Chapter 11: Network Models of Markets with Intermediaries

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Contents

11.1 Price-Setting in Markets

- Prices determine goods flows in markets

- Who sets prices?

  - **Second-price sealed-bid auction**: buyers via bids in a procedure chosen by sellers

  - **Procurement auction**: sellers via offers in a procedure chosen by buyers

  - **Large variety of other markets**: intermediaries (brokers, market-markers, middlemen)

11.1 Price-Setting in Markets: Trade with Intermediaries

- Point of intermediaries and advantages of markets with intermediaries
- Examples of some bigger trading markets: New York Stock Exchange (NYSE), NASDAQ-QMX, Direct Edge, Goldman Sachs, Investment Technologies Group (ITG)
- Characteristics

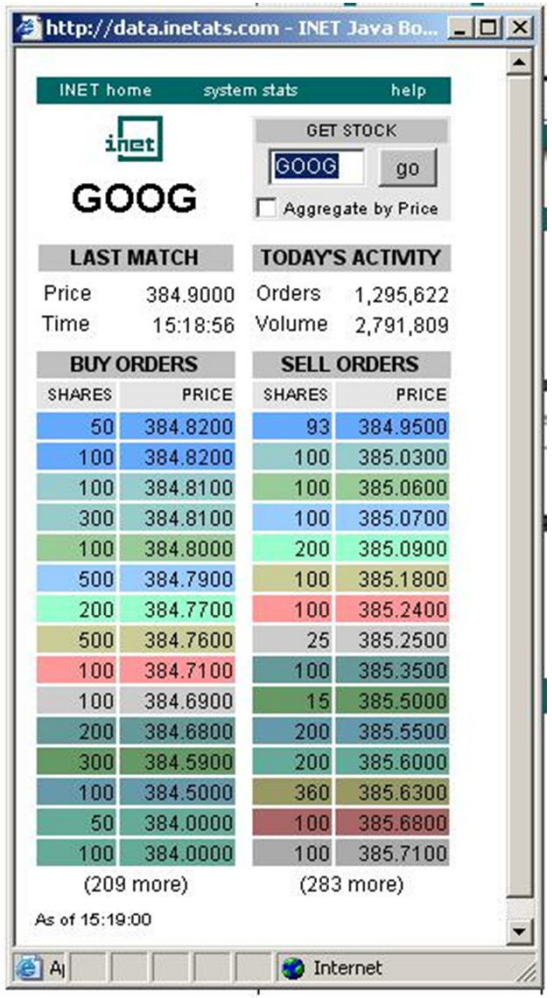
  - Match orders at prices determined by other markets

  - Prices set by people (specialists) or electronically by algorithms

  - Limited/Unlimited access to market

  - Trading availability

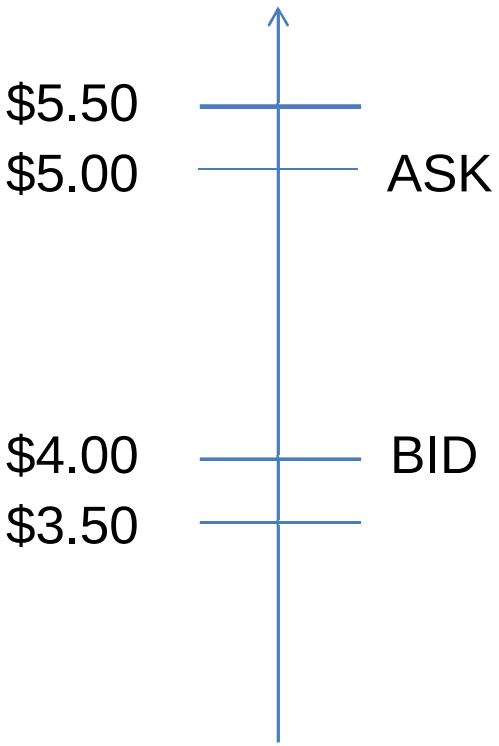
- Order book – a list of orders that buyers and sellers have submitted for a stock

