Econ 352 - Money, Inflation, and Banking: A Deeper Look

(See Williamson Ch. 18)

Trevor S. Gallen

Introduction

- We had a simple model of money markets so far
- This chapter looks to break into finance a little bit more
- So far, banks didn't really play a role!
- We'll look at the Diamond-Dybvig bank model
  - Dybvig, Diamond, and Ben Bernanke all won Econ Nobel in 2022 for work on this topic!
- First, we'll talk about some history of money & barter

Alternative Forms of Money-Commodity

- Historically, we had commodity money (Greeks, Romans)
- Coin in gold, silver, copper
- Big issues: chipping, sweating, plugging
- Process is expensive (mining, etc)
- Held up, with periodic big problems, for millenia

Private Bank Notes

- In U.S. 1837-1863, banks would produce their own currencies that bank would redeem
- Chicago bank might be trusted around Chicago, but not around New York, would take notes at a discount
- Big process of verification
- Also a lot of fraud & failures!

Fiat Money

- Our current system!
- Government prints pieces of paper, promises future demand via taxes
- Requiring money for taxes gives it intrinsic value, not just hopes others will accept it
- If govt requires that 10% of my budget be paid in dollars, I (and others) demand dollars, and will give up real assets for them!
- Sometimes people just say "only held up by faith," even if wrong

Transaction Deposits at Private Banks

- People don't just use dollars!
- Now, we send money digitally between banks, cleared through an interbank transaction (FedWire)
- We wouldn't include credit cards–credit created is not money, it's an IOU by a private entity

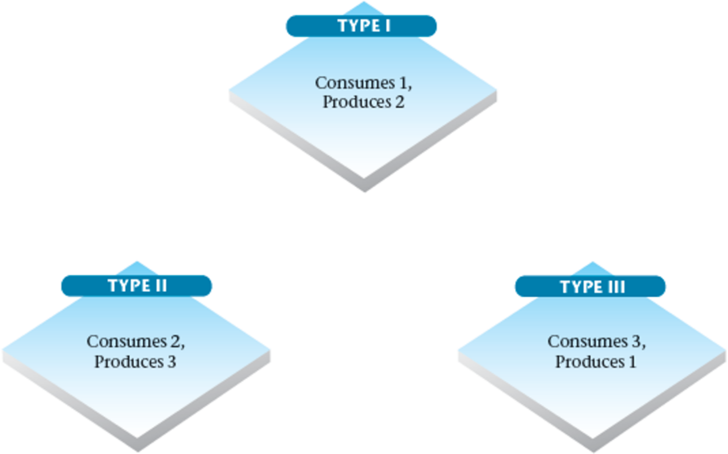
Unusual Money-Yap

- In Micronesia, they used large stones–1 ft to 12 ft long
- Not from island, quarried far away (hard to create)
- Money was frequently not moved physically, but just reassigned (small population knew who owned what)
- "Money is memory"
- Similarly, historical IOU's: playing cards in "New France" (Quebec)

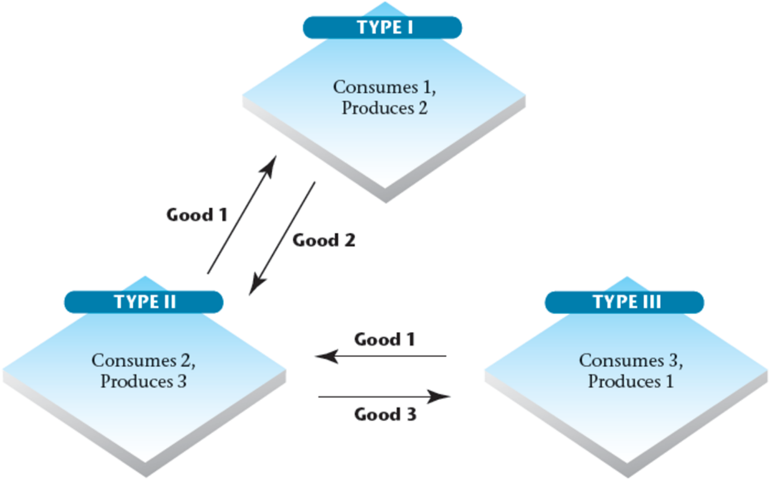
Money and Coincidence of Wants

- Money helps solve an issue in Barter
- Person 1 wants Person 2's production, Person 2 want's Person C's production, and Person C wants Person A's production
- Hard to find person who wants what you have!
- How can P1, P2 and P3 all solve this problem?
- If P2 accepts P1's production, can then trade to P3, solves situation
- Fiat money does too–if we all expect one another to accept it, we'll all be willing to accept it

