Sungkyunkwan University

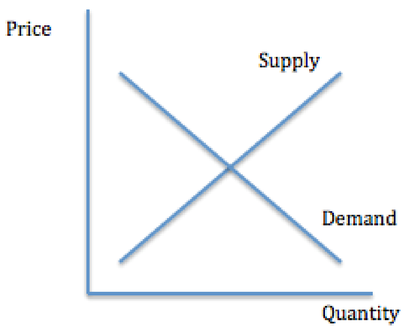
Product price and flow change in an agricultural distribution network

Daekyung Lee[1], Beom Jun Kim[1]

[1] *Department of Physics, Sungkyunkwan University, Suwon 16419, Republic of Korea*

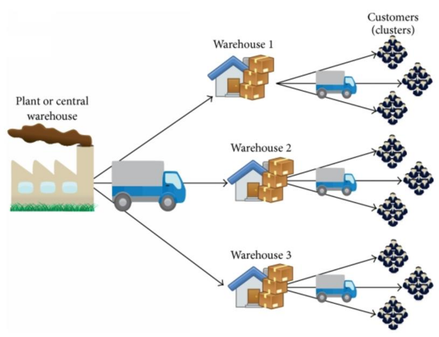
Introduction

Supply-demand theory



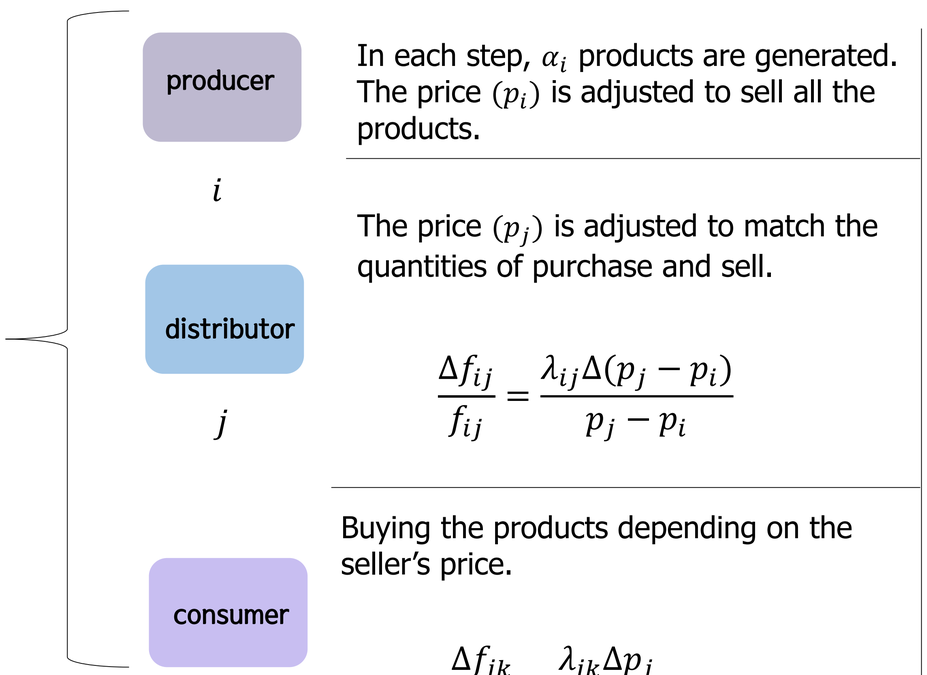
?

Distribution network

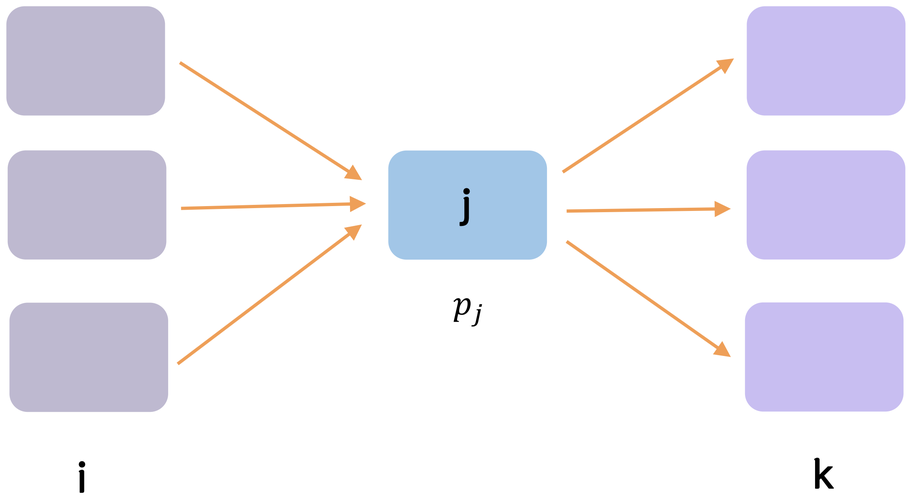


- Classical economics model → price is simply determined by supply and demand.
- Real distribution network in a complex network framework.
- How can we estimate the change of price in real network?