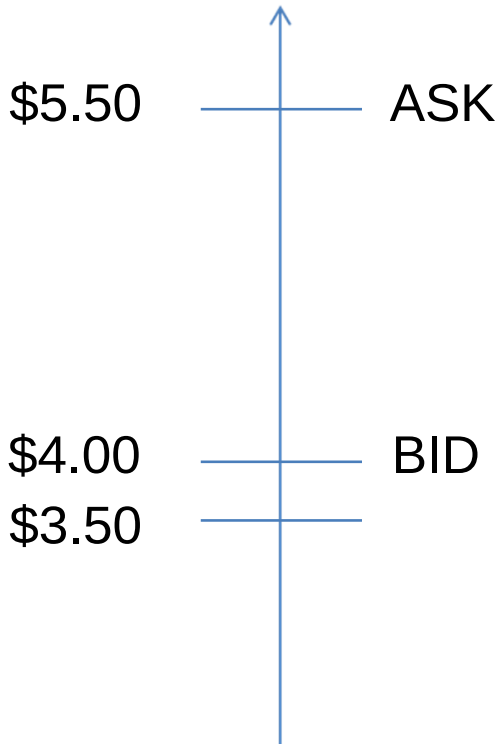


Source: www.data.inetats.com

11.1 Price-Setting in Markets: Trade with Intermediaries

- Limit orders





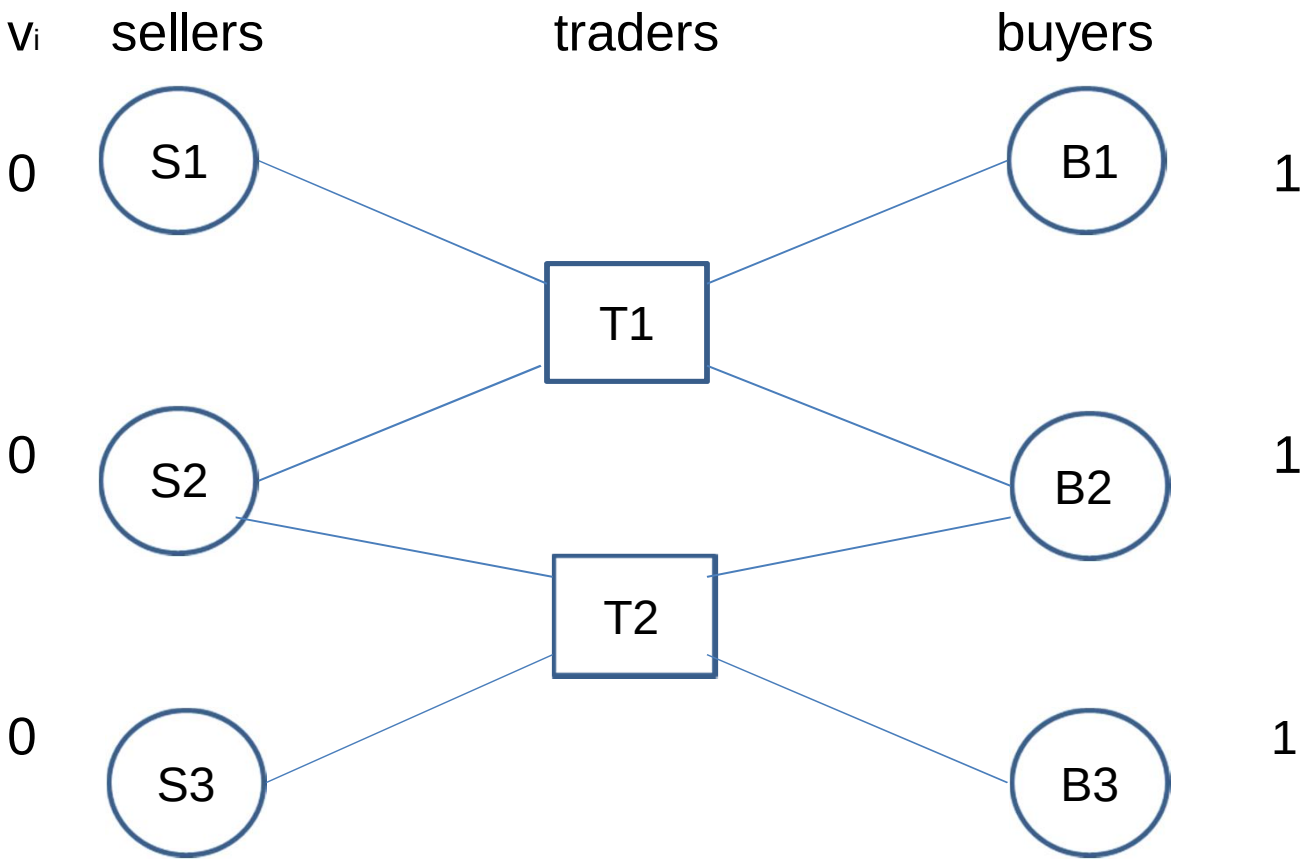
- Market orders
- “Dark pools”: Goldman Sachs’s Sigma-X, ITG

