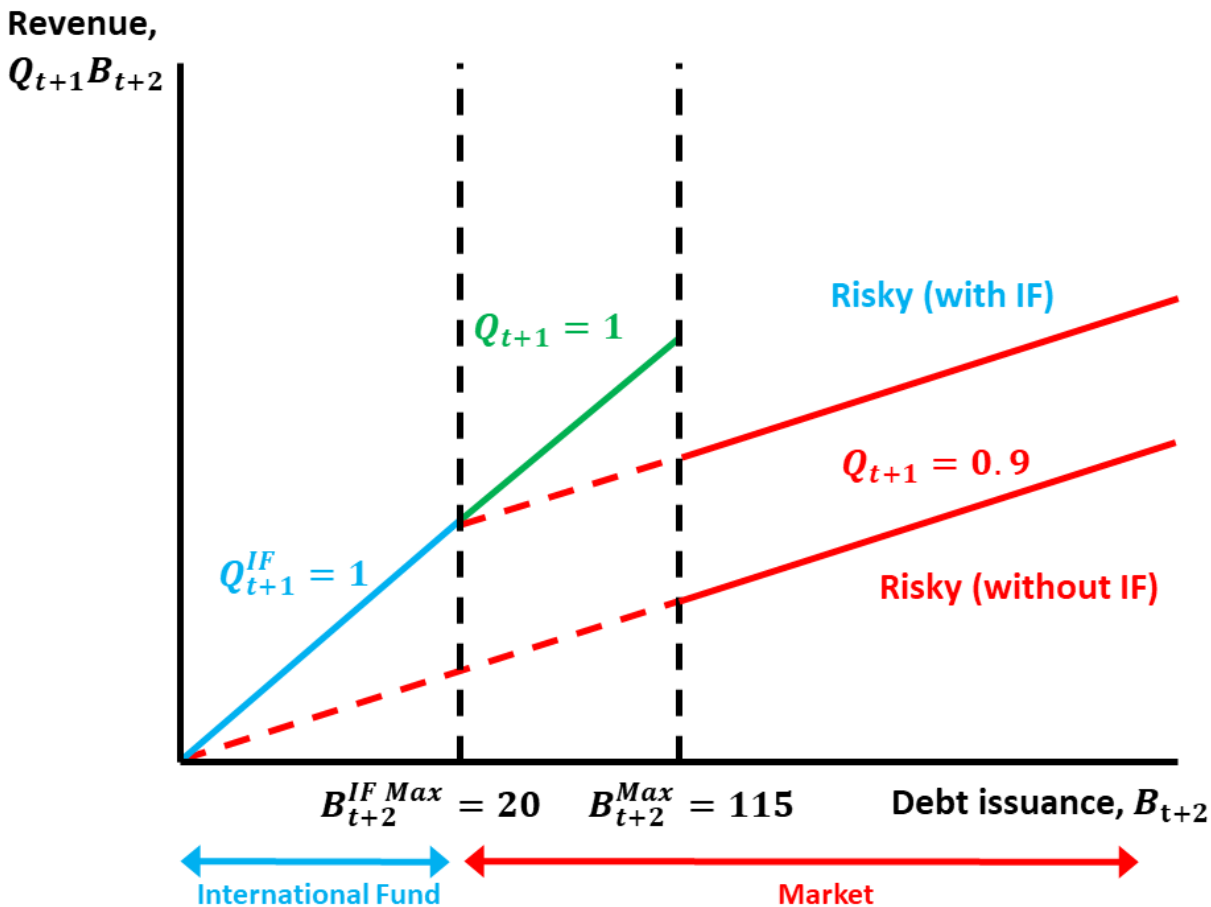
- Overall debt remains just below the debt threshold, and the equilibrium price is therefore **unique** at $Q_{t+1}^{\text{Safe}} = 1$.

- **Key result**: sufficiently large prospective purchases by IF may "eliminate the bad equilibrium." Why?

Problem 1 (c) - Bond Revenue Function, with IF I

- As $Q^{\text{IF}}_{t+1} = 1$ government first sells to IF, then market.