Model



- Typical distribution network consists of three types of node.
- Producer and distributor nodes have their own selling price p_i.
- Each link has its trade constant λ_{ij}.



$$\Delta f_j = \sum_i \Delta f_{ij} - \sum_k \Delta f_{jk} = 0$$

$$\rightarrow \sum_i \frac{\lambda_{ij}\Delta(p_j - p_i)}{p_j - p_i} - \sum_k \frac{\lambda_{jk}\Delta(p_k - p_j)}{p_k - p_j} = 0$$

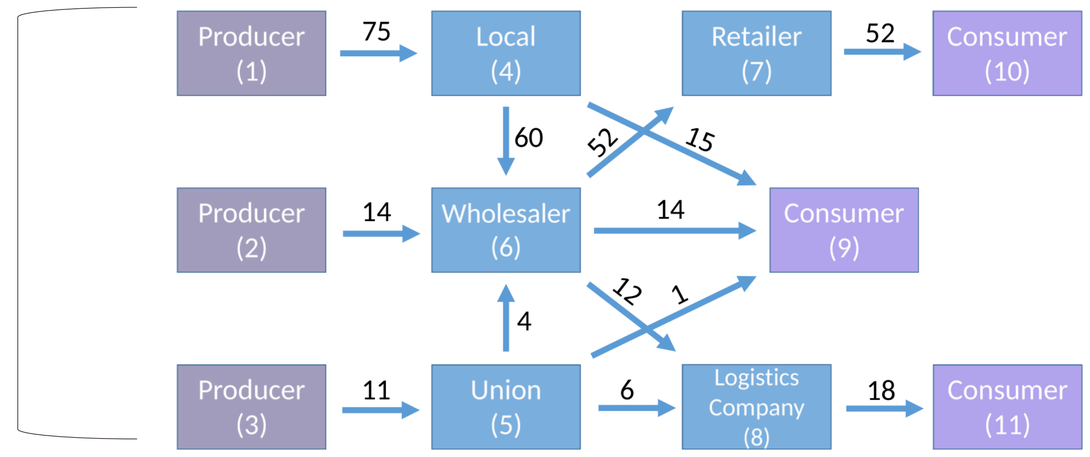
$$\rightarrow \Delta p_j = \frac{\Delta f_j}{\sum_i \frac{f_{ij}\lambda_{ij}}{p_j - p_i} + \sum_k \frac{f_{jk}\lambda_{jk}}{p_k - p_j}}$$

$\alpha_i = \alpha_i * 0.95$
#perturbation on amount of supply α_i

While not equilibrium:
  for i **in** producer:
    p_i is adjusted
  for j **in** distributor:
    p_j is adjusted

Real cabbage distribution network(2014)

Real data



assumption

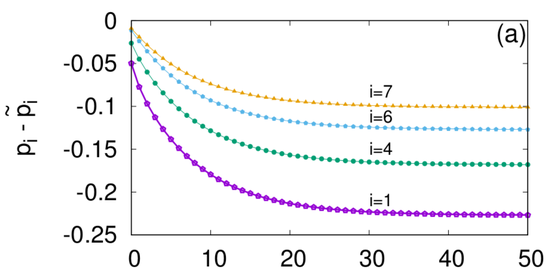
i	1,2,3	4,5	6,7,8	9,10,11
$\tilde{p}_i$	1000	2000	3000	4000

- 3 producer, 3 consumer, 5 distributor.
- We assumed the each initial price $\tilde{p}_i$ arbitrary.
- Each trade constant $\tilde{\lambda}_{ij}$ is determined by $\tilde{p}_i$ and $\tilde{p}_j$

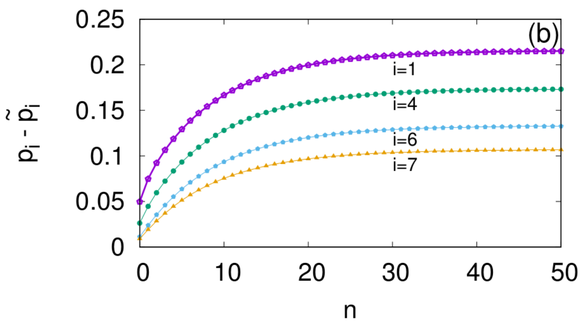
Result

1.Price change in time

α_1: 5% *increased*

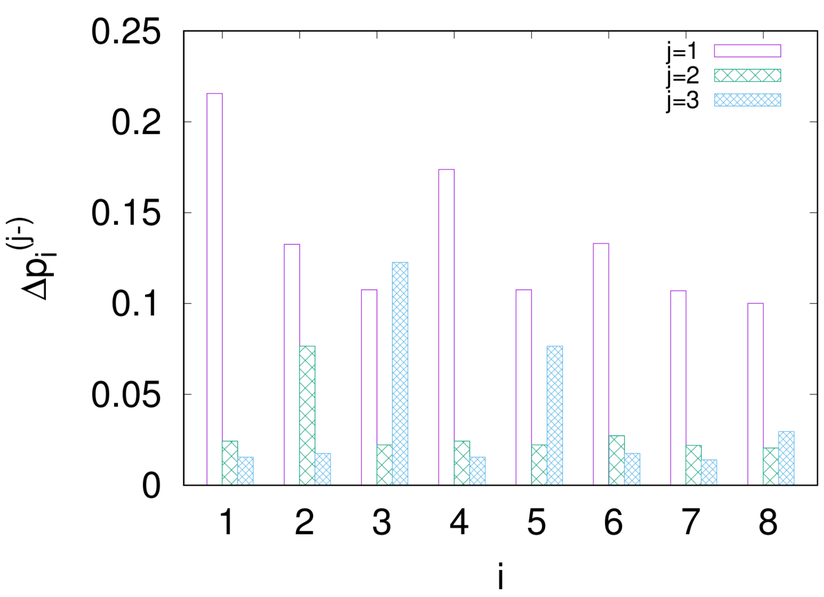


α_1: 5% *decreased*



→ New equilibrium prices emerge!

2.Price change with different fluctuation source



- When supply of j's producer increased with 5%, all nodes react differently.
- Changes of price are greatest for j=1, which has a large supply portion.
- Impact of supply changes decreases when detour route exist.

Summary&Conclusion

- We have extended the supply-demand theory to real distribution network.
- Price changes in real network investigated by real network structure.
- Detour route in distribution network is important to prevent rapid price change.