11.2 A Model of Trade on Networks

- Networks connect various buyers and sellers to different intermediaries
- Three principles of “our” networks
  - existence of intermediaries
  - access to intermediaries
  - difference in prices
- Trader’s strategy
- Seller’s/ Buyer’s strategy
- 2 stages:
  - traders choose simultaneously bids and asks
  - all sellers and buyers choose simultaneously traders

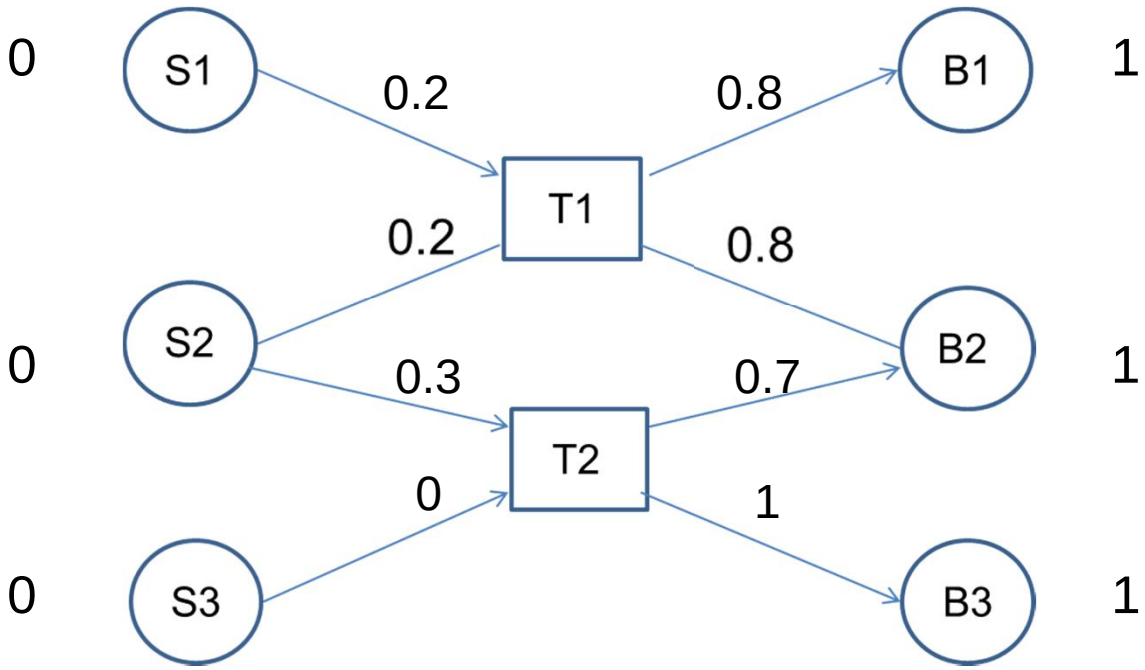
11.2 A Model of Trade on Networks

- Network structure – fixed, externally imposed



11.2 A Model of Trade on Networks: Prices and the Flow of Goods

- Network structure with bids b_{ti} and asks a_{tj}



- Penalties imposed on traders

11.2 A Model of Trade on Networks

- Payoffs

  - trader's payoffs:

    sum of asks - sum of bids (- penalty)

