Transactions role of Money

Lecture 3

References

- Kiyotaki and Wright (1993), “A Search-Theoretic Approach to Monetary Economics,” *American Economic Review* 83 (1), section I

- Lecture slides: simplified version of the KW model

Main model idea

- Model studies the role of money in the process of exchange: focuses on the function of money as a medium of exchange
- Model of money as fiat currency: money has no intrinsic value
- Search approach to model the role of money: the process of exchange and money's role in the process is modeled explicitly as a decentralized process where agents search for other agents with whom to trade
- Strategic approach to money as medium of exchange: when deciding whether to accept in trade an object other than one I desire for my own consumption - for example, money - I must conjecture as to the probability that other agents will accept it from me in the future
- Main result: the degree with which money is acceptable in exchange for goods does not depend on its physical properties, but results in equilibrium from the strategic interaction among agents

Agents, goods and endowments

- Economy populated by a large number of infinite-lived agents/consumers
- There is a large number of indivisible consumption goods, or real commodities
- Besides consumption goods, there is another indivisible good called fiat money
- Fiat money is an object that no one ever consumes, with no intrinsic value, and that can be thought of as a collection of pieces of paper
- Initial endowment
  - A fraction M of the consumers is endowed with one unit of money
  - A fraction 1-M of the agents is endowed with one unit of good

Preferences

- Introduce gains from trade: assume consumption goods and consumer tastes are differentiated, as captured by an exogenous parameter $0 < x < 1$
- In particular, x equals
  - The proportion of goods that can be consumed by any given agent
    Example: agent A can only consume 1/3 of the available goods
  - The proportion of agents that can consume any given good
    Example: 1/3 of the agents can consume good 1
- If agent A can consume good 1 we say that agent A likes good 1
- Consuming a good he likes yields the agent utility $U>0$
  Consuming other goods (or money) yields the agent zero utility

Technology

- Money cannot be produced by any private agent
- Consumption goods can be produced according to the following technology: when an agent consumes, he produces one unit of good within the same period ($\alpha \to \infty$ in KW, 1993)
- Agents who have not consumed cannot produce
- Agents cannot consume their own output or endowment (specialization)
- Money and goods are costlessly storable

Search and trading process

- Agents with money (money traders) and agents with consumption goods (commodity traders) look for other agents with whom to trade
- Traders meet pairwise and at random
- For simplicity: one meeting per period per agent ($\beta=1$ in KW, 1993)
- For simplicity, no transaction costs when either real commodities or money are accepted in trade ($\varepsilon=0$ in KW, 1993)
- Note that, given the assumptions, in equilibrium each agent can only have either one unit of money or one consumption good. This also implies there is always a fraction M of agents with money and a fraction 1-M with goods/commodities.

Money traders

- An agent with one unit of money seeks to exchange his unit of money with one consumption good he likes

- The exchange occurs only if:
  1. the agent with money meets an agent with one good he likes
  2. the randomly located agent is willing to accept money in exchange for the good

- In this case, the agent exchange money with a consumption good, consumes it with utility U, and produce a new consumption good to exchange next period

- If instead there is no exchange, the agent does not consume, keeps the unit of money and tries to exchange it next period

Commodity traders

- An agent with one consumption good seeks to exchange his good with one consumption good he likes

- This exchange occurs only if there is a “double coincidence of wants”
  1. the agent with a good meets an agent with one good he likes
  2. the randomly located agent likes the offered good

- Alternatively, the agent may exchange his unit of good with one unit of money

- This exchange occurs only if
  1. the agent with a good meets an agent with money and he is willing to accept money in exchange for the good
  2. the randomly located agent likes the offered good

Degree of acceptability

- Commodity goods and money are very different in terms of their degree of acceptability

- Commodity goods will always be accepted in exchange by *some* agents, since their consumption generates utility

  x = probability a randomly located agent accepts the offered good

  x is given by assumption

- Money, instead, will be accepted by an agent only if he expects to be able to use it in exchanges, that is, only if he expects that also other agents will accept money in exchange for the goods they like

