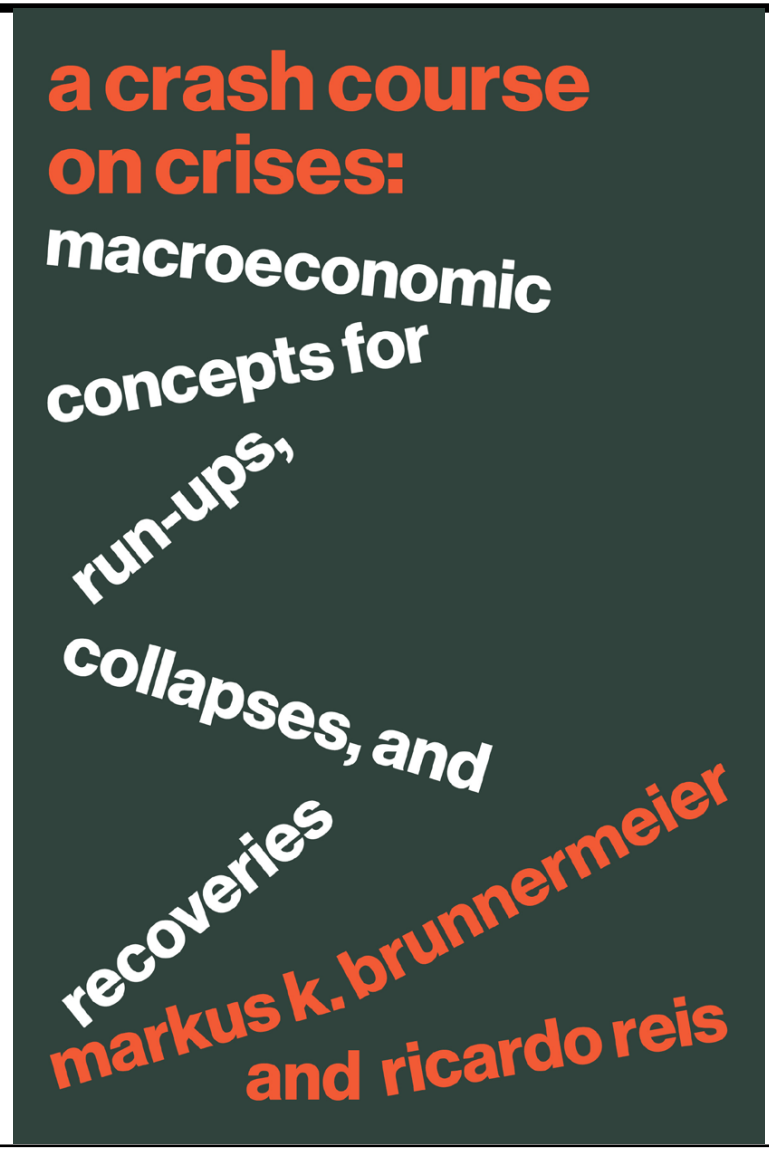
CHAPTER 6

SOLVENCY AND LIQUIDITY

Debt and the Challenging Illiquidity-Insolvency Distinction

The Run on the German Banking System in 1931

The Greek Sovereign Debt Crisis of 2010–12 and the IMF



DEBT CONTRACTS AND SOLVENCY

- Debt contracts: receive an amount now and promise to pay a fixed amount in future. They:
  - Allow lenders to exert discipline on borrowers because must be rolled over with some frequency
  - Save lenders the need to collect information on the exact payoffs of the borrower beyond their ability to meet the payments.
- **Solvent**: whether debtor has sufficient revenues in the present and future to repay the debt
- **Illiquid**: whether it can raise the funds to refinance the debt contracts coming due
- Future plays an important role in economic solvency:
  - Modern banks: high leverage means may have negative equity in present, but remain economically solvent by relying on future revenues to pay for the present debts
  - Sovereigns: only economic solvency is relevant as future tax and other fiscal revenues can be used to gradually pay down public debt.

SOLVENCY, FUTURE, AND THE INTEREST RATE

Solvency: whether the debtor has sufficient revenues in the present and future to repay the debt

- Future must be discounted by an interest rate to compare money then with money now. The interest rate used has large impact on solvency: the higher the interest rate, the less will future cash flows be worth.
- An economic institution with future revenues and debt will be insolvent at an arbitrarily high enough interest rate
- If the future cash flow is risky, the relevant discount rate is higher to reflect a risk premium
- With perfect and complete markets, there is a single interest rate which is relevant for determining solvency

FINANCIAL FRICTIONS AND ILLIQUIDITY

- In the presence of financial frictions, there may be multiple interest rates consistent with the institution being solvent

- For some interest rates, the institution can keep to its repayment schedule but for some others it does not have enough to pay the interest. Hence, they are solvent but illiquid
    - Even if discounted future cash flow is positive and fundamentals remains the same, financial frictions can make institutions unable to roll over their debt at a high enough interest rate

- The key diagnosis in a crisis is ability to distinguish between insolvent and illiquid institutions
    - Policy could potentially help in liquidity crisis

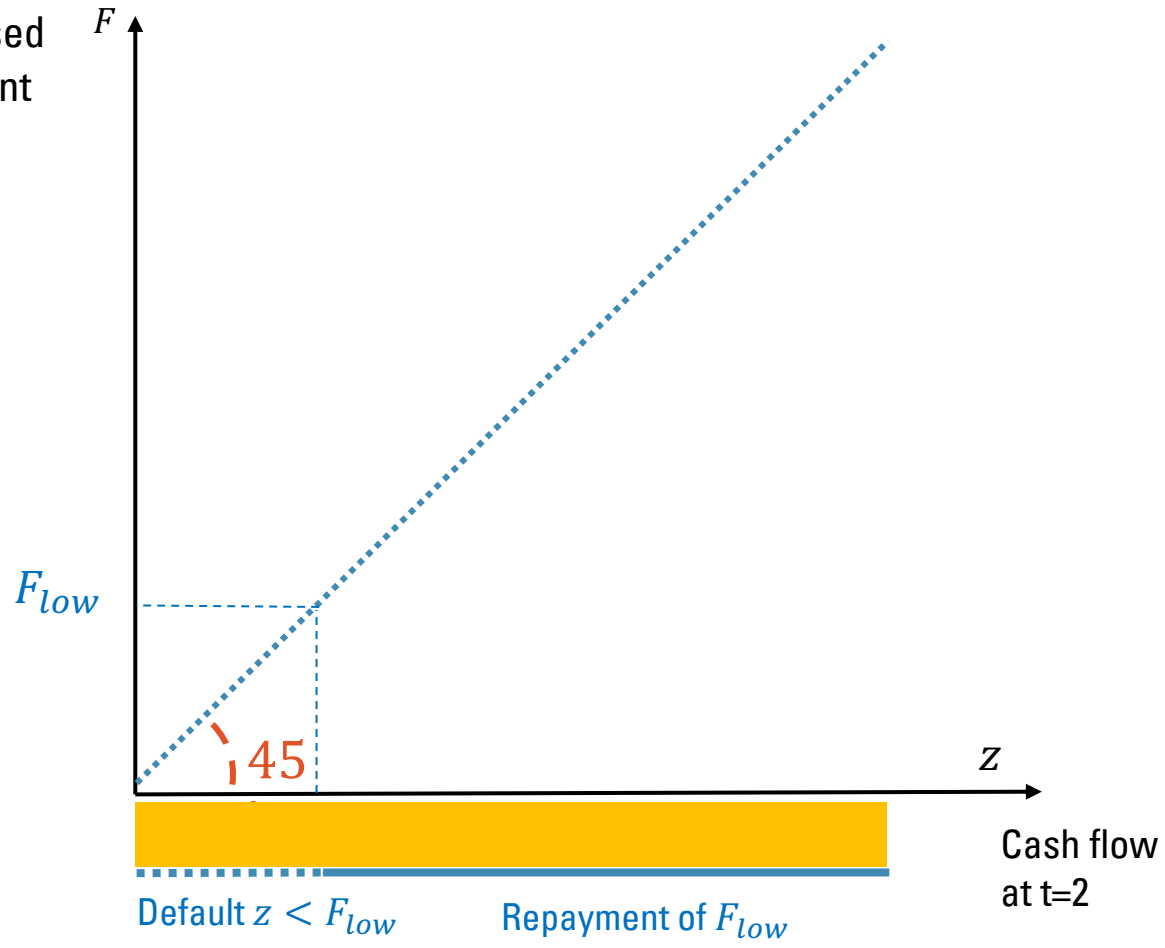
DEBT AND THE CHALLENING ILLIQUIDITY-INSOLVENCY DISTINCTION

A SIMPLE MODEL OF DEBT, SOLVENCY AND LIQUIDITY

- *Assume everyone is risk neutral and has no time-preference*
- Institution needs an amount q to finance a project with a future payoff of z
- The net return is then $z/q - 1$
- Suppose z is uncertain: it can randomly take any value between 0 and 1 with equal probability
- Expected value is 1/2 and the expected return is $1/(2q) - 1$
- With perfect markets, as long as the interest rate charged is below $1/(2q) - 1$, the institution is solvent

