Consumption Risksharing in Social Networks

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PRELIMINARY

Introduction

- In many societies, formal insurance markets are missing or imperfect $\Rightarrow$ agents use informal arrangements

  - Such arrangements often take place in the social network.

- This paper builds a model of informal insurance in the social network.

  – Connections generate value which is used as *social collateral* to enforce informal contracts.

- Our model yields results consistent with stylized facts about limited risksharing in developing countries.

Plan of the Talk

1. Theory: Informal insurance in social networks.

2. Model analysis:

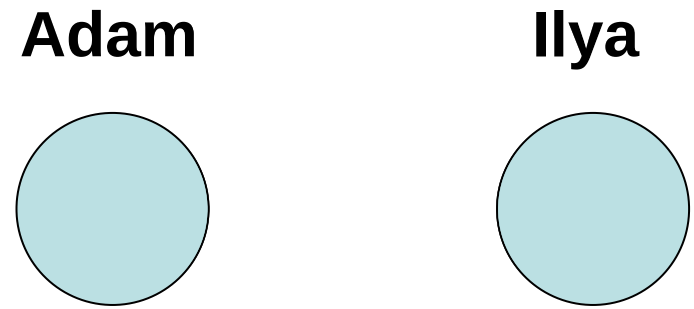
   A) The limits to risksharing;

   B) Constrained efficient arrangements and local sharing.