  Π = probability a randomly located agent accepts money

  Π is determined endogenously, as we will see

Payoffs, strategies and equilibrium

- Payoffs: expected utility from consumption of goods
- Strategy: rule that determines when to accept a good or money in exchanges; the optimal strategy maximizes the payoff, given the strategies of other agents (i.e., in solving for the optimal strategy, the strategies of the other agents are taken as given)
- Nash equilibrium: the strategy of each agent is optimal given the strategies of all other agents
- The equilibria considered here have two properties
  - they are symmetric (in equilibrium all agents adopt the same strategy)
  - they are stationary (the optimal strategy is constant over time)

Payoffs, strategies and equilibrium, cont.

- Optimal agent's strategy:
  - Accept a good if it is a good that he likes (i.e., with probability x)
  - Accept money with probability π when the other agents accept it with probability Π
- The agent determines the optimal response π to the common strategy Π of other individuals by comparing the payoff (expected utility) from holding money and the expected payoff from holding a consumption good at the beginning of a generic period t
- We call these two payoffs $V_M(t)$ and $V_C(t)$

Payoffs

- Utility from holding money in t

$$V_M(t) = \frac{1}{1+r}[(1-M)x\Pi U + (1-M)x\Pi\ V_C(t+1) + (1-(1-M)x\Pi)\,V_M(t+1)]$$

- Utility from holding a commodity in t

$$V_C(t) = \frac{1}{1+r}[(1-M)x^2\ U + Mx\pi\ V_M(t+1) + (1-Mx\pi)\,V_C(t+1)]$$

Payoffs, cont.

- Properties of equilibria
  - Stationarity → $V_M(t) = V_M(t+1)$ and $V_C(t) = V_C(t+1)$
  - Symmetry of strategies → $\pi = \Pi$
- Rewrite utility from holding money in t

$$rV_M = (1-M)x\Pi U + (1-M)x\Pi(V_C - V_M)$$

- Rewrite utility from holding a commodity in t

$$rV_C = (1-M)x^2U + Mx\Pi(V_M - V_C)$$

Payoffs, cont.

- Substracting

$$V_C - V_M = \frac{(1-M)xU}{r + x\Pi}(x - \Pi)$$

- The sign of the difference between expected utility from holding a good and money depends from the difference between the acceptance probability of goods, x, and the acceptance probability of money, Π

- Thus, we have three possible optimal strategies generating three possible equilibria