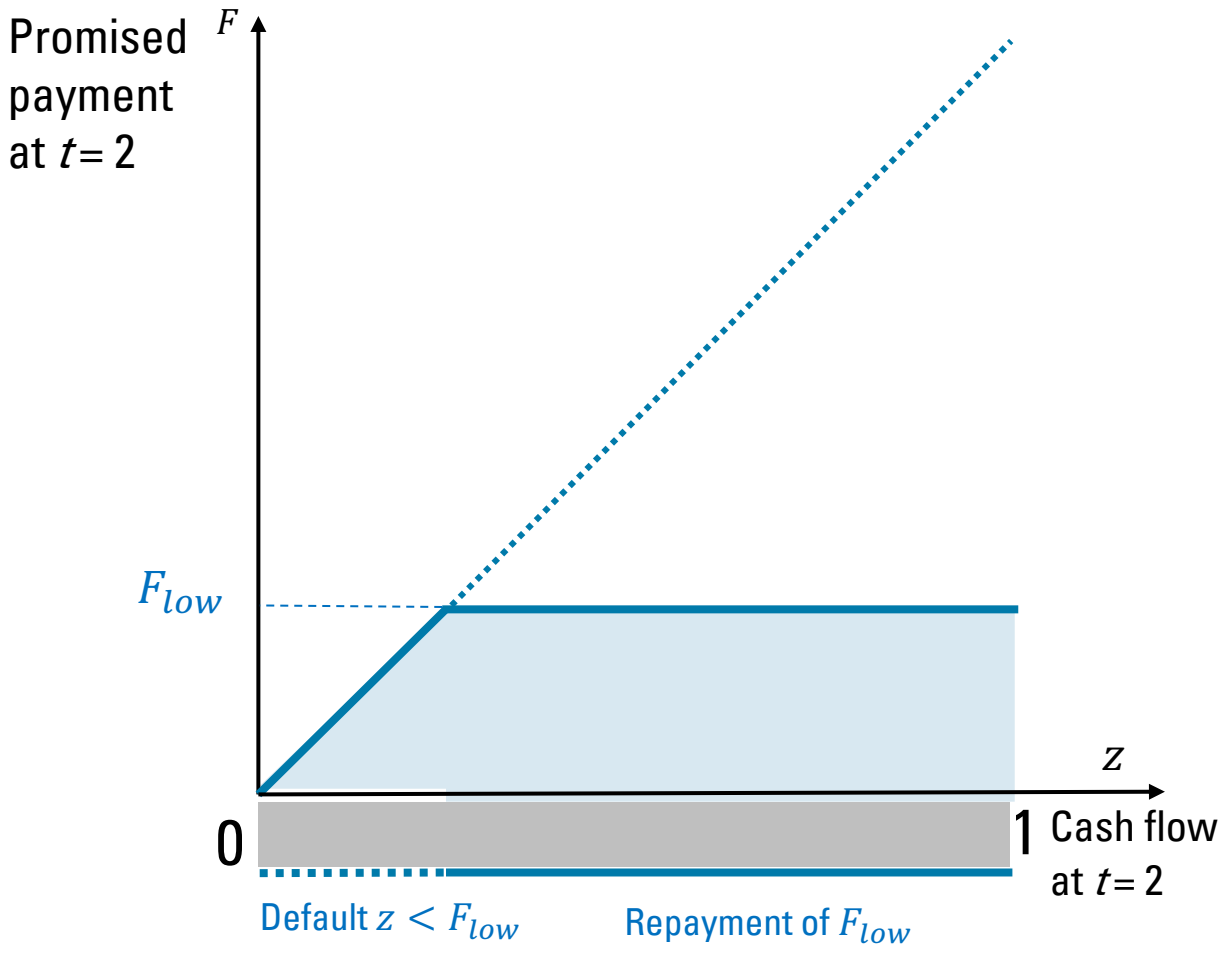
A SIMPLE MODEL: PERFECT MARKETS

- Debt contract: creditor gives amount q today, gets payment F in the future
- The institution can only issue debt contracts that may default
- If $z \geq F$, then repayment. Only F is paid to creditor and the rest is kept by institution as profits
- If $z < F$, then the most the institution can give is amount z



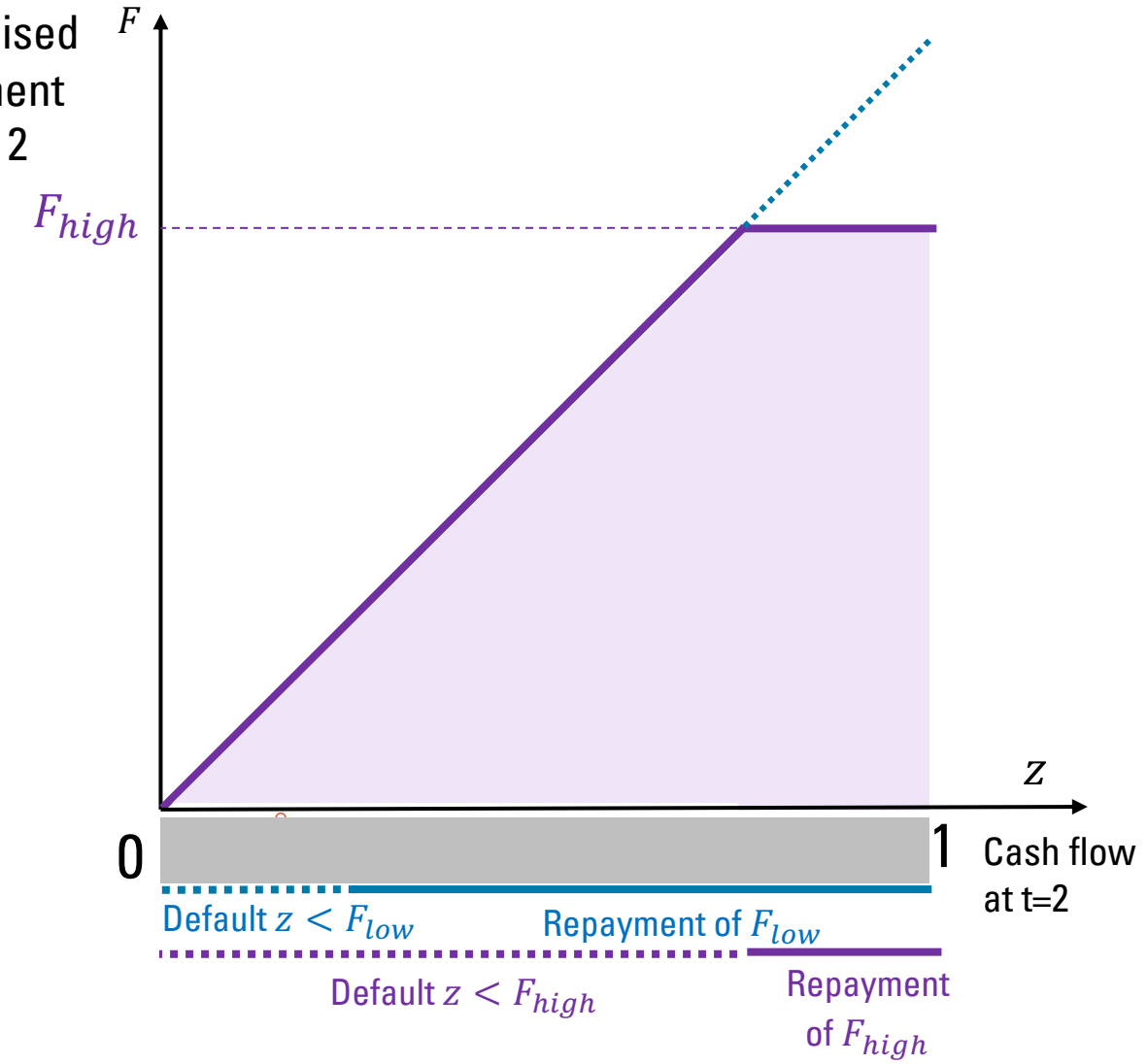
EXPECTED PAYMENT OF DEBT

- If the promised payment is F_{low} the payoff if the solid blue line
- When $z < F_{low}$, the payoff is the 45° line as the debt-holders get paid the whole residual value z of the project, which is below what was promised
- If $z \geq F_{low}$, then the payoff is the horizontal blue line
- The expected payment is $(1 - F)F + \frac{F^2}{2}$,or the sum of the shaded rectangle plus the triangle on its left