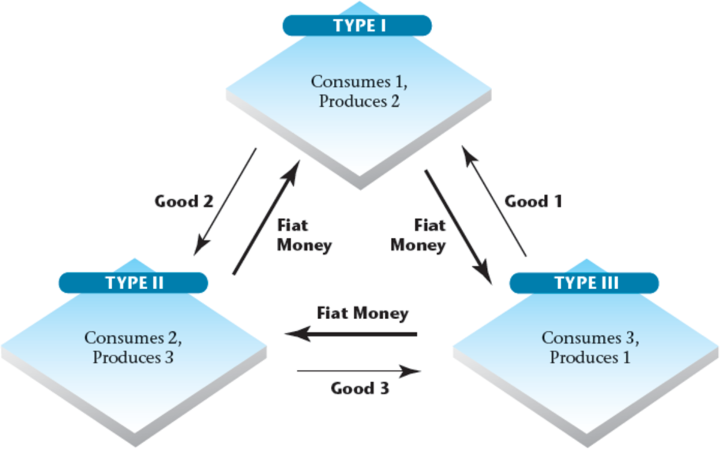
Absence of Double-Coincidence of Wants



Good 1 is Commodity Money



Fiat Money Solves



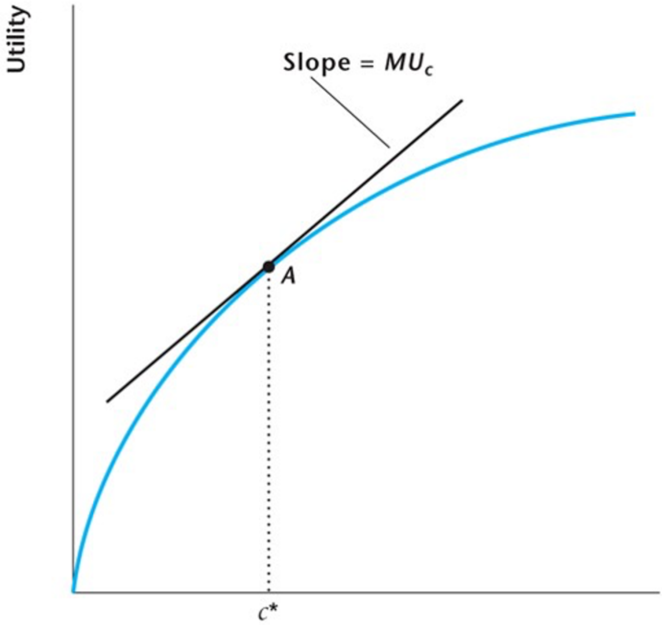
Long-Run Inflation in the Monetary Intertemporal Model

- Previously we had a model in which money was neutral: changes in the level of money have no effects
- But what about changes in the *growth rate* of money?
- Assume that money grows at a constant rate: $M' = (1 = x)M$
- And we have money demand: $M = PL(Y, r + i)$
- So:
$$\frac{M'}{M} = \frac{P'L(Y', r' + i')}{PL(Y, r + i)}$$
- In equilibrium, we have:
$$\frac{M'}{M} = \frac{P'}{P}$$
- Money growth determines inflation:
$$i = x$$

Summarizing Idea

- When M'/M increases, then P'/P increases, so inflation i increases.
- This increases the nominal interest rate: if we hold cash today to buy things tomorrow, consuming is now more expensive (or real wage tradeoff is lower)
- So leisure more today!
- Labor supply shifts in, output supply and demand shift in
- r could change, but we assume roughly cancel, so r constant
- *Changes* in money growth not neutral: "money may be neutral (changes in level doesn't matter), but isn't superneutral (changes in growth rate matter)"

Increase in Money Growth Rate



Friedman Rule

- The MRS summarizes the slope of utility, while MRT summarizes budget constraint/tradeoff
- Equilibrium was where:

$$MRS_{l,C} = MRT_{l,C}$$

- We had that for firmst, $MRT_{l,c} = w$, so:

$$MRS_{l,C} = w$$

- Which becomes:

$$MRS_{l,C} = \frac{MRT_{l,C}}{1+R}$$

- This is bad! Good means $MRS = MRT$, but there's an inefficient wedge due to nominal interest rates
- Government can fix by setting $R = 1$
- $R = r + i$, so $i = -r$ is best
- Idea: cash is causing inefficiencies, but can solve by setting return to cash same as return on bonds