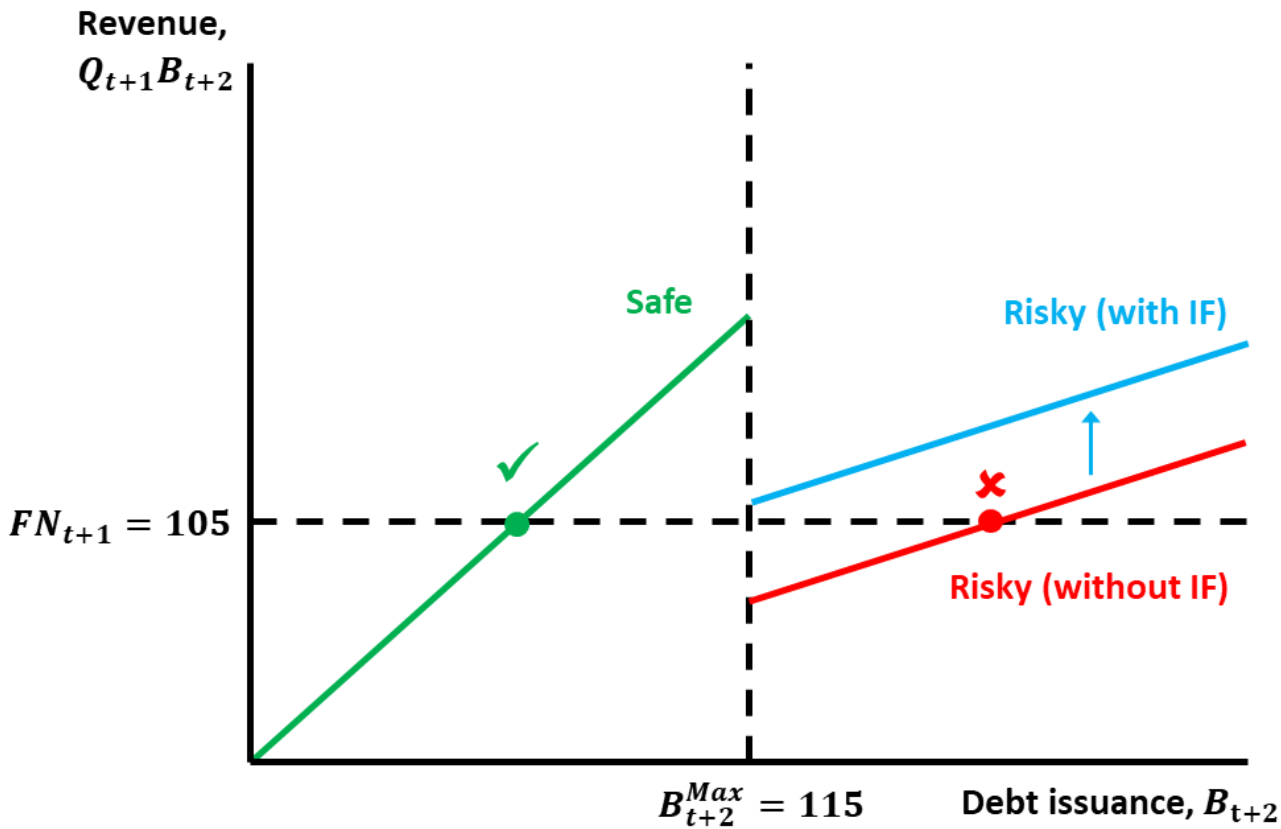
Construction of Bond Revenue Function, with IF



Problem 1 (c) - Bond Revenue Function, with IF II

- Average price of debt rises, eliminating "bad equilibrium".

Bond Revenue Function, with IF



Problem 1 (d) - Higher Deficit (Fundamental Default)

- *Reconsider the your answers to parts (b) and (c) above. Assuming that the primary deficit in period $t+1$ is 20, instead of 5. Should the International Lender of Last Resort intervene in this case? Discuss.*

- Government's FN_{t+1} are now:

$$FN_{t+1} = Q_{t+1}\mathcal{B}_{t+2} = G_{t+1} - T_{t+1} + \mathcal{B}_{t+1} = 100 + 20 = 120,$$

- Implies that $\mathcal{B}_{t+2}$ stock will grow above the threshold, $\mathcal{B}^{\text{Max}}_{t+2}$, even if investors purchased bonds at the default-free price:

$$\mathcal{B}_{t+2} = \frac{120}{1} = 120 > 115 = \mathcal{B}^{\text{Max}}_{t+2},$$

$$\mathcal{B}_{t+2} = \frac{120}{0.9} = 133.33 > 115 = \mathcal{B}^{\text{Max}}_{t+2}.$$

- The equilibrium bond price is therefore unique, and equal to $Q^{\text{Risky}}_{t+1} = 0.9$.

Problem 1 (d) - No Motive for IF Intervention

- Still ready to buy $\mathcal{B}^{\text{IF}}_{t+2} = 20$ at price $Q^{\text{IF}}_{t+1} = 1$. Thus:

$$\begin{aligned} FN_{t+1} = 120 &= Q^{\text{Market}}_{t+1}\mathcal{B}^{\text{Market}}_{t+2} + Q^{\text{IF}}_{t+1}\mathcal{B}^{\text{IF}}_{t+2}, \\ &= Q^{\text{Market}}_{t+1}\mathcal{B}^{\text{Market}}_{t+2} + 20, \end{aligned}$$

$$\text{which implies:} \quad \mathcal{B}^{\text{Market}}_{t+2} = \frac{120 - 20}{Q^{\text{Market}}_{t+1}} = \frac{100}{0.9} = 111.11.$$

- Despite intervention total debt stock **remains above** $\mathcal{B}^{\text{Max}}_{t+2}$:

$$\mathcal{B}^{\text{Market}}_{t+2} + \mathcal{B}^{\text{IF}}_{t+2} = 111.11 + 20 = 131.11 > 115 = \mathcal{B}^{\text{Max}}_{t+2}.$$