FACE VALUE AND EXPECTED PAYOFF

- Higher face value of debt F_{high}, the payoff is the solid purple line
- Payment is higher than F_{low} if get paid
- But get paid less than F_{high} often since default probability is greater
- Expected payment to creditor rises as the face value is higher. Creditors are better off to invest in projects with higher face value in terms of higher expected payment
- Maximum at F = 1, expected payment ½ (In this extreme case, debt holder becomes a de facto equity holder)



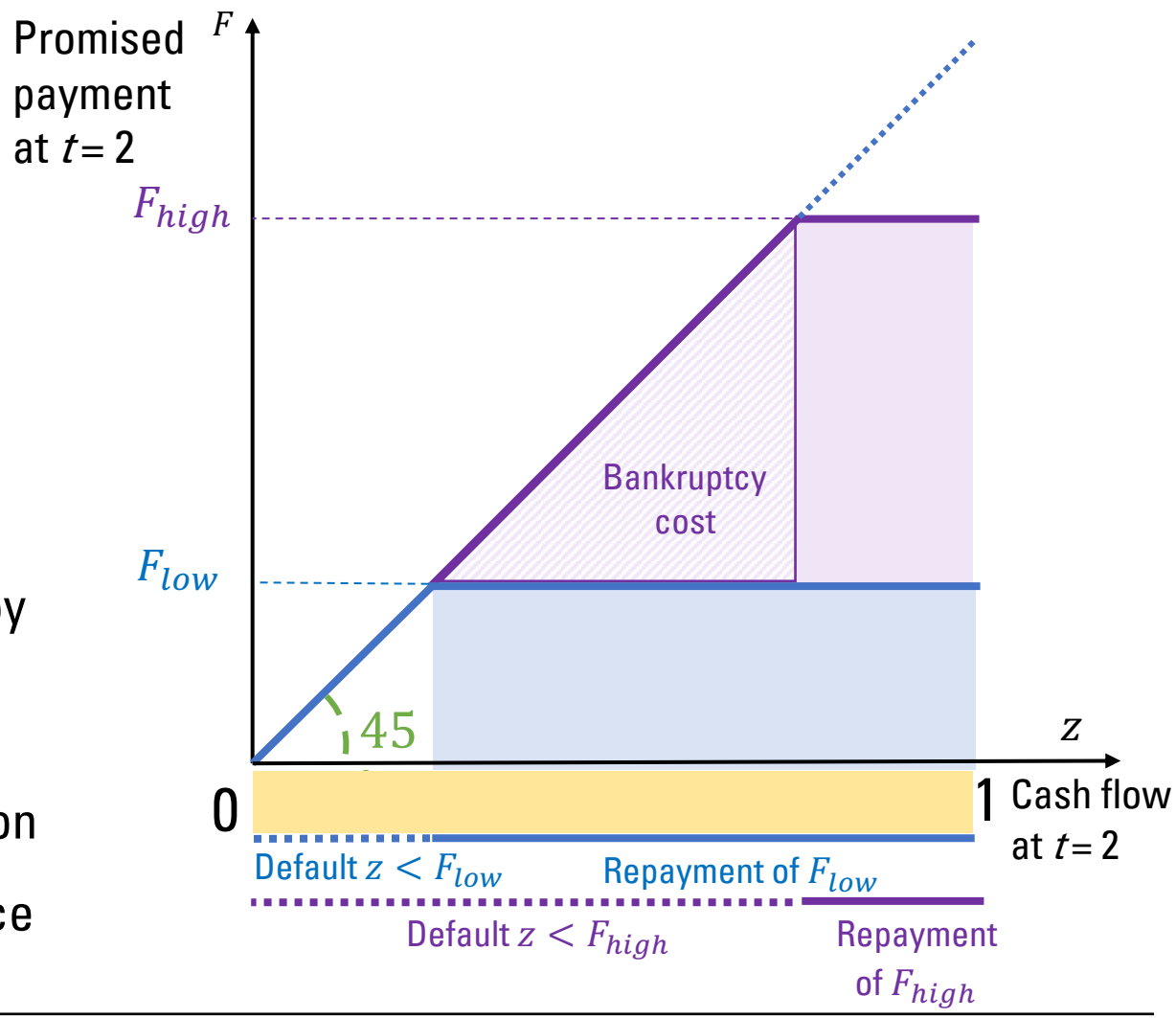
FINANCIAL FRICTIONS

- When a firm defaults, value is lost in that some of the payoff from the project disappears
- Insolvency is a costly process:
  - Lawyers
  - Bankruptcy court fees
  - Disgruntled borrowers tearing down the project before it is seized

- The creditor can no longer seize as much future payoff z as possible from the institution
- For simplicity, assume that *triggering default always leads to losing the whole value of the project*

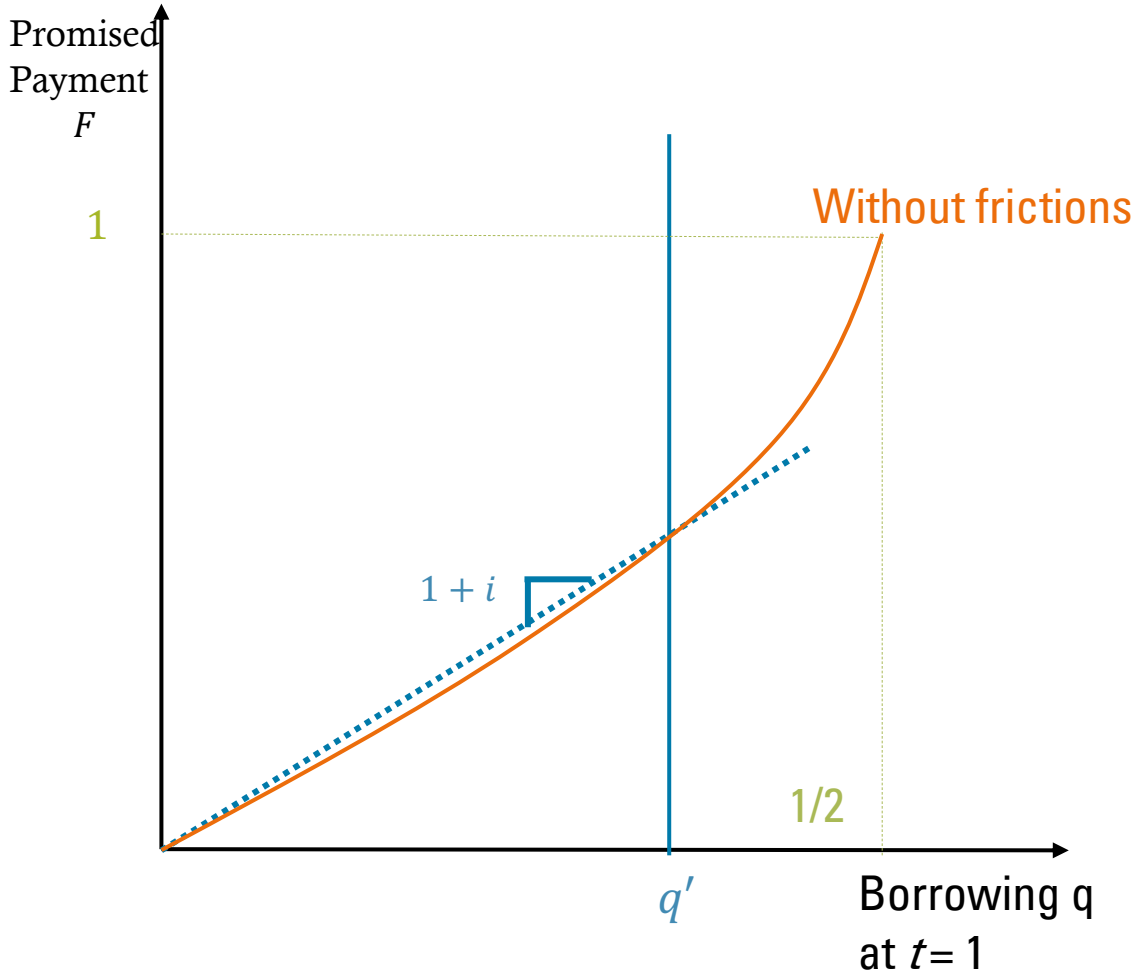
FINANCIAL FRICTIONS

- Now when $z < F$ both lender and borrower receive **nothing**
- Expected payoff is given by only the shaded rectangles $(1 - F)F$
- Both debt contracts now have the same expected payoff, represented by shaded rectangle
- Payoff in the triangle area have been eaten by the bankruptcy cost
- Total overall payoff depends on how the project is split between creditor and institution
- Extreme contract with $F = 1$ is worthless since always default