  - seller's payoffs: b_{ti} or v_i

  - buyer's payoffs: $v_j - a_{tj}$ or 0

- Examples

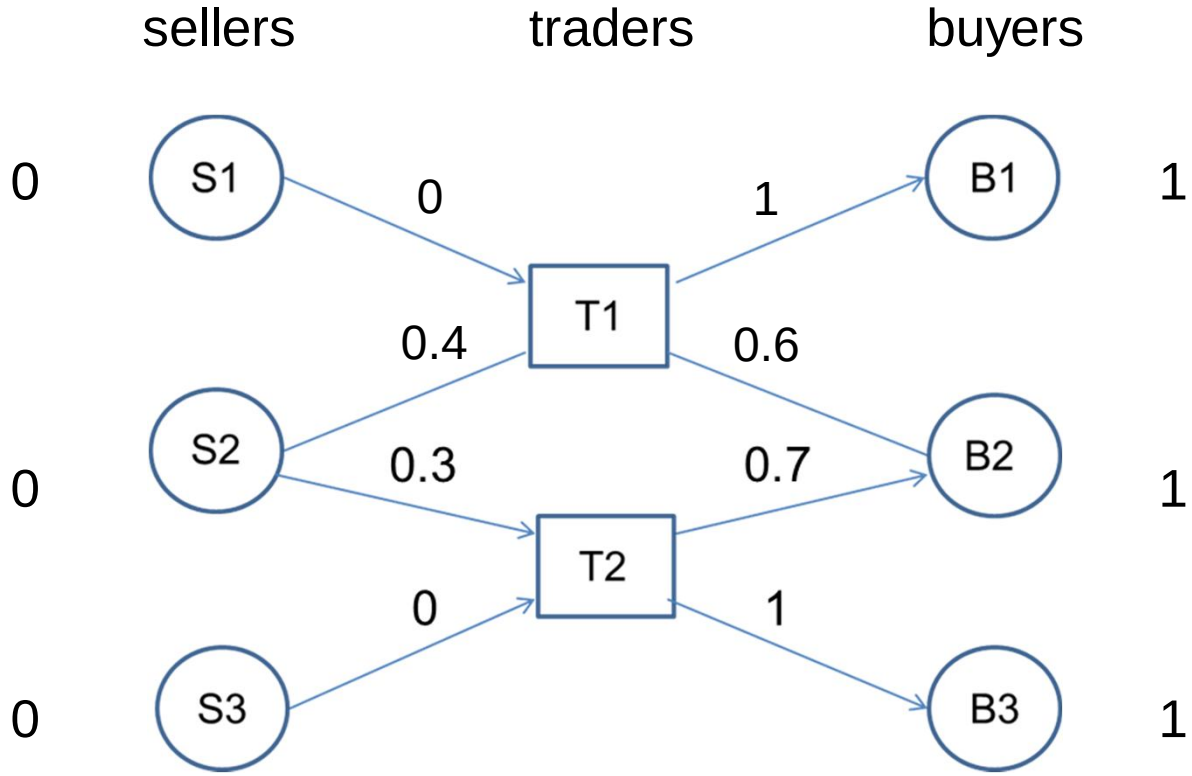
  Payoff of second trader: $0.7 + 1 - 0.3 - 0 = 1.4$

  Payoff of second seller: 0.3

  Payoff of second buyer: $1 - 0.7 = 0.3$

11.2 A Model of Trade on Networks: Best Responses and Equilibrium

- Trader T1 can make better offers about their bids and asks:



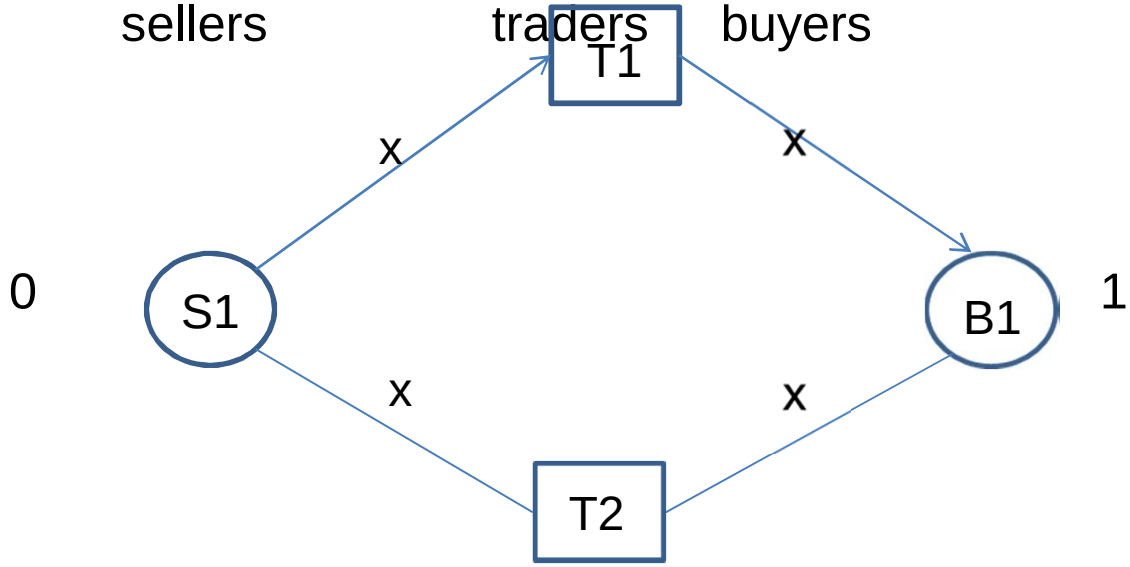
- Motivation for equilibrium

11.2 A Model of Trade on Networks: Best Responses and Equilibrium

- Nash equilibrium
  - each player knows the strategies of others
  - no benefit, if one changes their strategy but others don't
  - each players chooses the best response to others' strategies
- In our case, we need to consider the two stages of the problem
  1. reactions of buyers and sellers to posted prices
  2. choice of prices by traders
- "Subgame perfect Nash equilibrium"