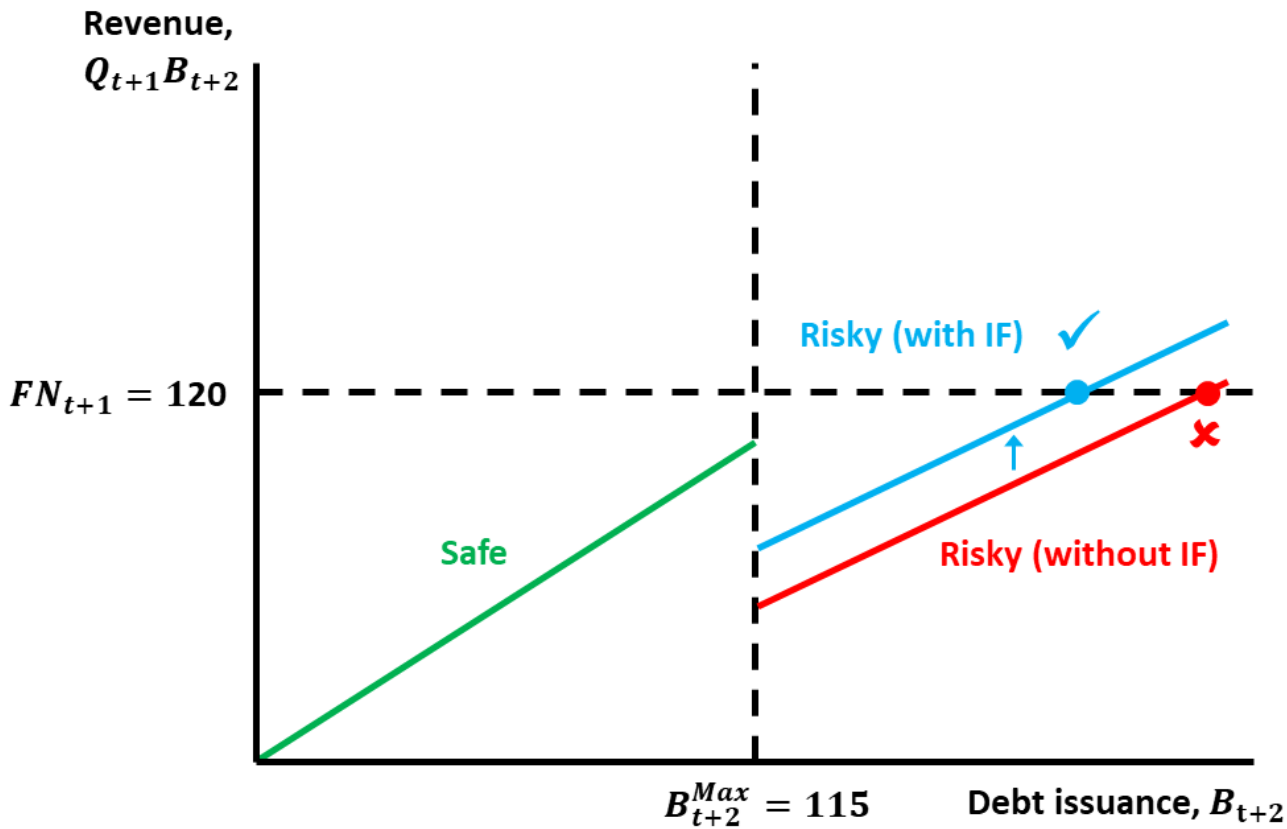
- **Unique equilibrium** price remains $Q^{\text{Risky}}_{t+1} = 0.9$.

- Key motivation for interventions by an IF no longer exists as investors are pricing "correctly".

Problem 1 (d) - No Motive for IF Intervention

- "Bad equilibrium" not eliminated after IF intervention.

New Bond Revenue Function, with IF



Problem 1 (e) - An Extension Question

- *(e) Is the involvement of the central bank in the sovereign debt market under part (c) bound to result in high inflation?*

- Assume domestic Central Bank (CB) replaces the IF in (c).

- CB interventions can eliminate the "bad equilibrium". The market price of debt will also be the default-risk free price:

$$Q_{t+1}^{\text{Market}} = Q_{t+1}^{\text{CB}} = 1.$$

- All bond holders pay the same price = price of CB liabilities.

- In period $t+2$, the government will **repay all bond holders in full**, including the central bank.

- Therefore **no possibility** of losses forcing the CB to raise seigniorage or inflation.

Problem 2: Debt Relief and Debt Overhang.

Problem 2 - Set Up

- *A country has a one-period external debt with face value equal to \$100. Debt is risky in the sense that the country is able to repay the full amount \$100 only if the economy is in a "good" state. In a "bad" state of nature, investors know that the country will only be able to pay \$25. The probability that the country will be in a "good" state is 1/3.*
- *(a) Assuming that international investors (the creditors) are risk neutral, calculate the secondary market price of debt.*
- Initially, the expected repayment is given by:

$$\$100 \times \frac{1}{3} + \$25 \times \frac{2}{3} = \$150/3 = \$50.$$

- As investors are **risk neutral**, the secondary market price is:

$$\frac{\text{Expected Repayment}}{\text{Face Value}} = \frac{\$50}{\$100} = 0.50.$$

Problem 2 (b) - Set Up

- *It is common knowledge that reducing total debt will improve the performance of the country. Namely, reducing debt from \$100 to \$80 at face value will raise the probability of the good state from 1/3 to 1/2. The government, the creditors and an international agency are contemplating different strategies to reduce debt.*

- *(b) Contrast the effects of the following strategies on the expected repayments and the secondary market price of debt:*

  1. *The creditors forgive debt for \$20 (at face value)*;

  2. *An international institution buys back from investors and forgives debt for \$20 at face value. It purchases bonds at the equilibrium secondary market price.*

Problem 2 (b.1) - Debt Forgiveness

- When country is forgiven \$20 of outstanding debt, the debt Laffer curve increases the probability of the high state to $\frac{1}{2}$. Expected repayments to investors thus rise to:

$$(\$100 - \$20) \times \frac{1}{2} + \$25 \times \frac{1}{2} = \$40 + \$12.50 = \$52.50.$$

- This increases the secondary market price of debt to:

$$\frac{\text{Expected Repayment}}{\text{Face Value}} = \frac{\$52.5}{\$80} = 0.656...$$

- Creditors benefit from a larger expected cash flow (\$52.50 instead of \$50, so +\$2.50).