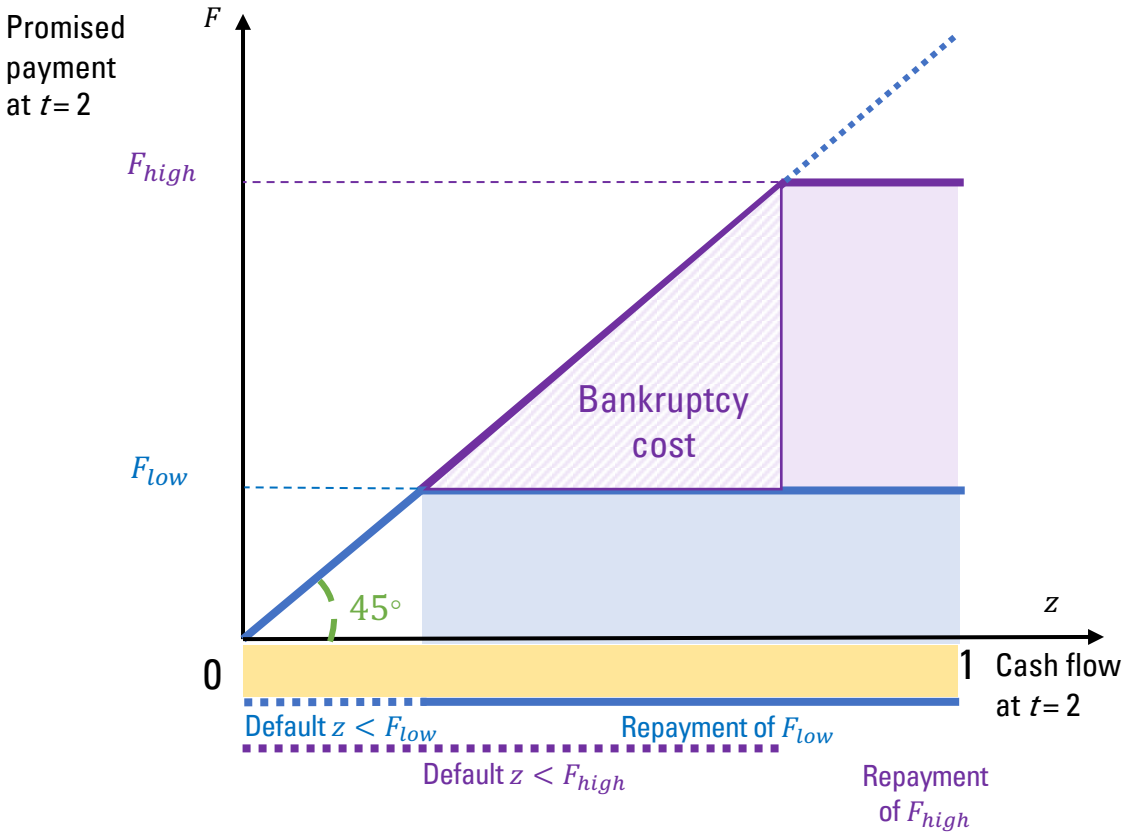
BORROWING (Q) AGAINST DEBT (F): WITHOUT FINANCIAL FRICTIONS

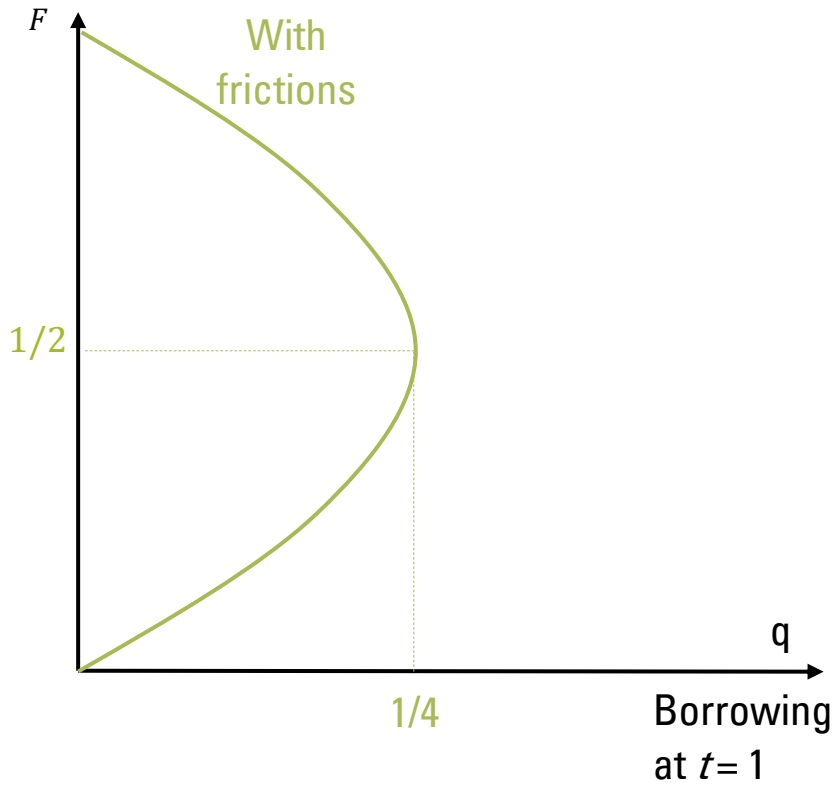
- Higher F, more expected payoff, can borrow more.
- (For simplicity assume that creditors discount future at rate 0, so expected payoff and amount borrowed are the same)
- For amount of borrowing q'
- F/q' is the yield on the debt, so interest rate is slope of ray from the origin
- Without frictions, as long as q' < 1/2, institution is solvent



WITH FINANCIAL FRICTIONS

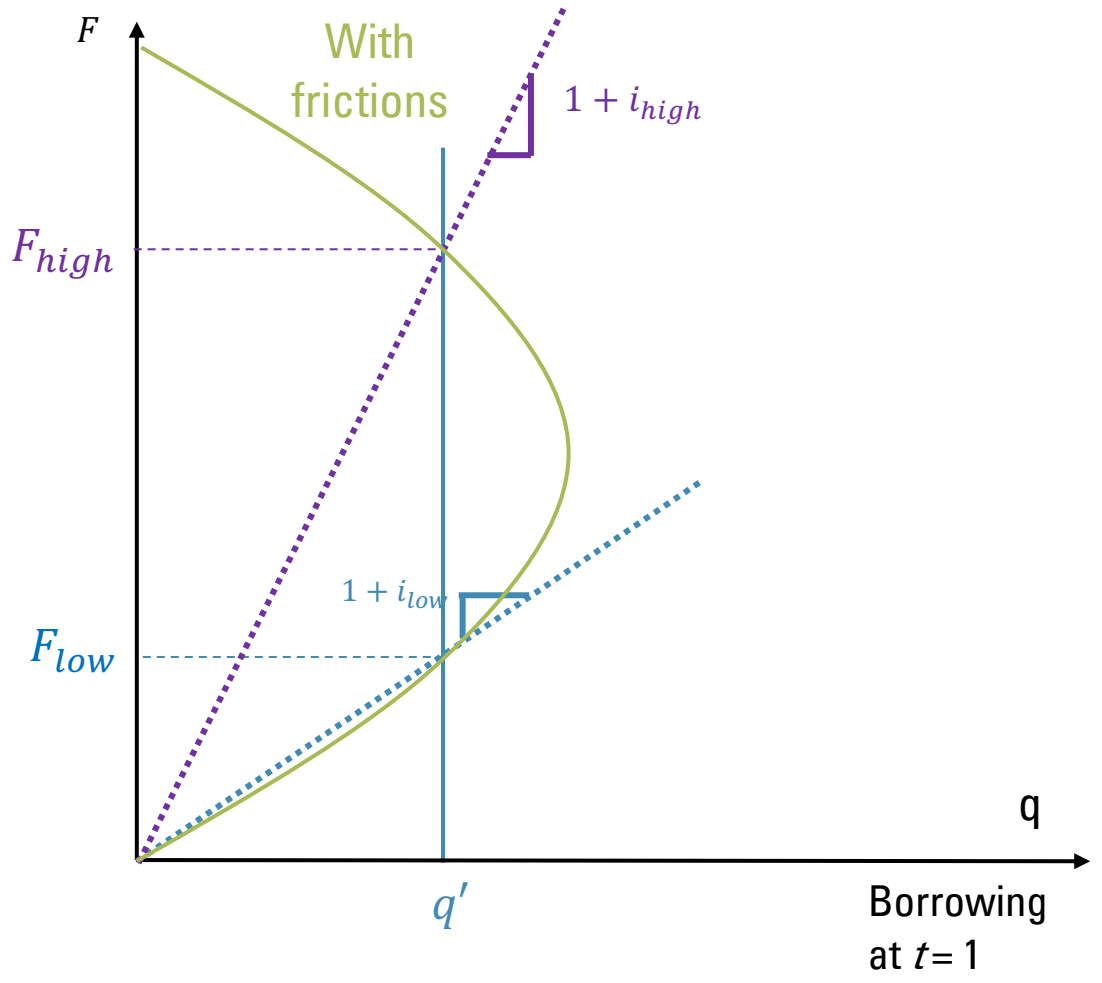
Now have a parabola, the maximum expected payoff is 1/2. The institution is insolvent if it needs to borrow more than 1/4.