Financial Intermediation

- Four important properties of assets:
  - Rate of return: when you purchase an asset, you get its value next period plus any dividends:

$$r_t^a = \frac{q_{t+1} + d}{q_t} - 1$$

  - Risk: dispersion in returns (less volatile is better!)
  - Maturity: how long is your loan for? (shorter is better!)
  - Liquidity: how quickly can you sell the asset? (more liquid is better!)

Financial Intermediation

- Financial Intermediaries:
  - Borrow from one group of economic agents and lends to another
  - Group of agents it borrows from is large, and so is group it lends to (diversified)
  - Transforms assets: borrows under different terms than it lends
  - Processes information
- All sorts of intermediaries! Mutual funds, insurance companies, banks

Financial Intermediation

- Some issues in lending without financial intermediation:
  - Matching borrowers with lenders is costly in time and effort
  - The ultimate lenders may not be skilled at evaluating credit risks
  - Because several lenders would often be required to fund any one borrower, there would be replication of costs required to evaluate credit risk
  - Because lenders economize on information costs by lending to few borrowers, lending is risky
  - Loans tend to be illiquid
  - Loans tend to have longer maturities than lenders would like
- Financial system tries to fix these problems

Note!

- Williamson has a treatment of Diamond-Dybvig
- I'm going to take my treatment from Doepke, Lehnert, and Sellgren (1999) Ch. 17.4
- Both give same idea, but I love Doepke, Lehnert and Sellgren's treatment!

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- Because of how banks are structured, they'll be vulnerable to **bank runs**

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  Bank runs are a common feature of the extreme crises that have played a prominent role in monetary history. During a bank run, depositors rush to withdraw their deposits because they expect the bank to fail. In fact, the sudden withdrawals can force the bank to liquidate many of its assets at a loss and to fail. In a panic with many bank failures, there is a disruption of the monetary system and a reduction in production.

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- We'll tell a highly stylized story about turnips now.

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7. If you're still alive, you can eat your turnip

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$$U(c_1, c_2, \Theta) = \left\{ \begin{array}{ll} \log(c_1) & \text{if } \Theta = 1 \\ Q \log(c_1 + c_2) & \text{if } \Theta = 2 \end{array} \right\}$$

- Where $1 > Q > F^{-1}$, which will control how important it is to consume if you're the second type.

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  - "People are have diminishing returns to consumption/are risk averse"
  - "The second type is willing to wait if it gains her anything"

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- On your own, you get expected utility:

  $\theta \cdot \log(1) + (1 - \theta) \cdot \log(1.1) = 0.5 \cdot 0 + 0.98 + 0.5 \cdot 0.095 = 0.046702$

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- We can all be better off by using insurance to smooth our consumption across states of the world

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- This is saying that I have 1 turnip: if I increase c_1^1 a little, I lose that whole amount (times the population weight). If I increase c_2^2, I only have to leave $\frac{1}{F}$ turnips in the ground (times their population weight) in order to pay them.

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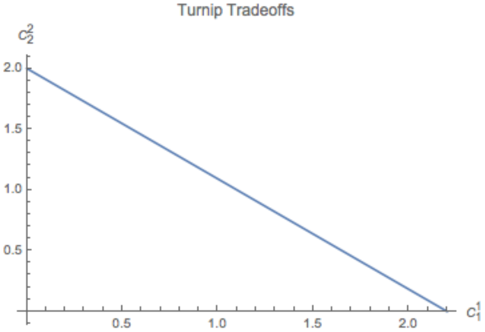
- Let's graph this, with $F = 1.1$ and $\theta = 0.5$

Budget constraint example



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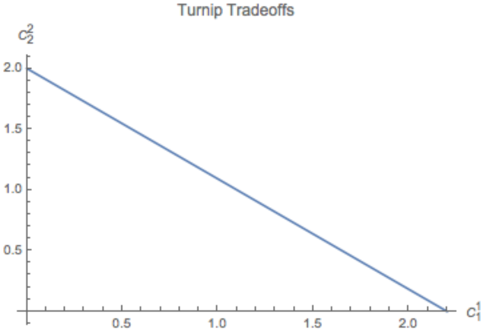