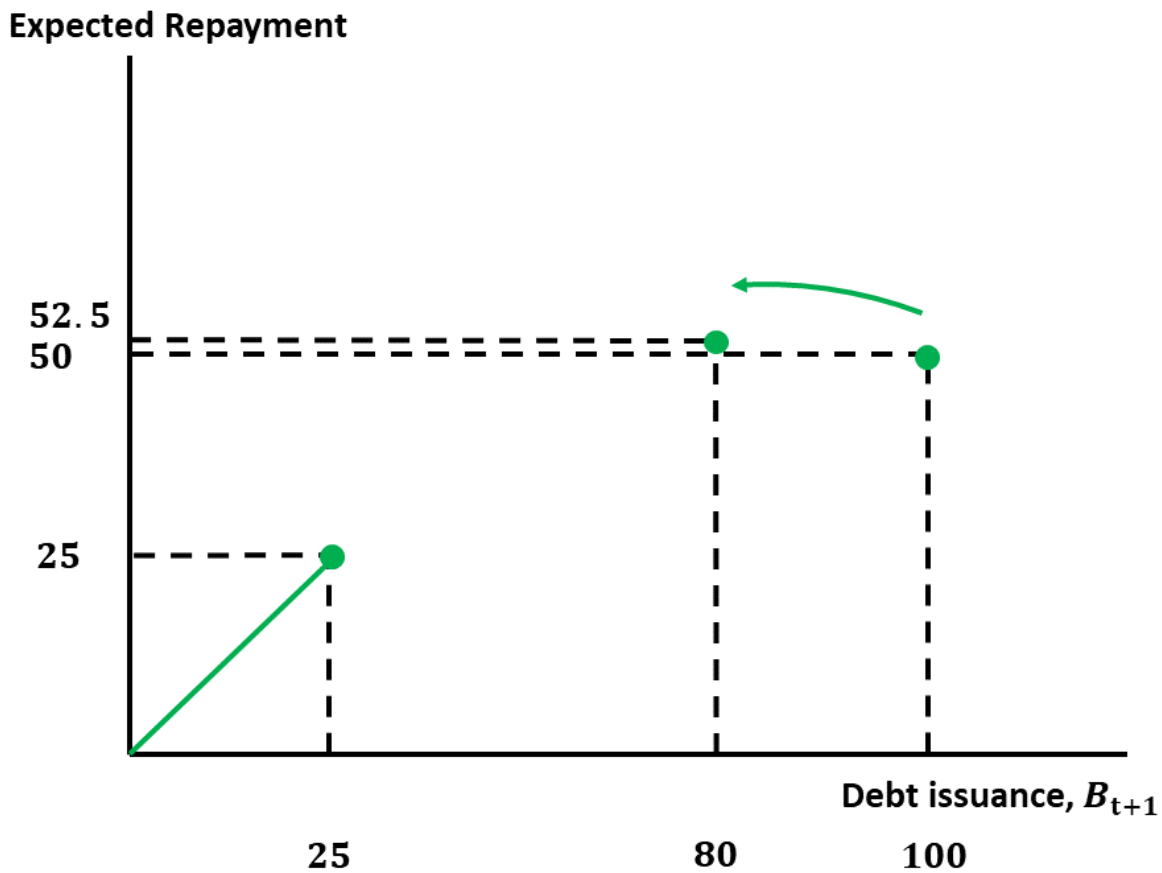
- Debtor country expects to pay \$2.50 more, though also benefits from higher probability of being in "good" state.

- **Free-rider** problem may mean forgiveness is not possible without a CAC.

Problem 2 (b) - An Aside: Debt Laffer Curve I

- This much we know for certain.

