

LECTURE 19: BANK RUNS

See Doepke, Lehnert, and Sellgren (1999) Ch. 17.4

Trevor Gallen

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- ▶ So we'll introduce a model of banks (and bank runs)

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- ▶ But there will be a big problem...what?
- ▶ Because of how banks are structured, they'll be vulnerable to **bank runs**

DIAMOND AND DYBVIG

- ▶ Diamond and Dybvig:

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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 - ▶ “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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- ▶ Then with probability θ you get utility $\log(1) = 0$ and with probability $(1 - \theta)$ you get utility $\log(1.1) = 0.095$.
- ▶ 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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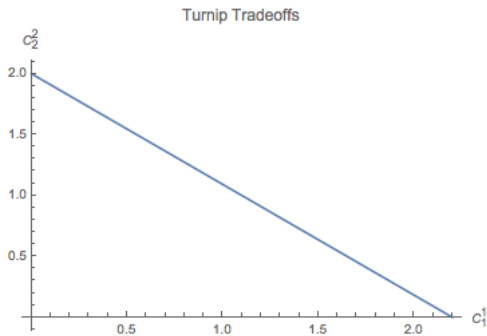
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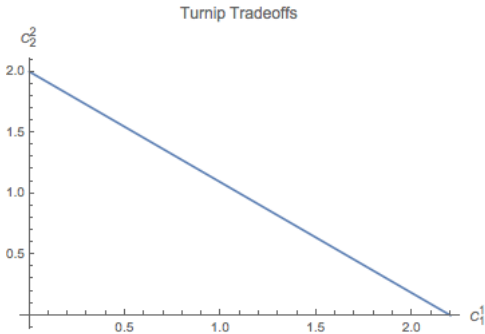
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- ▶ Let's graph this, with $F = 1.1$ and $\theta = 0.5$

BUDGET CONSTRAINT EXAMPLE

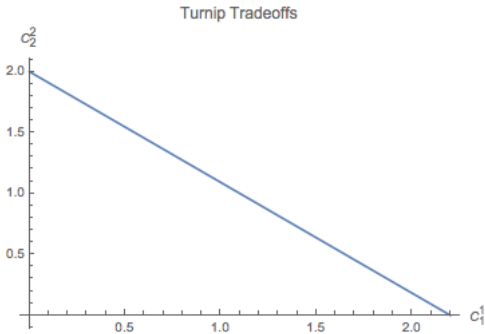


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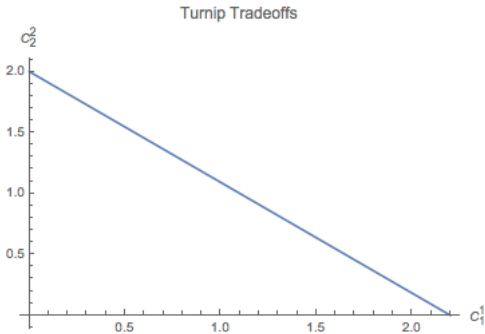
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- ▶ Or you could do something in the middle

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- ▶ If you don't do something that makes people as happy as possible, then another company will
- ▶ 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:

$$\frac{\partial \mathcal{L}}{\partial c_1^1} : \quad \frac{\theta}{c_1^1} - \lambda \theta = 0$$

$$\frac{\partial \mathcal{L}}{\partial c_2^2} : \quad Q \frac{1-\theta}{c_2^2} - \lambda \frac{1-\theta}{F} = 0$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} : \quad \theta c_1^1 + \frac{(1-\theta)c_2^2}{F} = 1$$

- ▶ 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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$$E_0(U(c_1^1, c_2^2, \Theta)) = 0.5 \log(1.\overline{01}) + 0.5 \log(1.0\overline{8}) = 0.046752$$