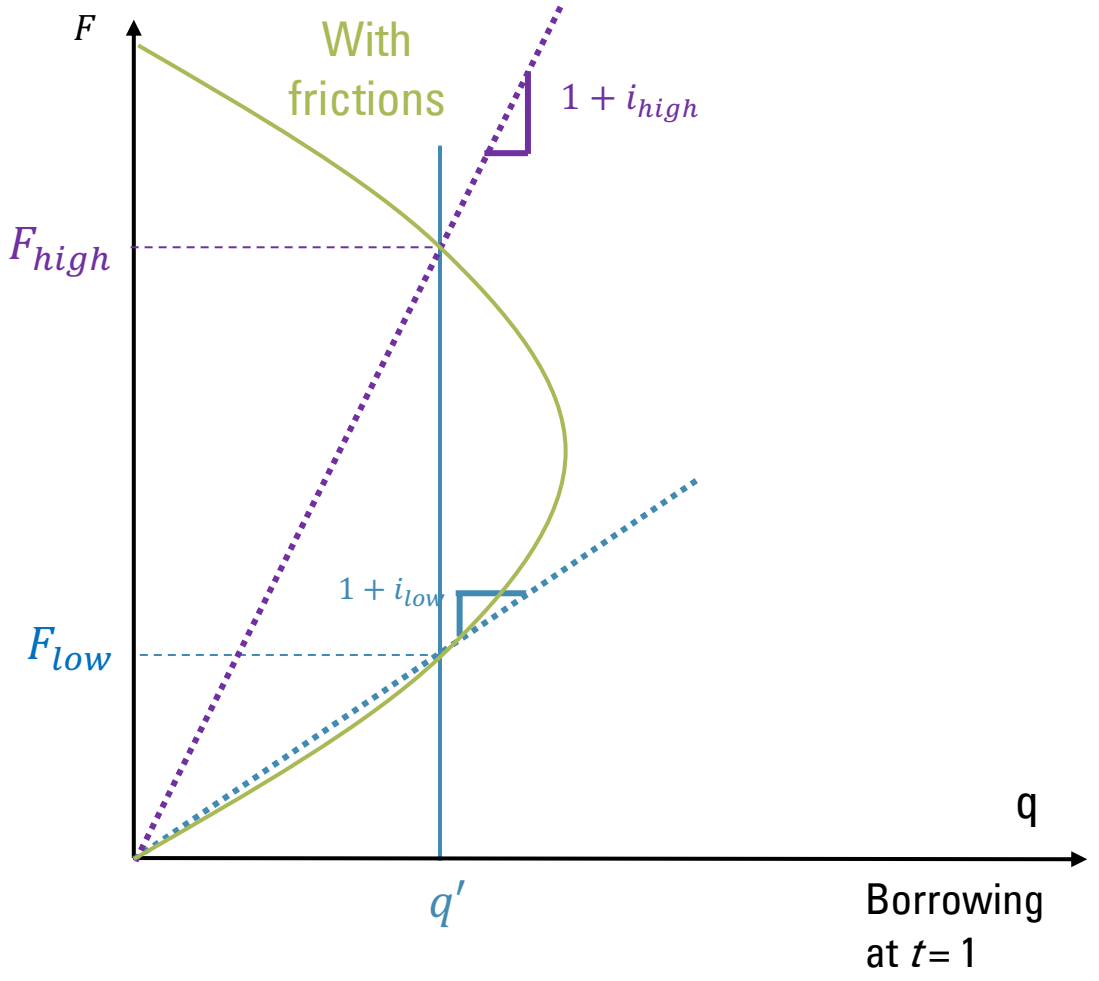
LIQUIDITY CRISIS

- The slope of a ray from the origin to the parabola gives the promised gross interest rate paid by the loan, $1 + i = F/q$
- If the interest rate is low at i_{low} then by promising to pay F_{low} the institution can obtain q' with lower probability of default
- If the interest rate is at i_{high} then it can still finance itself by promising F_{high} with higher probability of default



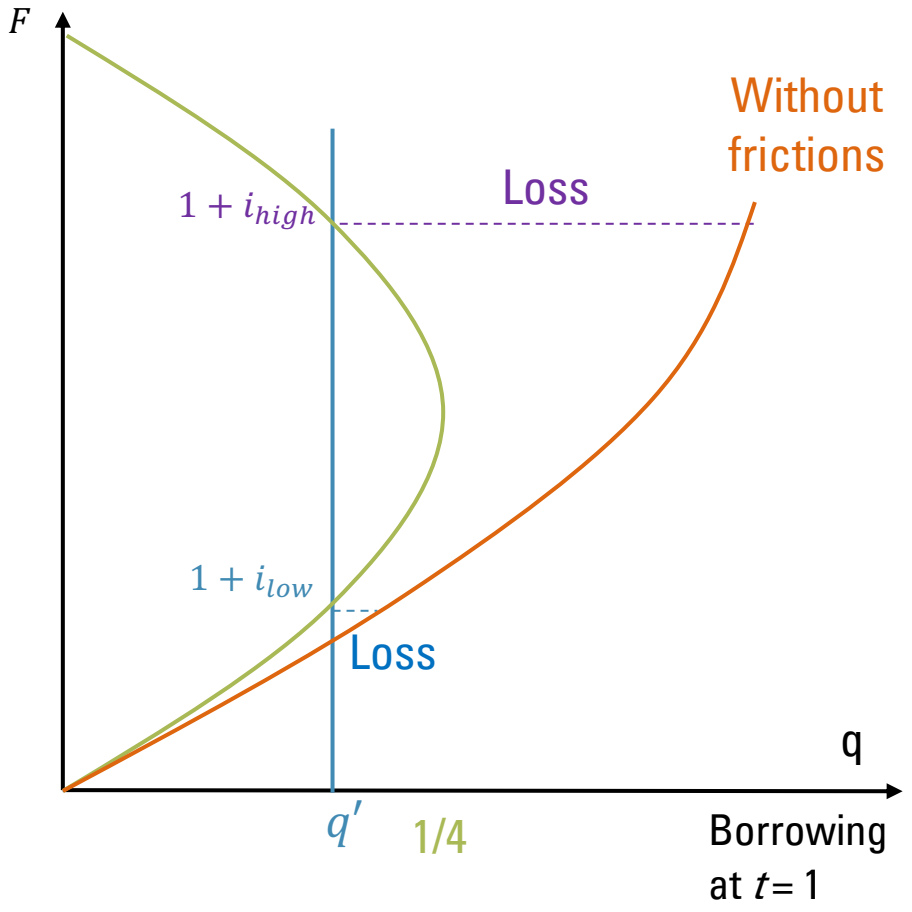
LIQUIDITY CRISIS

- If there is a change in market sentiments to the risk of default
  - Investors thinks it's more likely to default, they require higher interest rate i_{high} to compensate them for lending
- The institution needs to promise a higher payoff which also has a higher probability of defaulting
- Can enter liquidity crisis
  - The economy can suddenly jump from low to high (illiquid) face value equilibrium