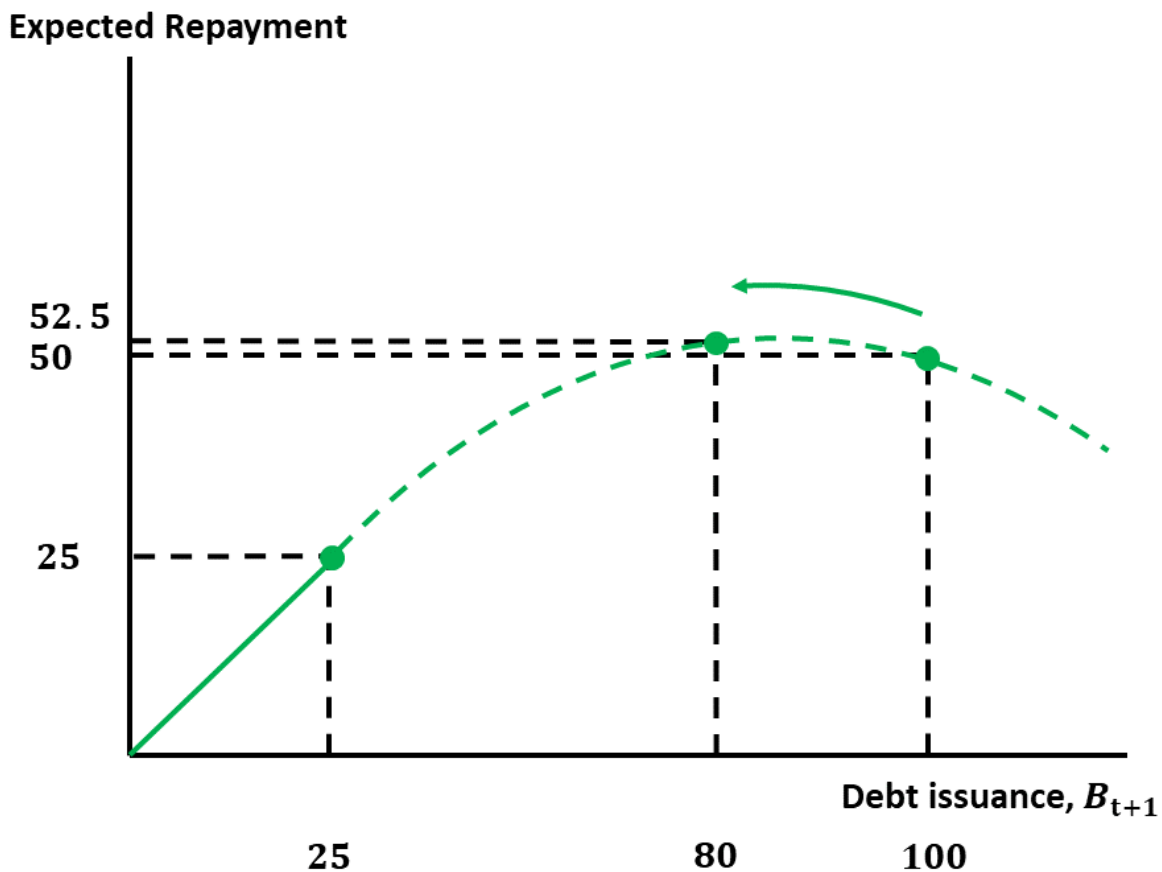
Debt Laffer Curve



Problem 2 (b) - An Aside: Debt Laffer Curve II

- If lowering debt gradually improves "good" state probability.

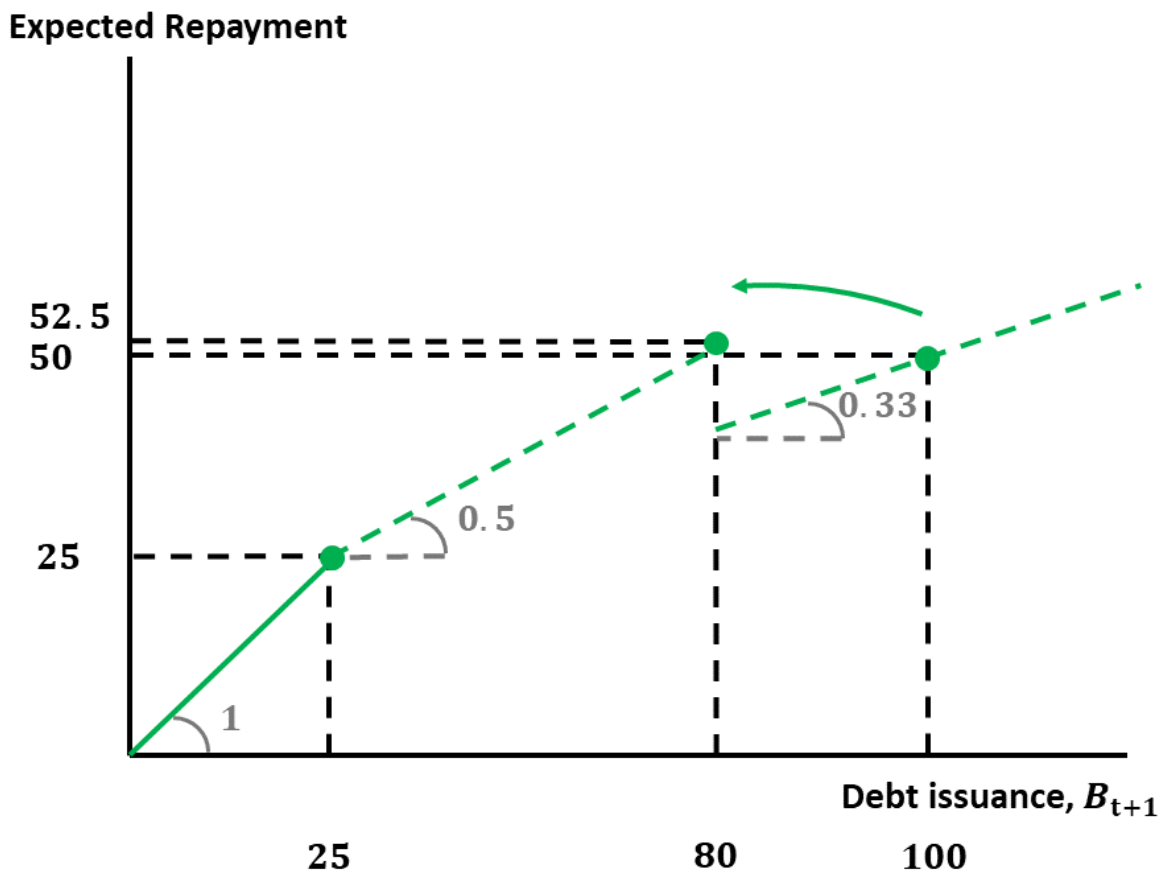
Continuious Debt Laffer Curve



Problem 2 (b) - An Aside: Debt Laffer Curve III

- Alternatively, could be a discrete jump.