11.3 Equilibria in Trading Networks

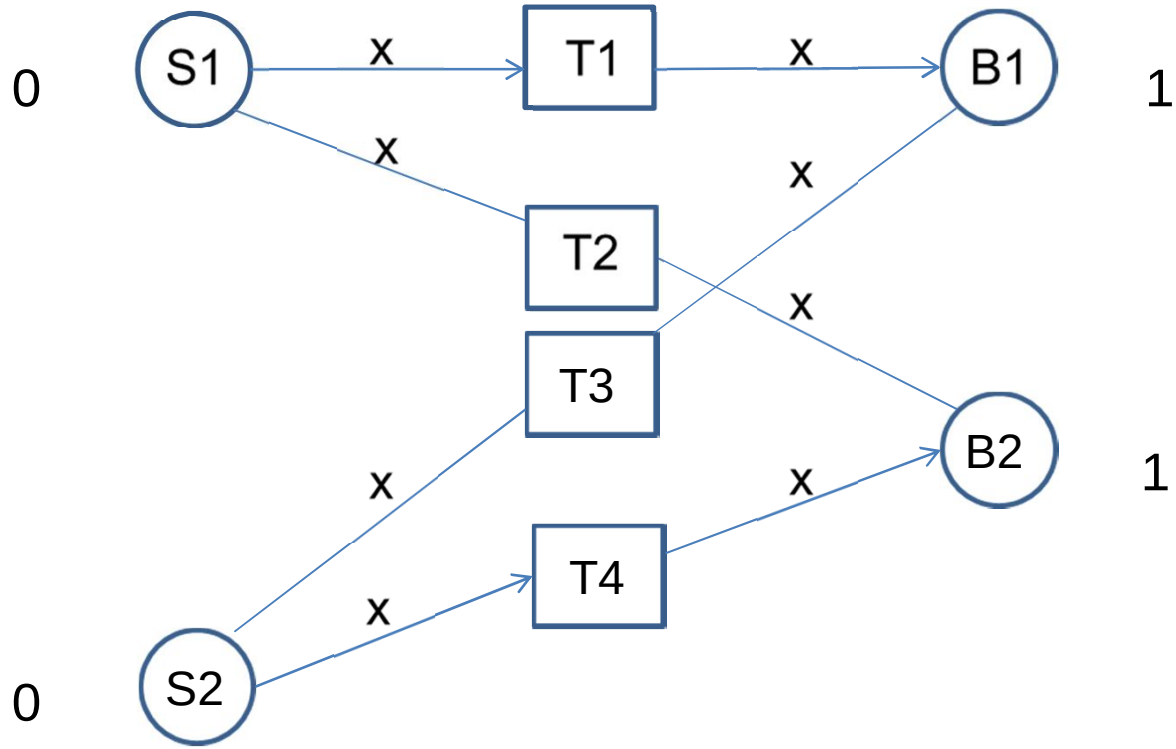
- **Monopoly**: Buyers and sellers can deal with only one trader
- **Perfect Competition**: buyers and sellers can choose among several traders



- Traders make no profit in any equilibrium
- Type of equilibrium determines which seller/buyer receives higher profit
- Game determines only the range of possible equilibria