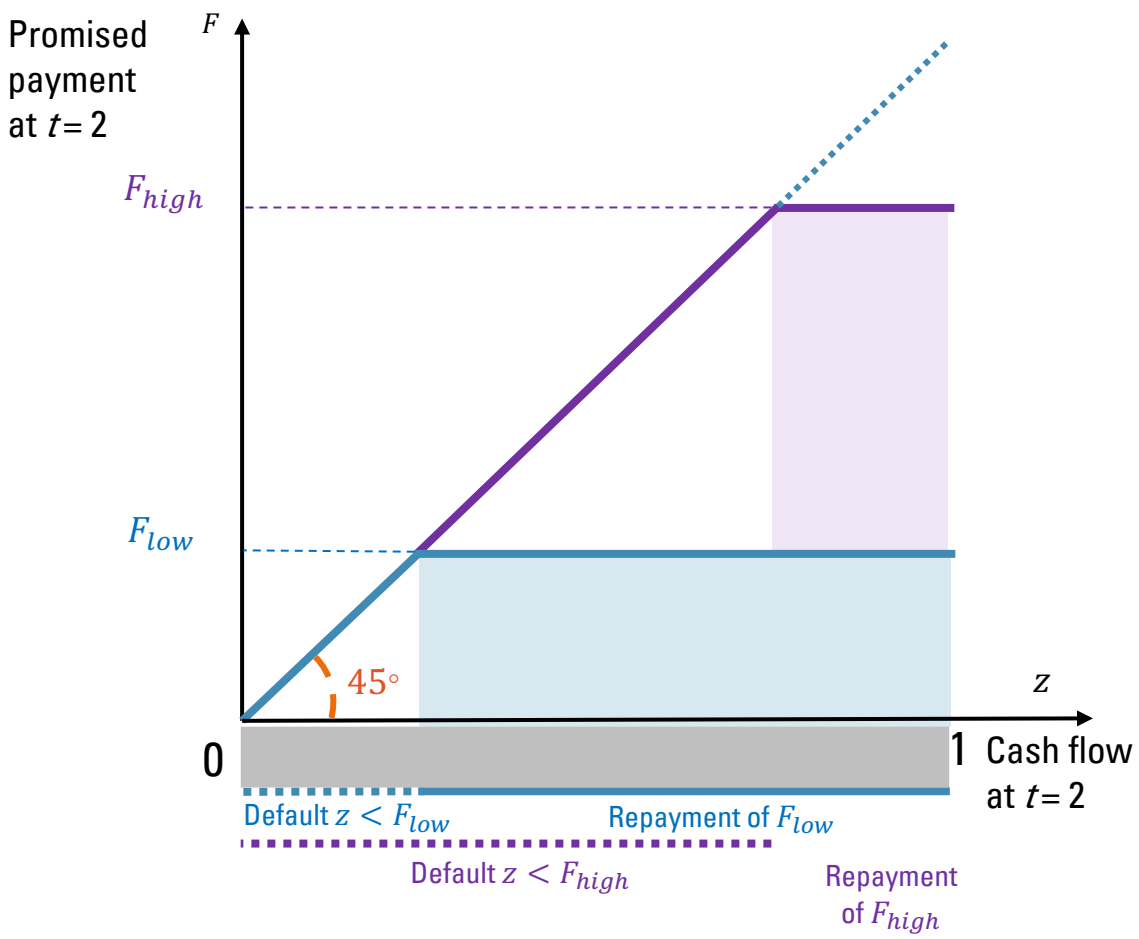


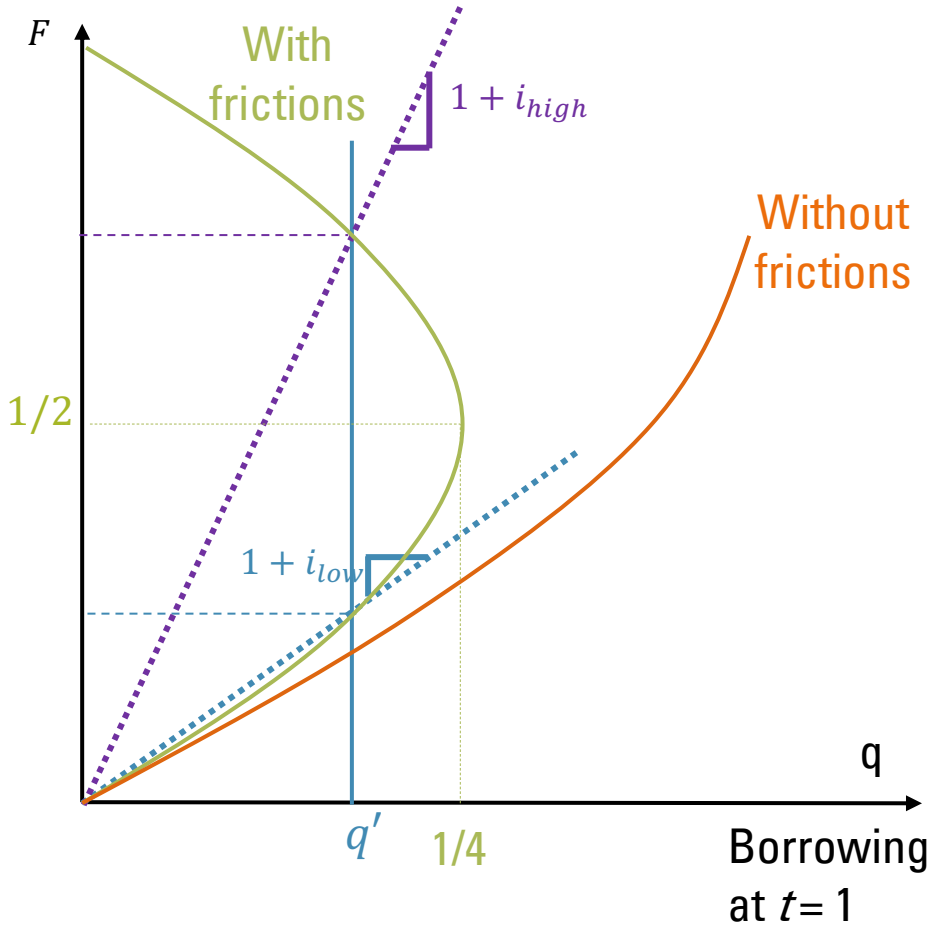
LOSSES FROM INSOLVENCY

- The borrower (and society) is worse off with higher interest rates as it is more likely for the social costs of default to materialize
- Horizontal difference between the green and orange curve in the second figure is equal to area of triangles lost in previous figure
- Measures the expected costs of default
- Cost of default is higher with i_{high}



FULL ANALYSIS





SOLVENCY OF THE SOVEREIGN AND ILLIQUIDITY

- Hard to ascertain where the curve is, or what is causing the rise in interest rates
- Solvency is hard to ascertain for countries since it depends on fiscal surpluses and commitment of politicians to pay their debts
  - The **political uncertainty** makes sovereign debt prone to liquidity and solvency crises
- A small negative shock and/or shift in market beliefs could push a country to insolvency if it is near the peak, and moves the economy to high-interest rate equilibrium and raises the default probability
- The institution can try to avoid being caught in the illiquid equilibrium by reducing the amount q it needs to borrow:
  - To hold more assets with high market liquidity (cash etc.), institution could use these assets to borrow less when equilibrium is switched
  - To avoid maturity mismatch between the project's completion and the debt, avoids rolling over debt which can lead to crisis

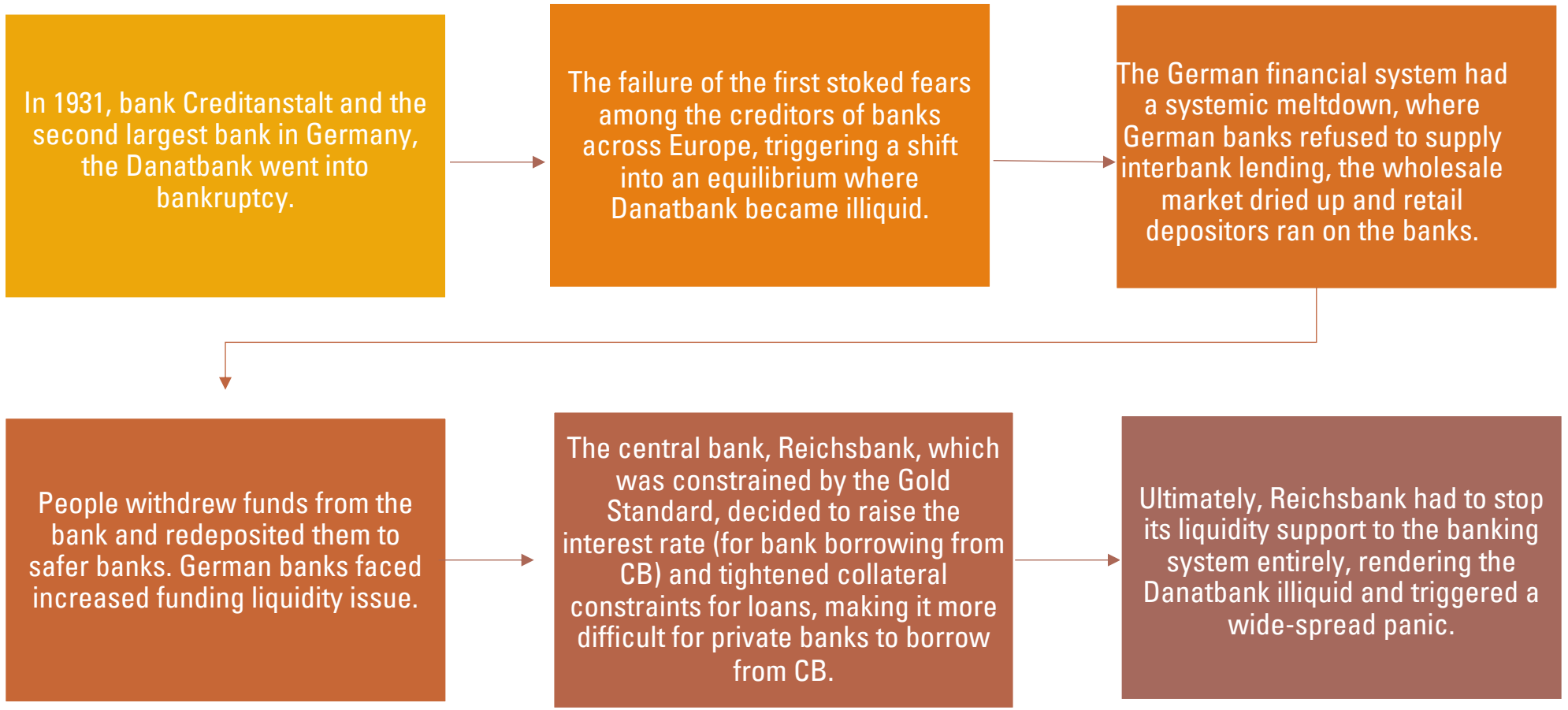
WHAT DOES IMF HELP ACCOMPLISH?