Discrete Debt Laffer Curve



Problem 2 (b.2) - Debt Buyback

- Upon announcement of IF buy-back the secondary market price immediately jumps to its new equilibrium value, 0.656, as anticipation of IF forgiveness increases expected repayment. Buy back cost for IF is then:

$$\$20 \times 0.656 = \$13.125.$$

- This is more expensive than pre-announcement price (which would also arise with IF purchases but no forgiveness):

$$\$20 \times 0.50 = \$10.$$

- Creditors get $+\$13.125$ from selling \$20 units to IF and still expect \$52.50 from remaining debt holdings after forgiveness. Relative to initial expected repayment, \$50, they gain:

$$+\$13.125 + \$52.50 - \$50 = \$15.625.$$

- Expected payments from debtor country rise as before.

Problem 2 (c) - Welfare Analysis

- *(c) Discuss costs and benefits of each strategy for the government, the creditors and the international agency.*

- Debtor country has **no clear preference** as expected financial payments and the macro benefits from reducing the debt burden are identical under both schemes.

- Creditors are better off under both schemes, but **prefer debt buyback**, as in this case they also benefit from extra cash used by the IF to buy debt.

- IF is clearly worse off under the debt buyback, but may face welfare losses against its objective function if cannot persuade creditors to undertake forgiveness (free-rider problem).

Problem 2 (d) - Set-Up

- *The government of the country proposes a "debt swap." Investors are given the option to exchange existing bonds with new "safe" debt at a non-negotiable predetermined rate. The new bonds have seniority (will be paid first) and their issuance is capped to make sure that they will always be paid out at face value. While a swap is usually detrimental to creditors, the government claims that the swap will actually favour them, because by reducing debt overhang, it will raise the probability of the good state from 1/3 to 1/2.*

- *(d) Calculate the swap rate, the stock of old debt that remains in the market after the swap, and the gains/costs for the debtor and the creditors, assuming that the swap will indeed raise the probability of the good state. Will creditors oppose the debt swap?*

Problem 2 (d) - Debt Swap

- Government may issue \$25 units of the new (senior) debt as this is the maximum which may **always** be repaid.
- Price of old (junior) debt depends on expected payment in the **"good state"** divided by its face value. Junior debt is worthless in the "bad" state as only senior debt is repaid:

$$\frac{\frac{1}{2} \cdot \text{Face value of remaining old debt stock} + \frac{1}{2} \cdot 0}{\text{Face value of remaining old debt stock}} = 0.5.$$

- As price of senior debt is clearly 1, this infers a 2:1 swap rate, exchanging 2 units of junior debt for 1 unit of senior.
- Thus $2 \times \$25 = \$50$ units of old (junior) debt removed.
- The remaining \$50 units will give the owners a positive claim **only in the good state of nature**.
- **Check**: Final outstanding debt (junior + senior) $= \$75 < \$80$, so justified in using $\frac{1}{2}$ as probability of "good" state.

Problem 2 (d) - Welfare

- Expected cash flow calculated at new probabilities.

- Old debt pays \$50 in the high state only, while the new debt pays \$25 in both states of nature. Hence:

$$\mathbb{E}[\text{Cash Flow}] = (\$25 + \$50) \times \frac{1}{2} + \$25 \times \frac{1}{2} = \$50.$$

- Creditors are **indifferent** to the swap, and will not oppose it.

- Expected payments from the debtor country remain \$50, but again some off model benefits may arise.

- This solution may appeal to IF, as probability of "bad" state is lower, **without using own funds**.

Problem 2 - Summary Table

- The expected **financial** payoffs to each stakeholder are:

Stakeholder	Forgiveness	Buyback	Swap
Debtor	-2.50	-2.50	0
Creditor	$+2.50$	$+15.625$	0
IF	0	-13.125	0

- Also require some (not modelled) **non-financial** payoffs:
  - Debtor would not agree to forgiveness or buyback unless benefits from moving to the "good" state (GDP $\uparrow$ or u/e $\downarrow$).
  - IF would not agree to buyback unless benefits from moving to the "good" state (e.g. lower risk of contagion other countries).

Essay 1: The Costs of Incomplete Monetary Union.

Essay 1 - Set Up

- *Briefly discuss which lessons can be drawn from the recent experience of the euro area, concerning the risks of joining a monetary union. In your answer, assess the role, if any, of the institutional framework of the euro, in exacerbating the transmission of the global crisis.*

- Key questions this essay should answer:
  - In general, what are the costs of a currency union?
  - What is an optimal currency area?
  - How does the euro area compare?
  - Specifically, did European institutions exacerbate the global financial crisis?

Essay 1 - What are the Costs of a Currency Union?

- In a currency union member states **forego autonomous monetary policy** and the **flexibility** of an exchange rate margin of adjustment.

- Traditional theory (Mundell, 1961) states this can be more or less consequential for an economy depending on whether:

  1. Shocks are **symmetric**.
     - Ex-ante, exogenous symmetry.
     - Ex-post, flexible prices and/or mobile factors of production.
  2. Policy can respond efficiently.
     - Unconstrained fiscal space.
     - Diversified income risk (insurance policies).

Essay 1 - What is an Optimal Currency Area? (US)

- An optimal currency area would fulfil all these criteria.

1. Not even fully satisfied by the US:
   - Shocks are not necessarily symmetric across states and regions.
   - Prices and wages are not necessarily fully flexible.
   - Local business cycles, despite high factor mobility.
2. Yet federal budget and integrated capital markets:
   - **Risk sharing** across states.
   - Resident households/firms insulated from state-wide shocks. High local governments risk premia have limited spillovers to residents.
   - Few state bonds issued, but large, liquid market for safe USTs.

Essay 1 - How Does the Euro Area Compare?

- The EA experience since GFC is quite different.