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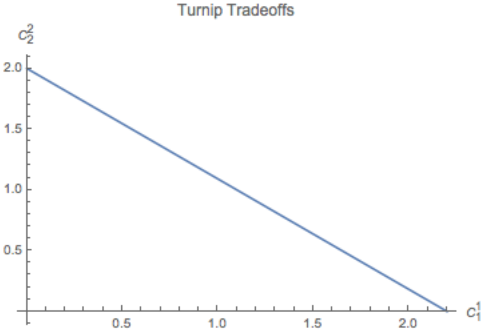

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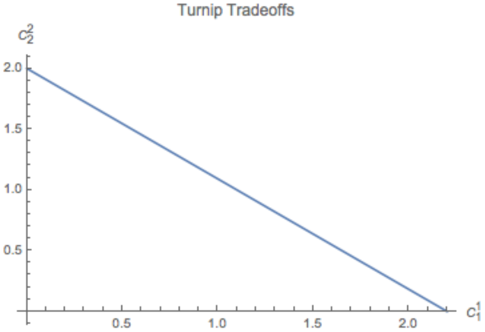

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- If you uproot the whole 1.1 turnip and give it all to the half of the population that's type 2 in period 2, then they get 2.2 turnips each.
- Or you could do something in the middle

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- Competition forces you to make the best decision for your population
- Let's write down the utility maximization problem

Insurance utility maximization

$$\mathcal{L}(c_1^1, c_2^2, \lambda) = \theta \log(c_1^1) + (1-\theta) Q \log(c_2^2) + \lambda \left(1 - \theta c_1^1 - \frac{(1-\theta)c_2^2}{F}\right)$$

- Taking first order conditions, we get:

$$\begin{aligned}
\frac{\partial \mathcal{L}}{\partial c_1^1} : \quad & \frac{\theta}{c_1^1} - \lambda\theta &=& \quad 0 \\
\frac{\partial \mathcal{L}}{\partial c_2^2} : \quad & Q\frac{1-\theta}{c_2^2} - \lambda\frac{1-\theta}{F} &=& \quad 0 \\
\frac{\partial \mathcal{L}}{\partial \lambda} : \quad & \theta c_1^1 + \frac{(1-\theta)c_2^2}{F} &=& \quad 1
\end{aligned}$$

- It's easy to solve these three equations for our three unknowns, c_1^1, c_2^2, and λ

Insurance utility solution

- Solving for c_1^1, c_2^2, and λ, we get:

$$c_1^1 = \frac{1}{\theta + Q(1-\theta)} \qquad c_2^2 = \frac{QF}{\theta + Q(1-\theta)}$$

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- Assuming that $1 > Q > F^{-1}$ is, say, 0.98:

$$c_1^1 = \frac{1}{0.5 + 0.98(1-0.5)} = 1.\overline{01}$$

$$c_2^2 = \frac{0.98 \cdot 1.1}{\theta + 0.98(1-\theta)} = 1.0\overline{888}$$

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- Solving for c_1^1, c_2^2, and λ, we get:

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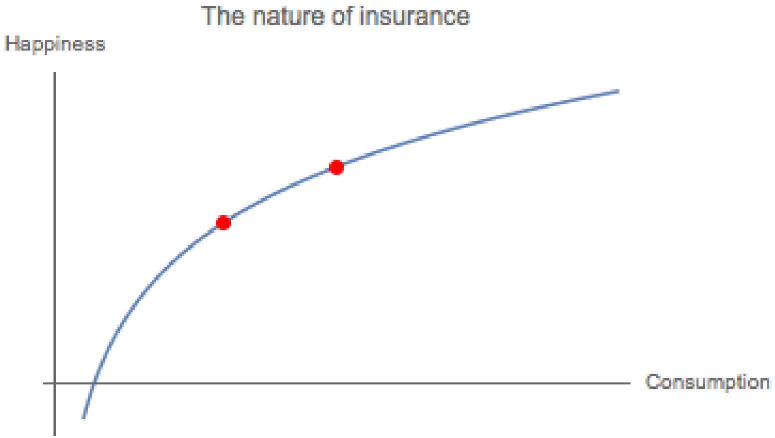
- We did it! Improved utility slightly.