- Commits a fixed interest rate (higher than i_{low} and lower than i_{high}) on loans
- If the country is **illiquid**: IMF lends to the country to eliminate the liquidity crisis. No wealth is transferred as the country is able to pay back the loans
- If the country is **insolvent**: No loan should be made, since it transfers the wealth of foreign taxpayers and they will bear part of the losses from insolvency
    - The country should default and move on
- From past experience, it is very very hard to distinguish between illiquidity and insolvency

THE RUN ON THE GERMAN BANKING SYSTEM IN 1931

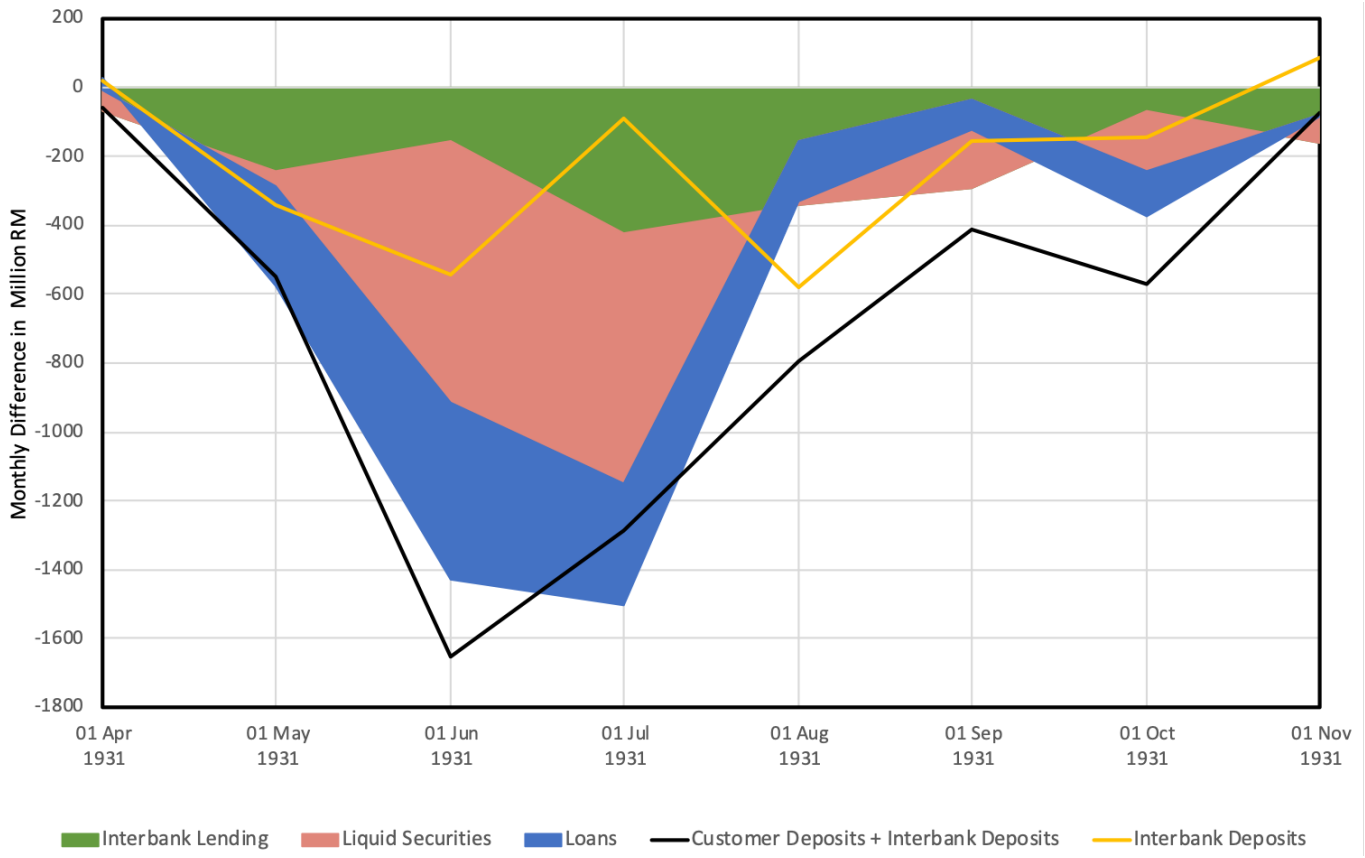
If illiquidity problems are not addressed in time, they morph into a solvency problem.
They can spread and bring the whole financial system down.

THE SEQUENCE OF EVENTS



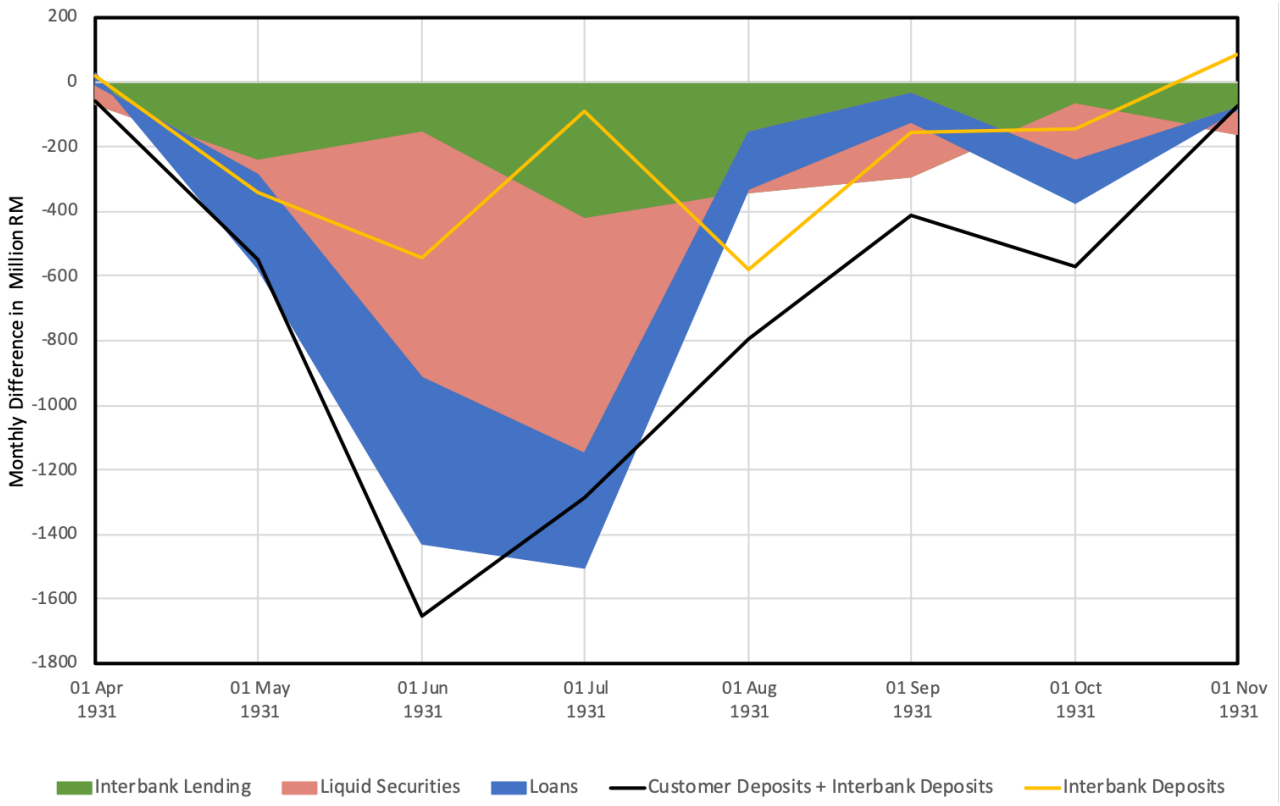
CREDITANSTALT IN 1931

- The figure depicts the decline of assets across the banking system in the shaded area
- As banks faced increased funding liquidity problems, they sold off their liquid asset holdings in 1931
- One bank's reduction in interbank liquid asset holdings is another bank's reduction in funding liquidity