1. Persistent differences across EA states:
   - Lower factor mobility to start with.
2. Large differences as a result of sovereign risk:
   - **No risk sharing** across states.
   - **No insulation** for domestic residents. Borrowing costs reflected EA breakup risks and diverged across EA.
   - Deep fragmentation between "core" and "periphery".

Essay 1 - Summary

- Organising these thoughts in a table:

Theoretical Requirements	US	EA
Exogenous symmetry	✗	✗
Flexible Prices	✗	✗
Mobile Factors of Production	Limited (✓)	✗
Fiscal space	Limited (✓)	✗
Diversified Income Risk	Limited (✓)	✗

Essay 1 - Did EA Institutions Exacerbate the GFC?

- Fragmentation costs reduced **monetary policy** effectiveness:
  - Borrowing rates continued to reflect country-risk, and interest rate cuts (and other policy) were **not fully transmitted**.
  - Union level disagreement of appropriate monetary stance.
- Fragmentation costs reduced **fiscal policy** effectiveness:
  - High-risk countries needed to adopt austerity during downturn.
  - Low-risk countries incentivised similarly to retain low-risk status.
- Slow aggregate EA recovery, with **insufficient** policy support.
- Heavily asymmetric debt distribution and financial fragmentation **continues today**.

Essay 1 - What was Missing?

- In short, a public debt **backstop**. See Draghi's Jackson Hole 2014 Speech.
- Lost in translation when transferring monetary policy from national authorities to the ECB.
- Took until September 2012, for ECB to put the Outright Monetary Transactions (OMTs) programme in place.
- To address moral hazard (default costs arising at union level, while decisions taken locally), OMTs only activated if the country is in a ESM programme (thus subject to conditionality).
- Also **banking union** to streamline financial regulation across EA. Since 2014 SSM/SRM for Supervision and Resolution.

Essay 2: International Financial Institutions.

Essay 2 - Set Up

- *Write a synthetic essay discussing how the behaviour of international financial intermediaries may have exacerbated financial fragility and may have amplified the real effects of the global financial crisis. List and discuss the main lessons for policies and institutions pursuing the stability and efficiency of the international monetary and financial system.*

- Key questions this essay should answer:
  - What is the "leverage cycle"?
  - What is a "diabolic loop"?
  - What are the main lessons?

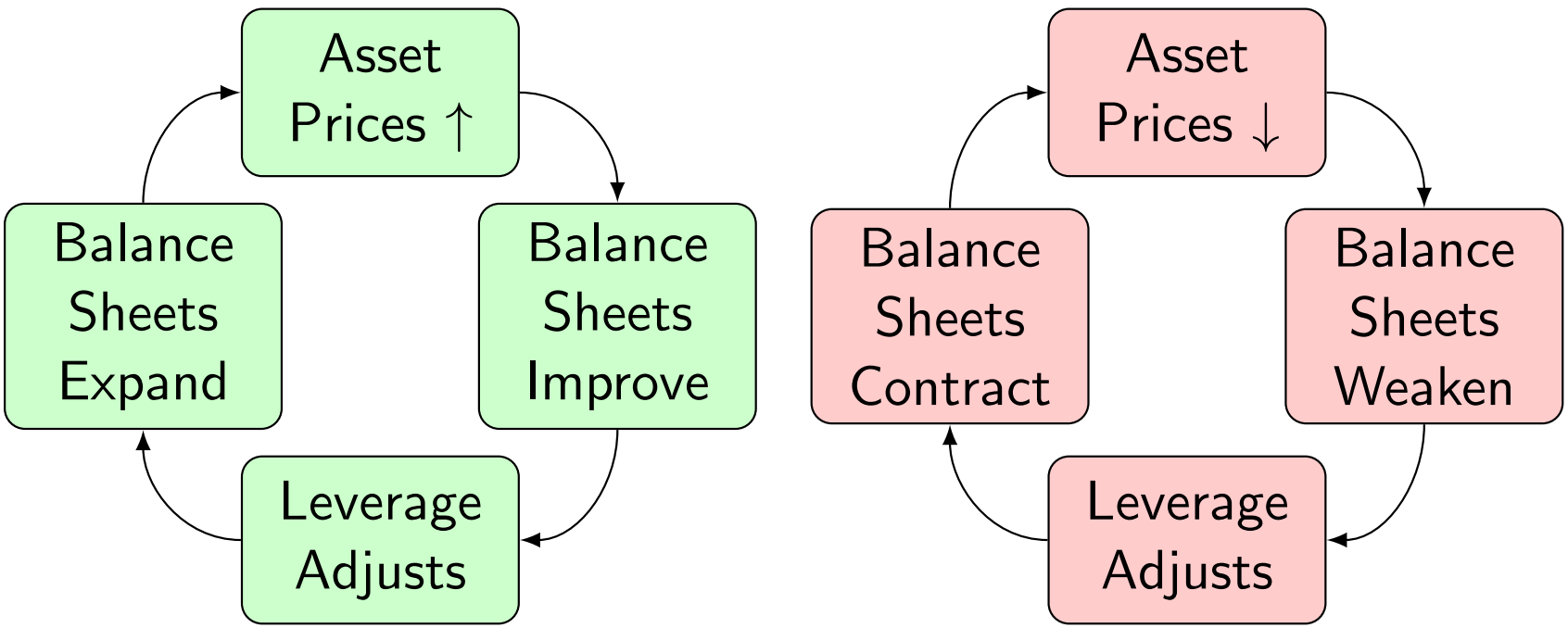
Essay 2 - What is the "Leverage Cycle"? I

- Adrian and Shin (2010) data suggest leverage is:
  - Acyclical for commercial banks.
  - Pro-cyclical for investment banks.
  - Countercyclical for households.
- Financial intermediaries thus target constant or pro-cyclical leverage ratio.
- Given initial asset price change, leverage targets imply a cycle.