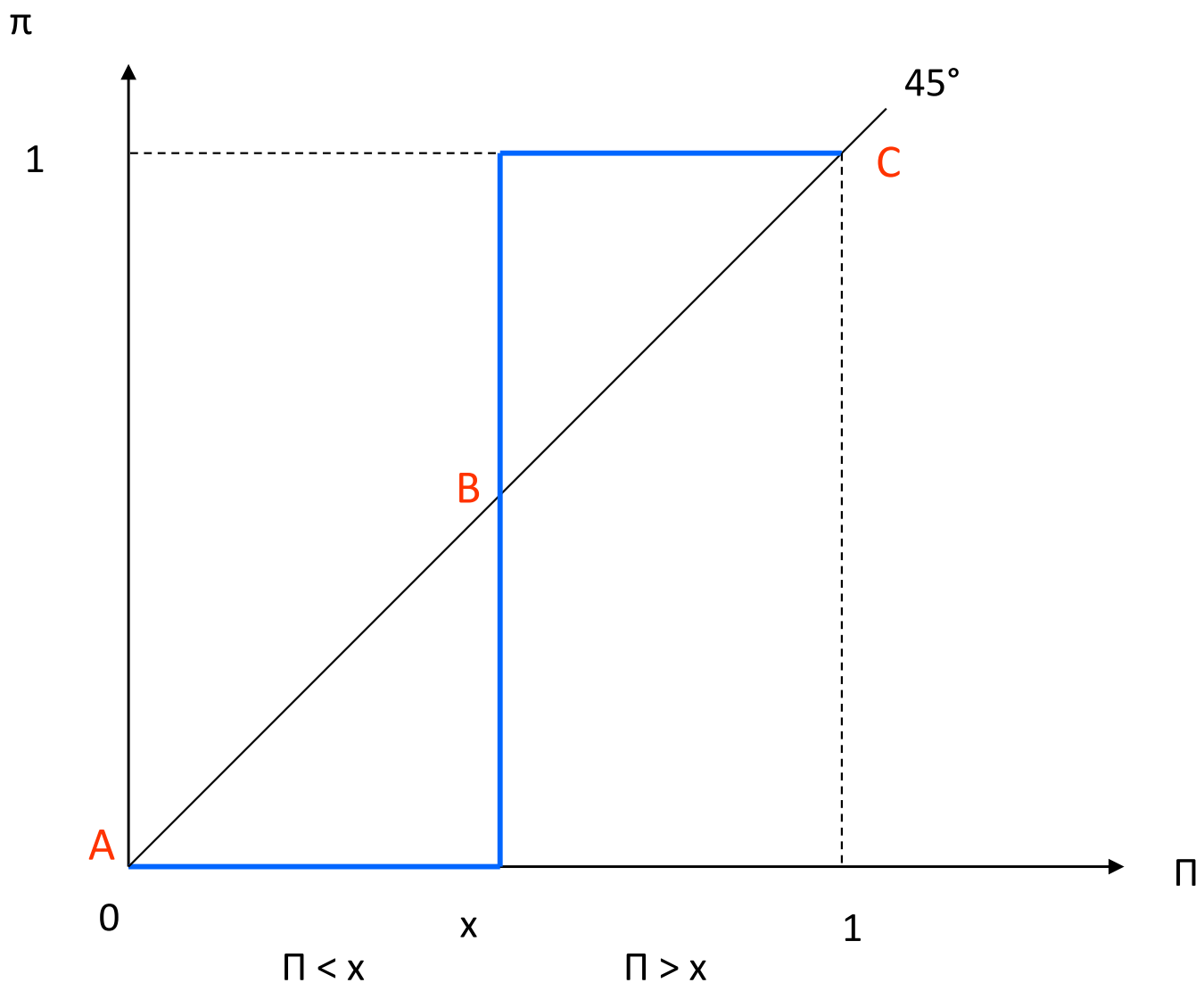
Optimal strategies

1. $\Pi < x \Rightarrow V_C > V_M \Rightarrow$ Agent never accepts money in exchange of a real commodity $\Rightarrow \pi=0$
   Money is accepted with a lower probability than a barter offer, than it is harder to trade using money than barter

2. $\Pi > x \Rightarrow V_C < V_M \Rightarrow$ Agent always accepts money in exchange of a real commodity $\Rightarrow \pi=1$
   Money is accepted with a greater probability than a barter offer, than it is easier to trade using money than barter

3. $\Pi = x \Rightarrow V_C = V_M \Rightarrow$ Agent is indifferent between money and a real commodity
   $\Rightarrow \pi$ is anything between 0 and 1
   Money is accepted with the same probability than a barter offer, than it is equally easy to trade using money or barter

Optimal strategies and equilibria



Equilibria

1. Nonmonetary equilibrium (Π=0): Agents expects that money will not be accepted, so they never accept it. Money is valueless and is not used.

   Point A in Figure.

2. Pure monetary equilibrium (Π=1): Agents expects that money will be accepted, so they always take it. Money is universally acceptable.

   Point C in Figure.

3. Mixed monetary equilibrium (Π=x): Agents are indifferent between accepting and rejecting money as long as other agents take it with probability Π=x. Money is only partially acceptable.
   Point B in Figure.

Results

- This model clarifies the strategic nature of the use of money as a medium of exchange
- The acceptability of money in exchanges is not linked to intrinsic properties (physical properties) of money, rather it is determined endogenously as a result of the particular equilibrium of the economy
- Multiple equilibria are possible and are characterized by different degree of acceptability of money (null, partial or total)
- Equilibria are self-fulfilling: if agents expects a certain degree of acceptability and choose their strategies accordingly, their actions imply that the expected degree of acceptability realizes in equilibrium