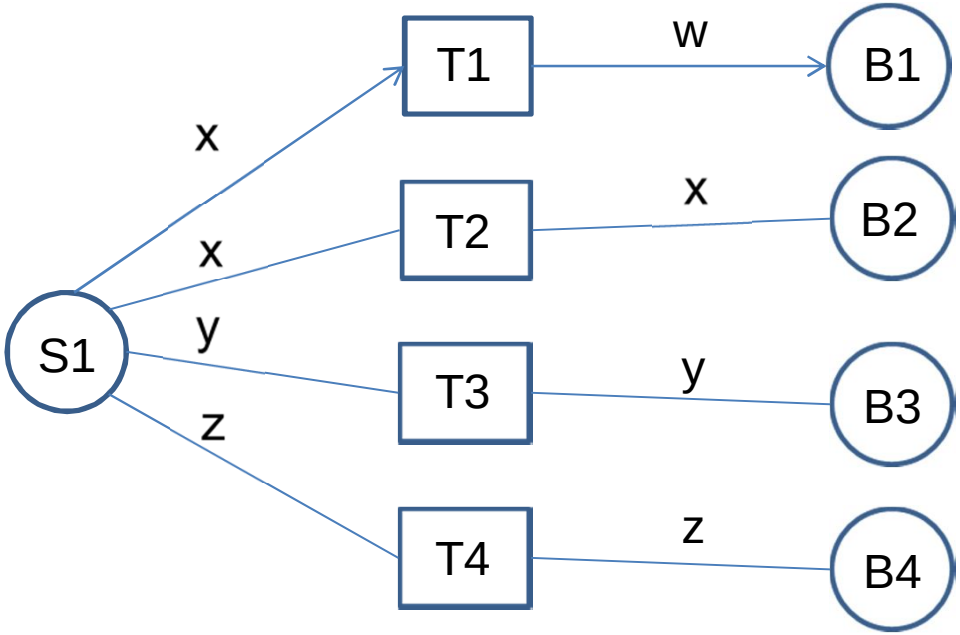
11.3 Equilibria in Trading Networks

- **Implicit Perfect Competition**
  - all bids and asks are 0
  - zero profit for traders because of network structure



11.4 Further Equilibrium Phenomena

- **Second-price auctions**



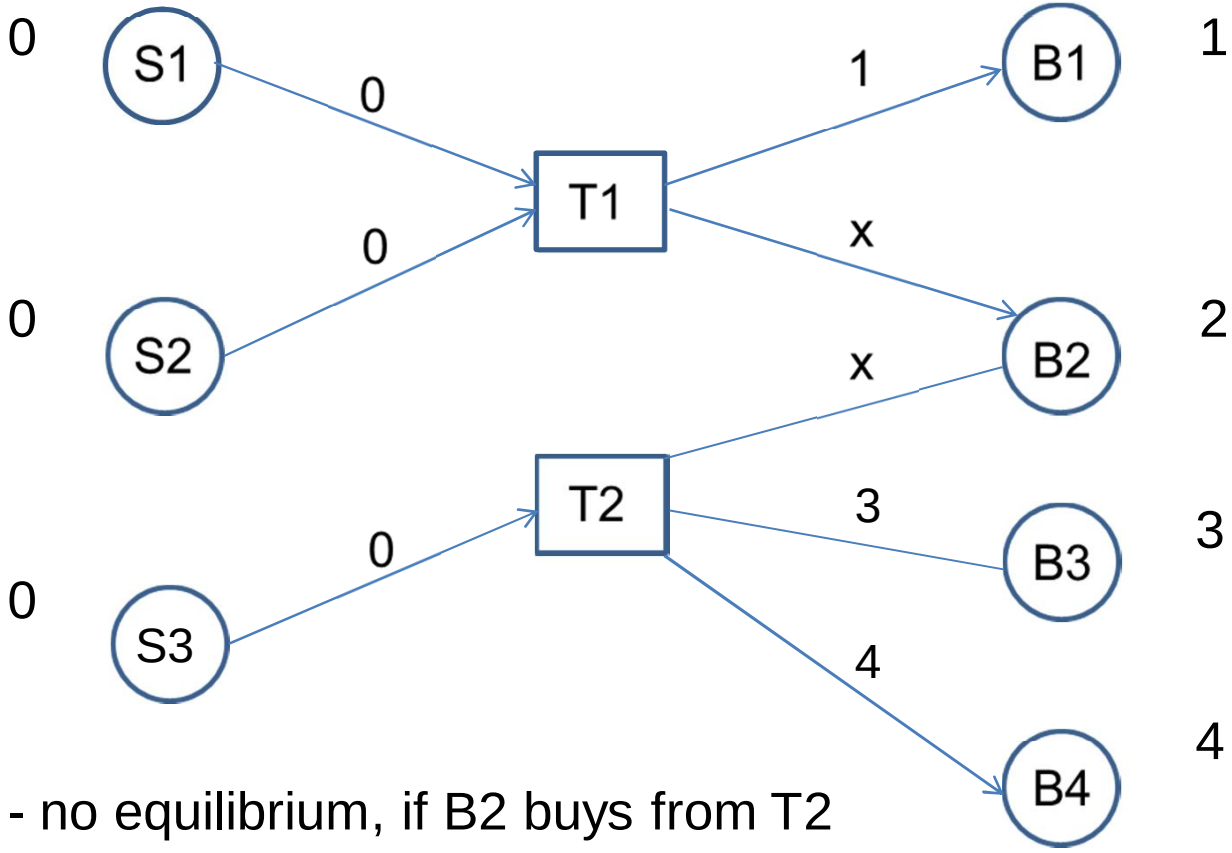
w>x>y>z

- seller receives the second highest valuation in payment

- “crossing pair”: bid is higher that corresponding ask – still an equilibrium (pathological), when trader doesn’t make the trade