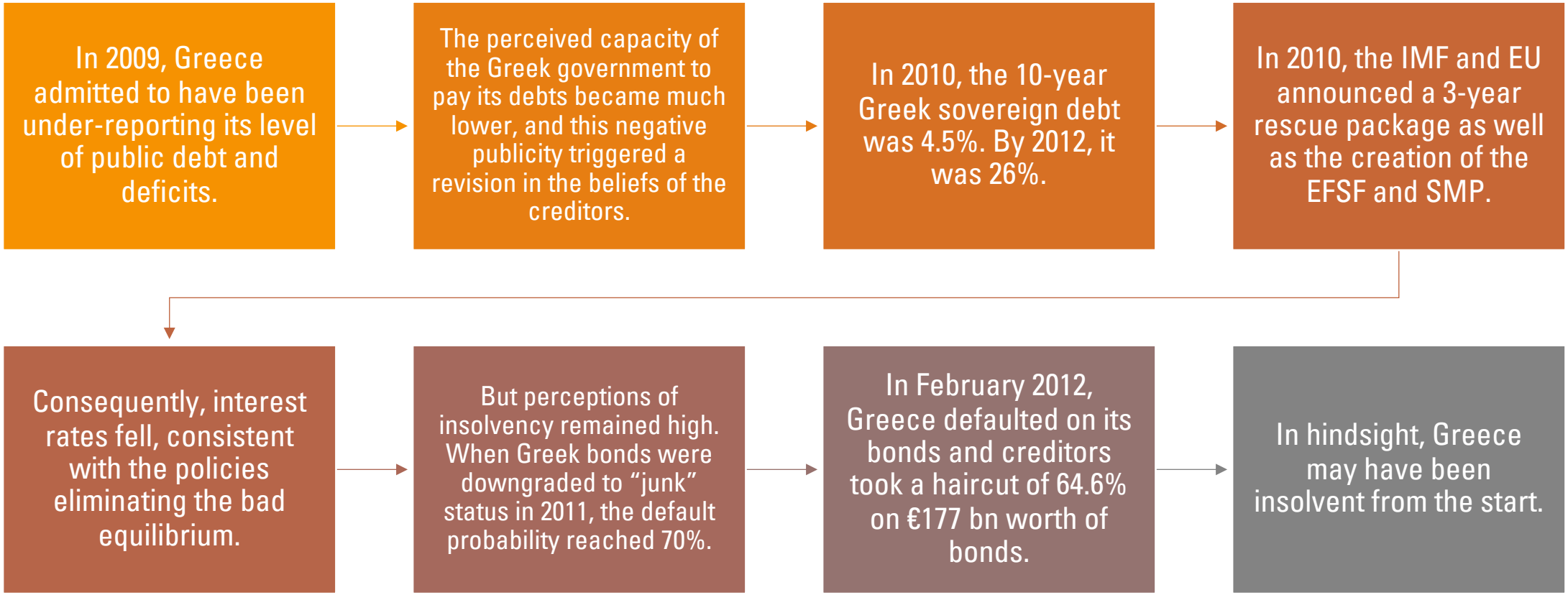
CREDITANSTALT IN 1931

- The lines in figure depict the liability side of the consolidated banking system
- Showing that, initially, primarily the interbank borrowing declined followed by a sharper decline in deposits in June 1931
- As the central bank **raised interest rates** to stop outflow of capital, this made more difficult for private banks to borrow
- Amplifies the shock

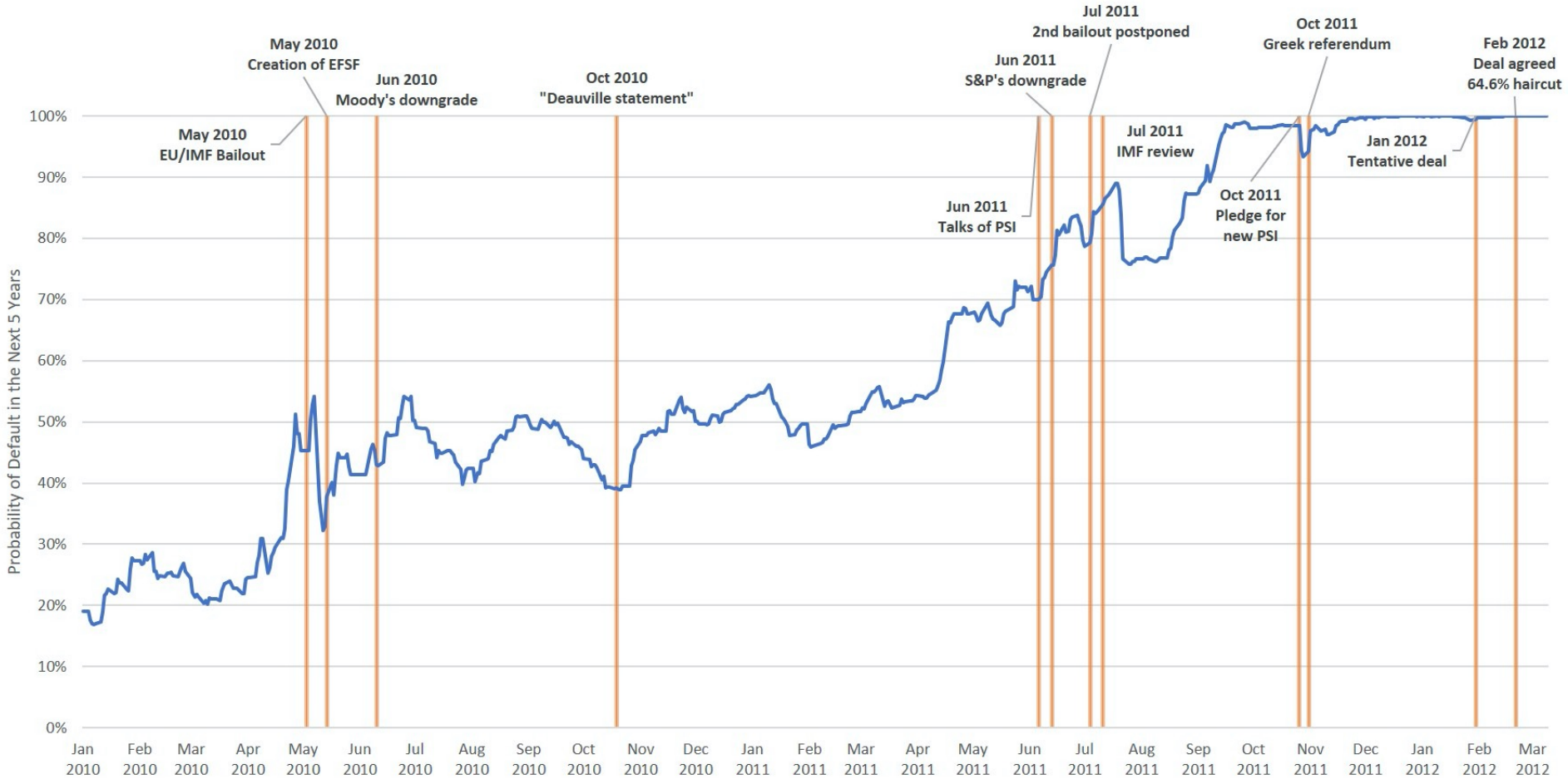


THE GREEK SOVEREIGN DEBT CRISIS OF 2010-12 AND THE IMF

THE SEQUENCE OF EVENTS



THE PERCEIVED INSOLVENCY PROBABILITY OF GREEK BONDS



INSOLVENCY AND ILLIQUIDITY IN PRACTICE

- At the same time, similar capital flows and spikes in interest rates happened in Italy, Portugal, and Spain.
- None of them defaulted on their debt and, after only a few years of public capital inflows, they were able to return to relatively lower interest rates.
    - These countries were perhaps solvent but illiquid
- Maybe, but at the start of 2010, in comparison to Greece, Portugal had twice as high net external debt, Italy's GDP per capita had grown 45% less in the previous ten years, and Spain's banks were in worse shape.
- *In real time, distinguishing insolvency and illiquidity is an almost-impossible task.*

SUMMARY

- With perfect and complete markets, there is a single interest rate which is relevant to determine solvency
- However, with financial frictions, there may be multiple interest rates consistent with the institution remaining solvent
- A change of beliefs, causing a move from the low to high-interest rate equilibrium, can cause a liquidity crisis
- Liquidity crisis could transform into solvency crisis if they are not addressed in time
- It is difficult to distinguish whether an institution is insolvent or just illiquid
- Greece appeared to be illiquid, thus spurring the IMF and EU to intervene with rescue packages, when it indeed did default in 2012