Insurance?



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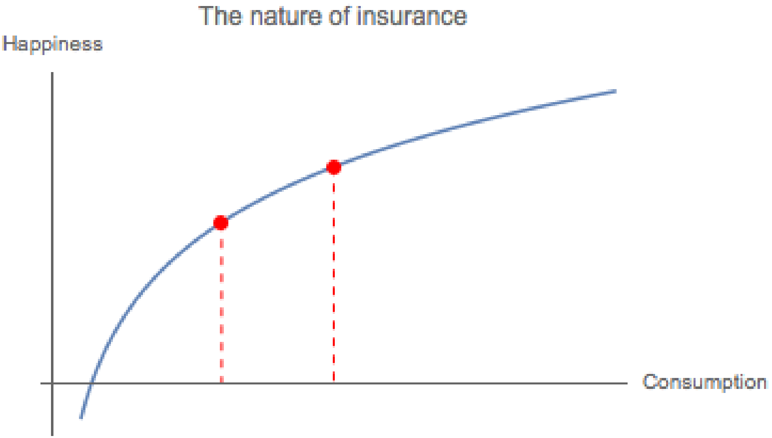

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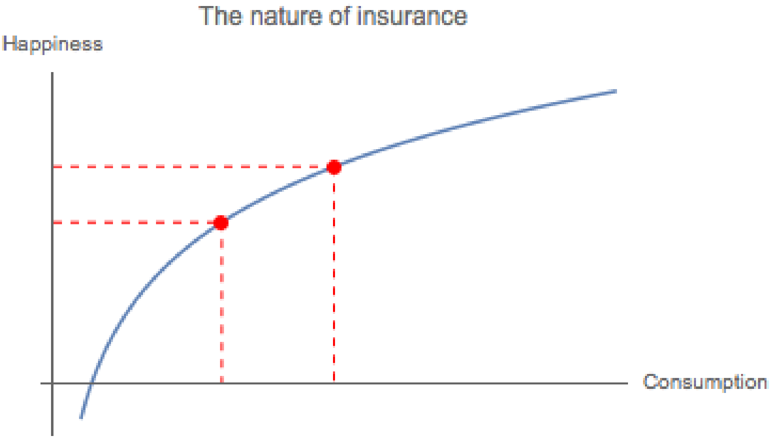

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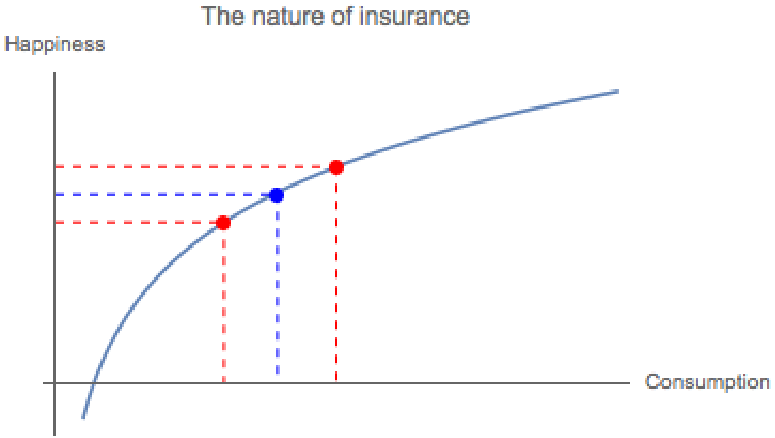

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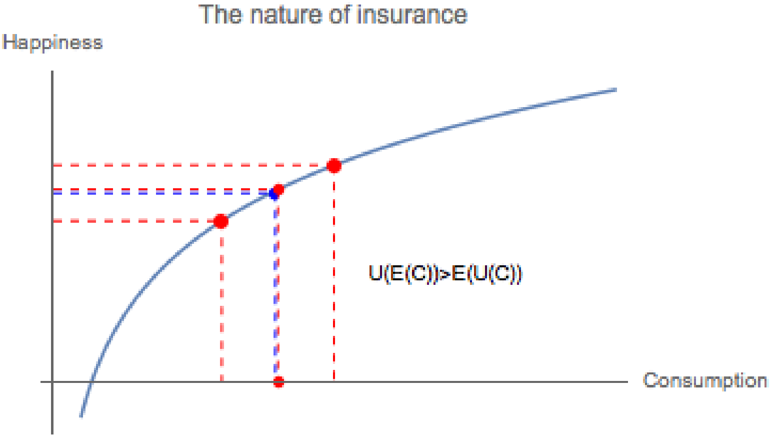

Utility of expected consumption preferred to expectation of utility.