11.4 Further Equilibrium Phenomena

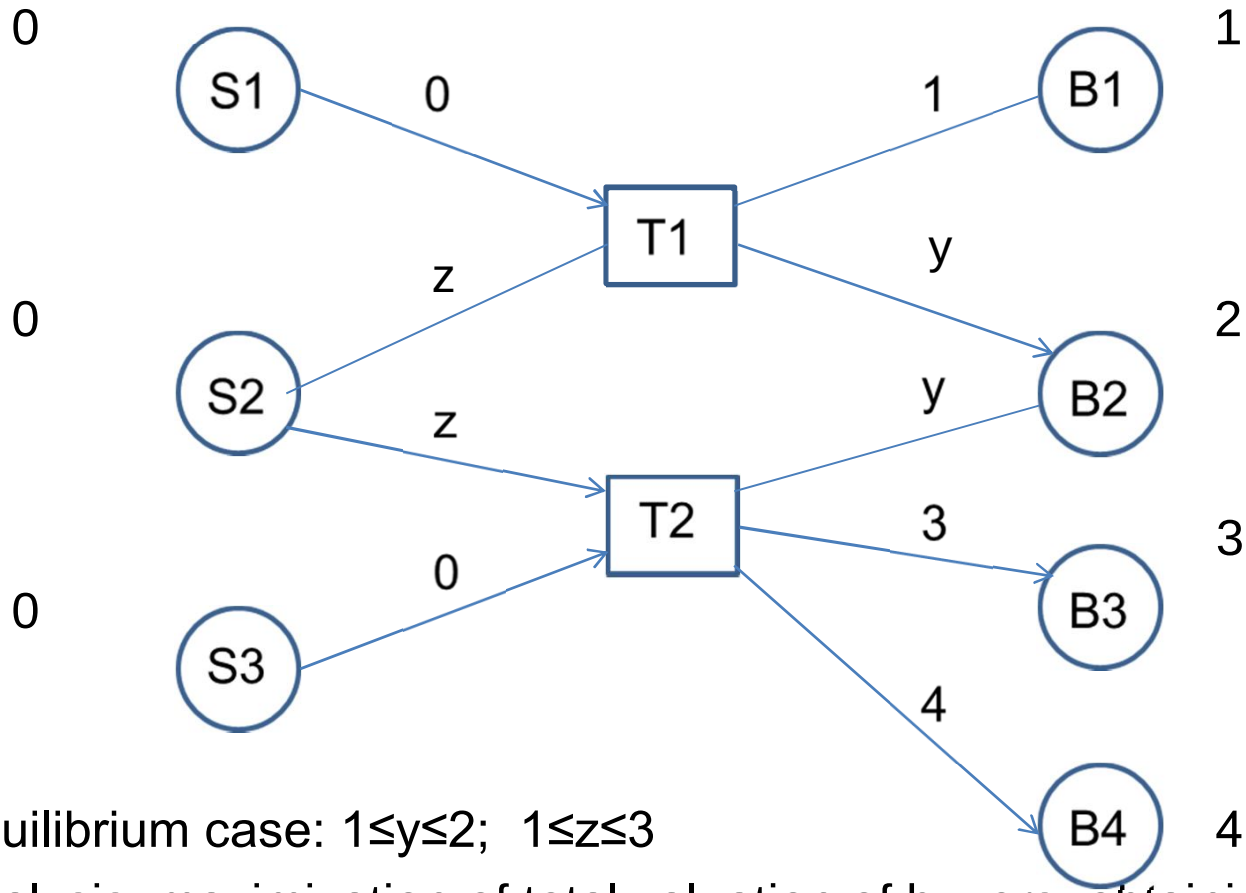
- **Ripple Effects from Changes to a Network**



- no equilibrium, if B2 buys from T2
- equilibrium case: 0≤x≤2
- analysis: restriction of flow of goods

11.4 Further Equilibrium Phenomena

- **Ripple Effects from Changes to a Network**: Equilibrium after adding a new link