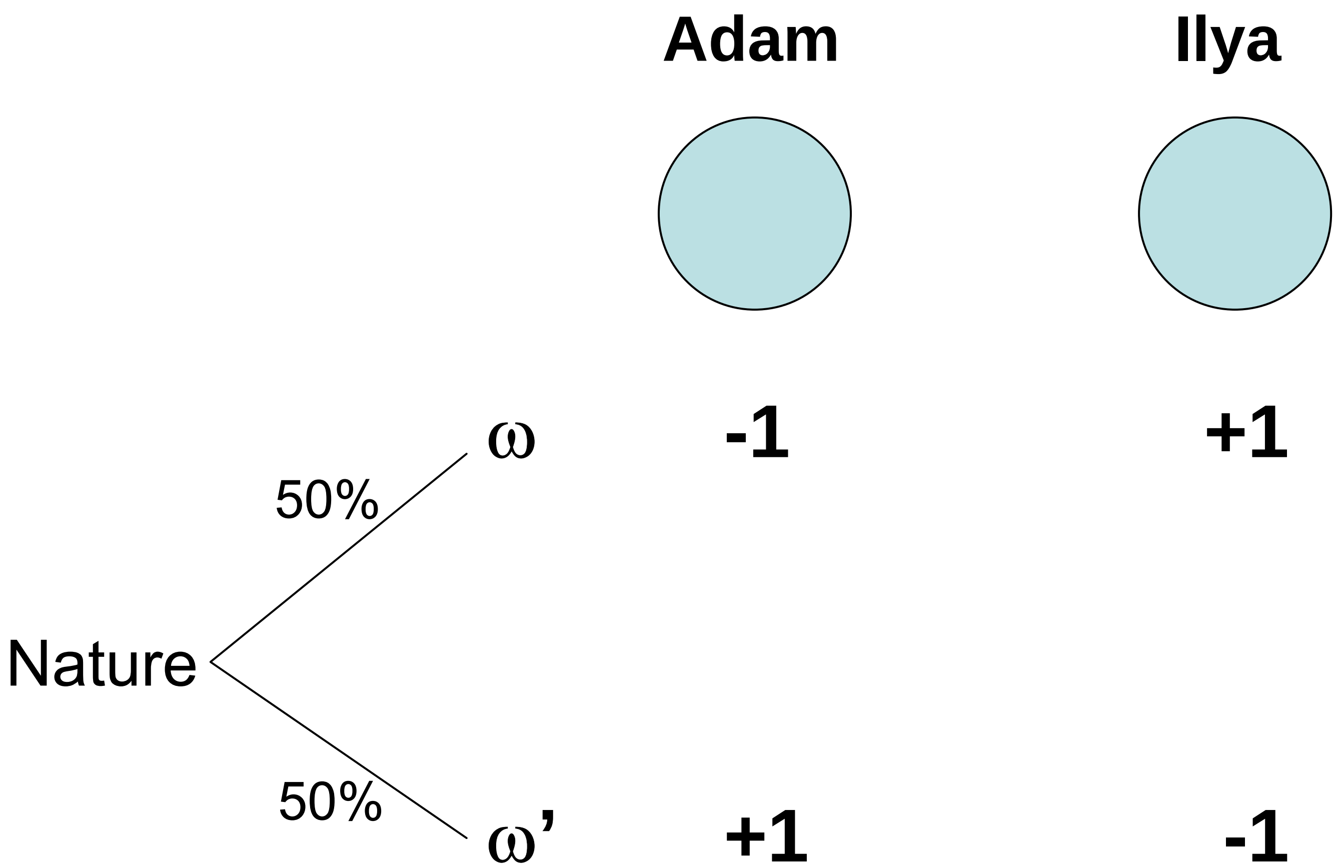
Related literature

- Bloch, Genicot and Ray (2006): Characterize networks that are stable under certain risksharing arrangements.
- Bramoulle and Kranton (2005): Explore risksharing without enforcement constraints.
- Mobius and Szeidl (2006): Borrowing in a social network.
- Wilson (1968): Risksharing in syndicates.
- Cochrane (1991), Townsend (1994), Udry (1994): Limits to full risksharing in the data.

The benefits of risksharing



The benefits of risksharing



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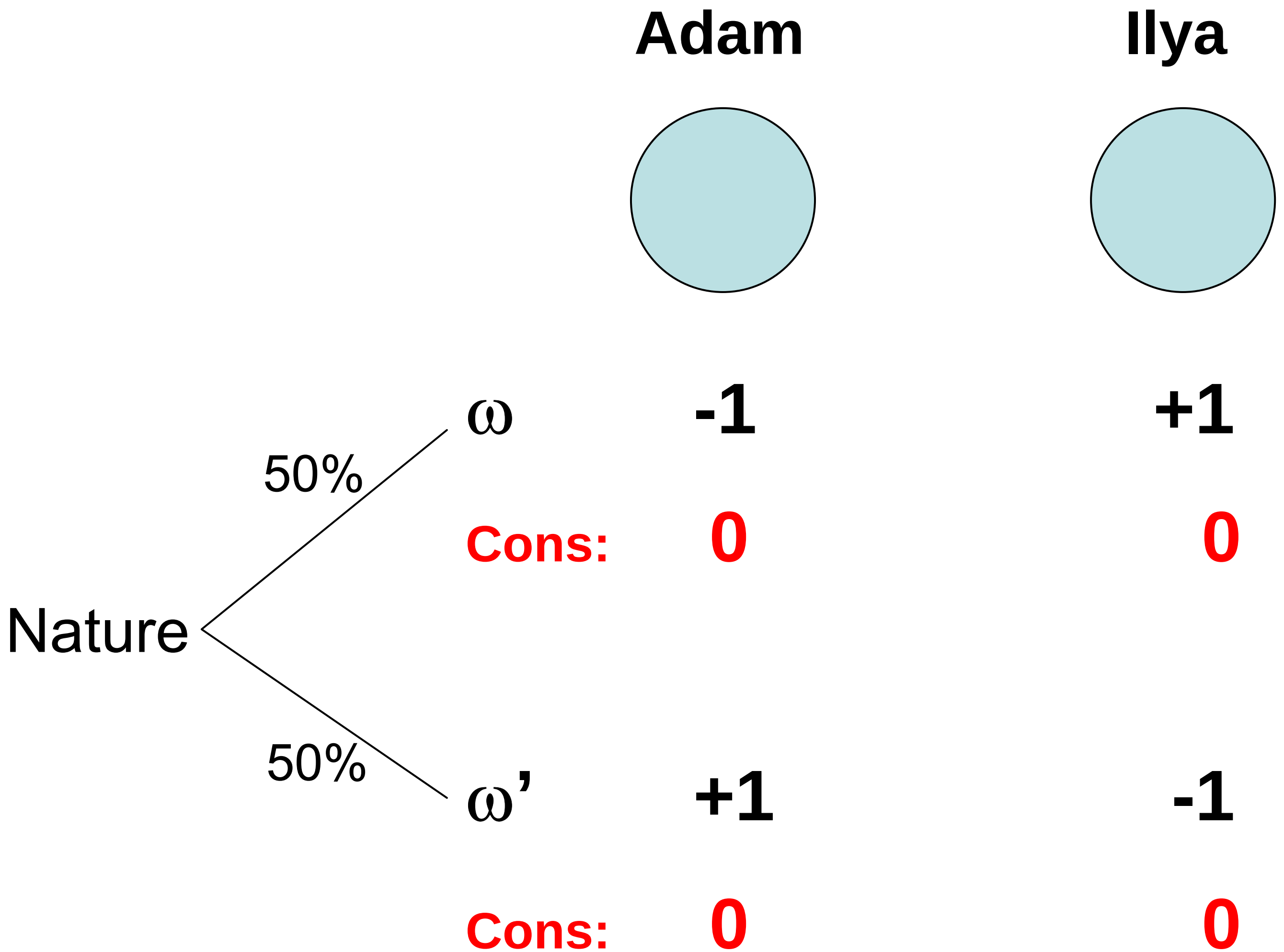