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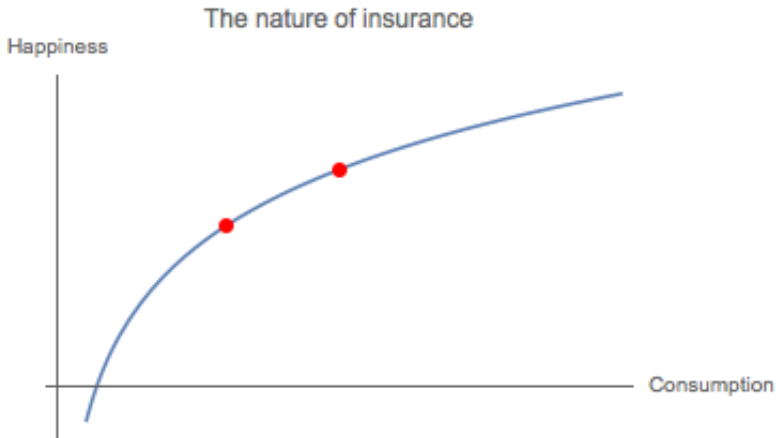
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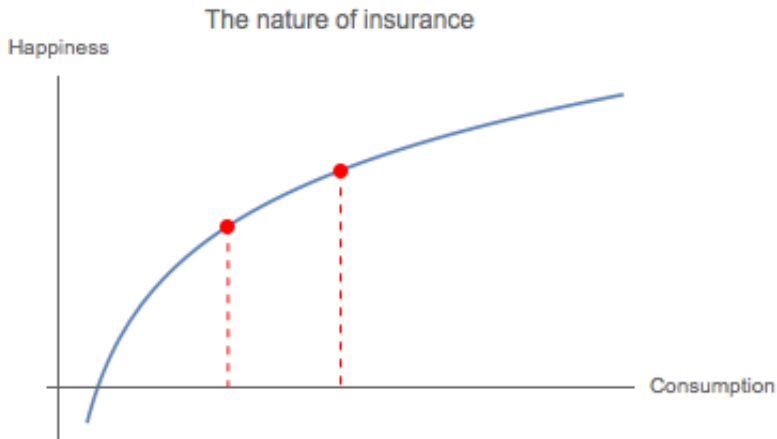
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- ▶ We did it! Improved utility slightly.

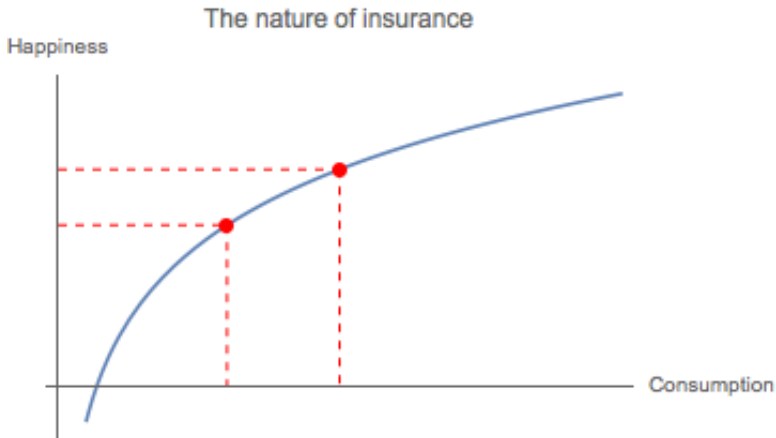
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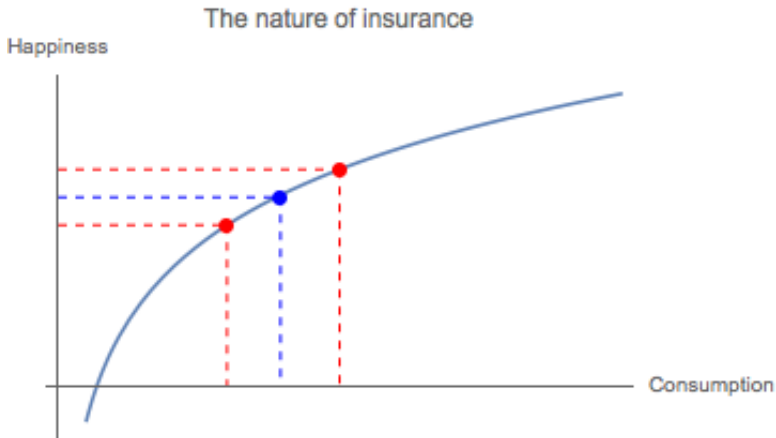
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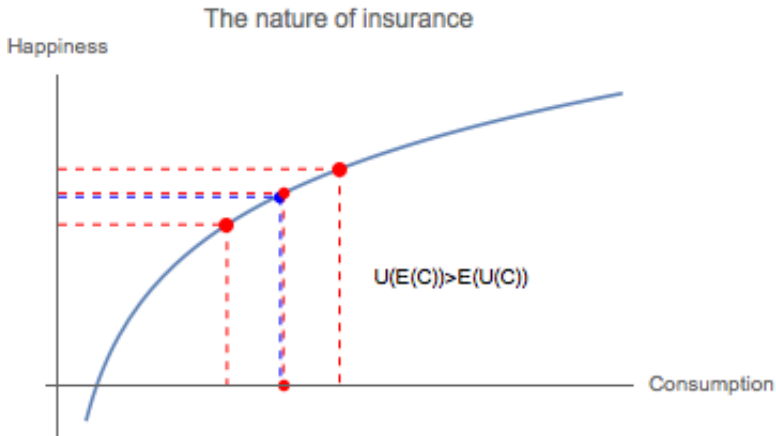
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Utility of expected consumption preferred to expectation of utility.

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 $1.0\bar{1}$ and type 2 will get $1.0\bar{8}$
- ▶ 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 $1.0\bar{8}$ if 50% of population withdraws
- ▶ What if 80% withdraws? Then I only get

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

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

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

- ▶ 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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 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.