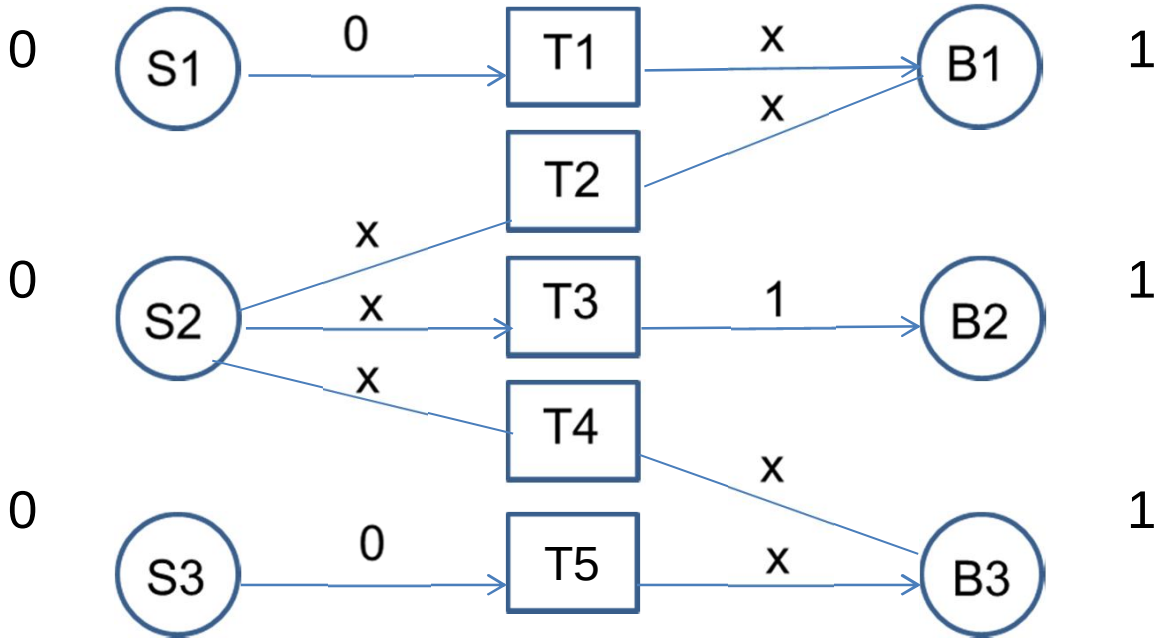
- equilibrium case: $1 \le y \le 2$; $1 \le z \le 3$
- analysis: maximization of total valuation of buyers, obtaining the good

11.5 Social Welfare in Trading Networks

- Equilibrium should be socially optimal, with maximum social welfare
- $(b_{ti} - v_i) + (a_{tj} - b_{ti}) + (v_j - a_{tj}) = v_j - v_i$
- More richly connected networks allow a higher social welfare
- Equilibria and Social Welfare
  - at least one equilibrium exists in every network
  - every equilibrium achieves the social optimum

11.6 Trader Profits

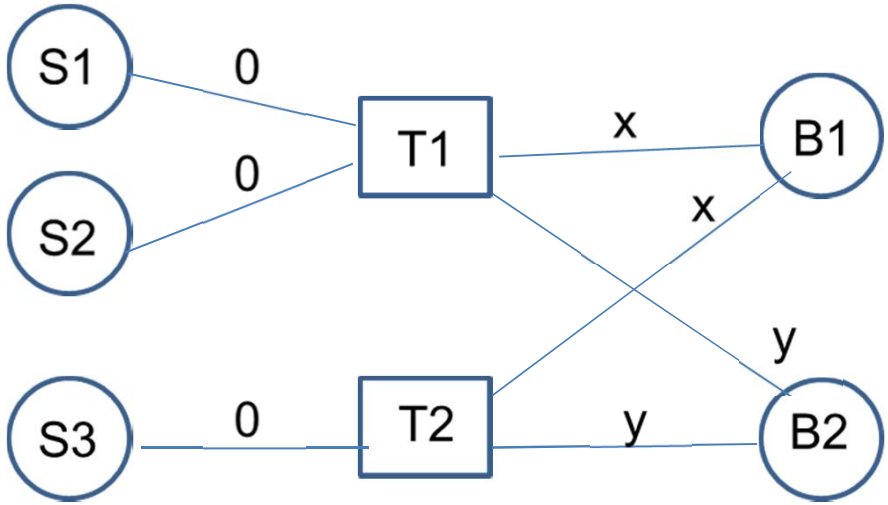
- Tend to go down in more richly connected networks
- Tend to go up when trader is essential to the network
- Depend on the equilibrium



- equilibrium: $0 \leq x \leq 1$
- social welfare of buyers and sellers varies between 1 and 2
- traders T1, T2 und T5 can make profit

11.6 Trader Profits

- Eqiulibrium with no trader profit, despite monopoly



- x=y=0

- T1 can trade one or two goods; T2 can trade one or zero goods

- Trader T has a positive profit in (some) equilibrium when T has an "essential edge" to another node

Conclusion

- Markets with intermediaries
- Equilibria
- Competition among intermediaries