Essay 2 - What is the "Leverage Cycle"? II

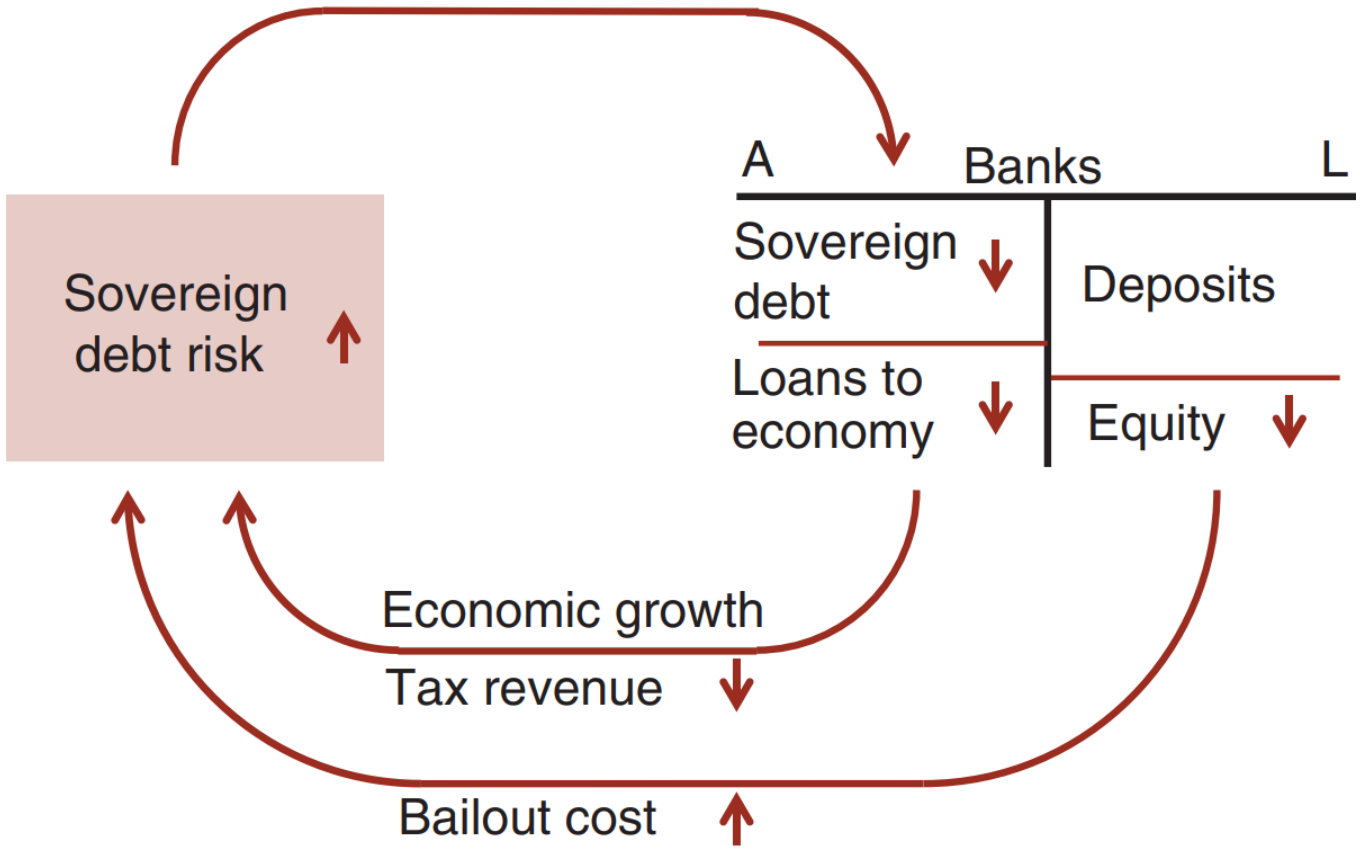
- **Key point**: Asymmetry between cycles as in downturn a fall in asset prices may remove all equity causing bankruptcy.

- During "good times" leverage increases, gradually reducing loss absorption capacity.



Essay 2 - What is a "Diabolic Loop"? I

- Banking and sovereign risks may endogenously **interact**.
- A fragile banking system **amplifies** sovereign risk.
- Can you explain the diagram below?



Source: Brunnermeier et al (2016), Figure 1.

Essay 2 - What is a "Diabolic Loop"? II

- Actually Brunnermeier et al (2016) say there are two loops:
  - Bailout loop.
  - Real-economy loop.
- Relevant since financial globalisation spurred excessive risk taking.
- Implicit guarantees to domestic financial institutions absorbing **foreign** risk diverged from **domestic** tax-base.

Essay 2 - What are the Main Lessons?

- **Swap lines** (in international reserve currency) to ease liquidity of foreign institutions (global banks).
- Benefits from cross-border asset diversification and banking integration are **limited** with high leverage.
- International financial architecture needed **reform** (via capital ratios, liquidity ratios). FSB/other regulators.

Next Class

Next Class

- We have one more class (next week).
- This will be a revision session, focussed on exam technique.
- In the meantime please attempt the suggested questions by the faculty, under exam style conditions.