Insurance problem: summary

- We have a problem in which people can invest and earn interest
- But sometimes some people want their money now
- Think of mortgages like planted turnips
- Banks will allow people to withdraw whenever
- People can benefit by participating in this "insurance" system, where we're insuring your liquidity needs
- Now we'll reframe this as a bank problem, but with one difference (what?)
  - People can withdraw at any time! (No proof of type)

Bank problem

- Banks have the same problem as insurance companies, with a small twist:

  1. They'll make promises in period 0 about how much you can receive if you withdraw in period 1 or period 2
  2. They then have to keep those promises no matter how many people actually do withdraw in period 1

- The point:
  - If too many people withdrew in period 1, then there would be nothing left in period 2!
  - If I fear too many people are going to withdraw in period 1, then I'll withdraw in period 1 even if I'm of type 2

- Bank run!

Bank problem

- Banks face the same basic problem: choose an interest rate r_1 for type 1 and then whoever withdraws in period 2 gets the rest:

$$c_1^1 = 1 + r_1$$

$$c_2^2 = F\frac{1-\theta(1+r_1)}{1-\theta}$$

- If for some reason θ, the proportion that withdraw in period 1, is very high, then c_2^2 goes down.
- If c_2^2 ever slips below c_1^1, then all the type 2's should run on the bank.
- How should a bank choose r_1?
- Maximize utility

Bank maximization problem

- Banks must maximize consumer expected utility, plugging in for c_2^2:

$$\theta \log(1 + r_1) + (1 - \theta) Q \log \left(F \frac{1 - \theta(1 + r)}{1 - \theta} \right)$$

- You can notice that this is the exact same problem as the insurance company faced, with $1 + r_1 = c_1$ and the budget constraint plugged in:

- Consequently, it has the same maximization solutions:

$$1 + r_1 = \frac{1}{\theta + Q(1 - \theta)}$$

- The bank chose the interest rate so everything is exactly the same as the insurance problem.

- If all goes according to plan, type 1 will get $1.0\overline{1}$ and type 2 will get $1.0\overline{8}$

- Type 2's won't want to run on the bank if nobody else is

Bank runs

- What if for some reason I fear that too many people are withdrawing?
- Bank pays them out and I get the residual. I should get $1.0\overline{8}$ if 50% of population withdraws
- What if 80% withdraws? Then I only get

$$c_2^2 = F\frac{1-\theta(1+r)}{1-\theta} = 1.1\frac{1-0.6\cdot 1.0\overline{1}}{1-0.6} = 1.05$$

- Then I don't want to run
- What if 89% withdraws? Then I get:

$$c_2^2 = F\frac{1-\theta(1+r)}{1-\theta} = 1.1\frac{1-0.89\cdot 1.0\overline{1}}{1-0.89} = 1.001$$

- If I fear that 89% of the population should withdraw, then I'll withdraw too!
- That means that (say) 90% of the population is withdrawing, the heat is turned up for others who aren't withdrawing
- Self-fulfilling Bank run!

Bank runs: the story

- If everyone is doing what they're supposed to, then there's no problem, everyone is happier and the economy is better than if there were no banks
- But if I *fear* too many people are withdrawing at once, then I should withdraw, creating a self-fulfilling bank run
- This happens because banks make promises that they are able to keep only when people think they're able to keep them
- Pro and con of banks:
  - On the one hand, they improve utility
  - On the other hand, they're vulnerable to bank runs
- Is there a way to avoid bank runs?

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    2. Deposit insurance
    3. Mutual funds
    4. Lender of last resort

- Let's talk about each in turn

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- This method fails if you don't know θ in advance! It would be a bad day for many of the type 1's if the government declared that only 25% of the population can withdraw!

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- This method can be expensive, because it insures both *illiquid* and *insolvent* banks!

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- This method works, unless you decide that mutual funds really have promised implicitly (which is what happened in the financial crisis to MMMF's)

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- This is called **Bagehot's Rule**: in times of crisis, lend without limit, to solvent firms, against good collateral, at high rates.

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- We know how to solve! Flood the system with liquidity.