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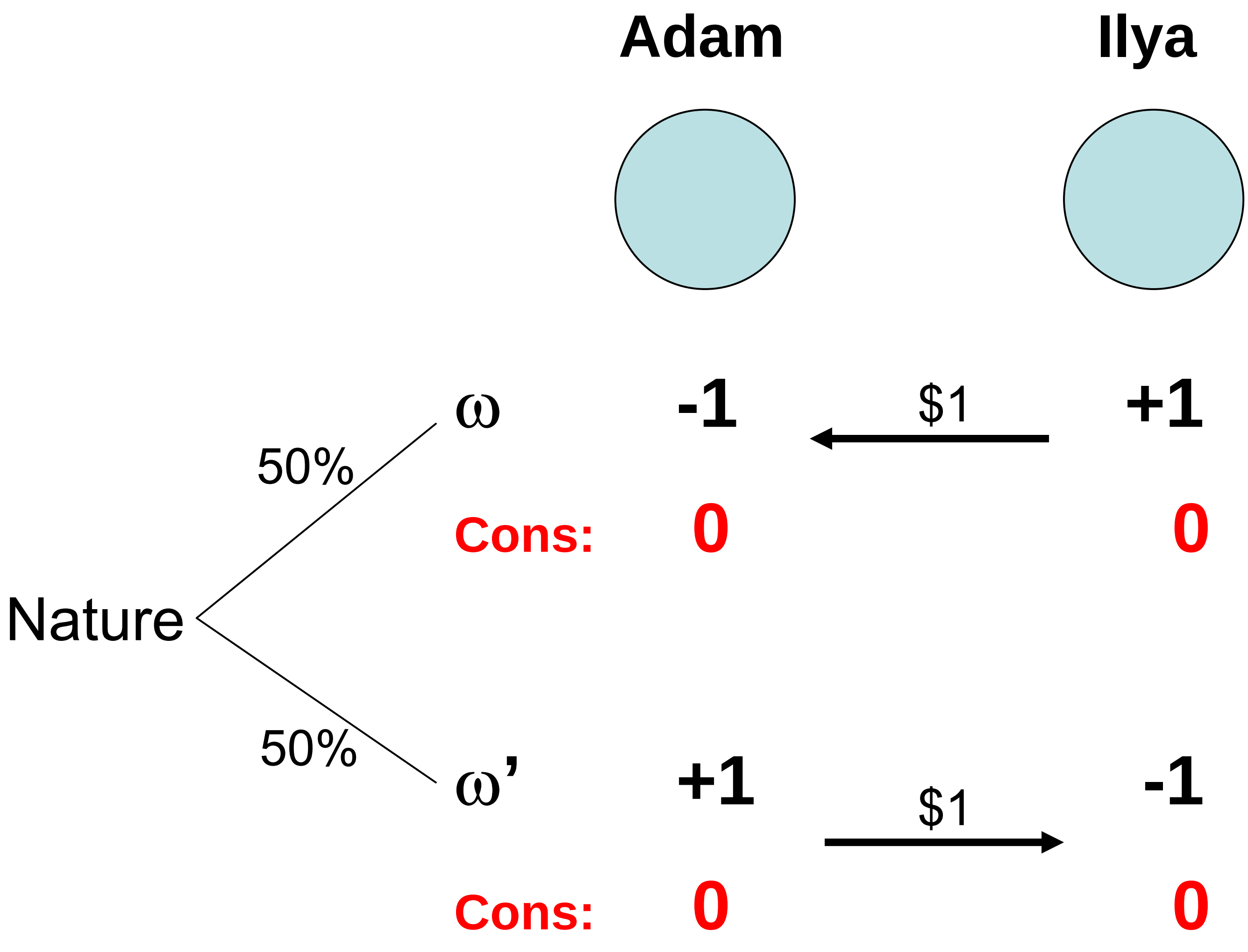
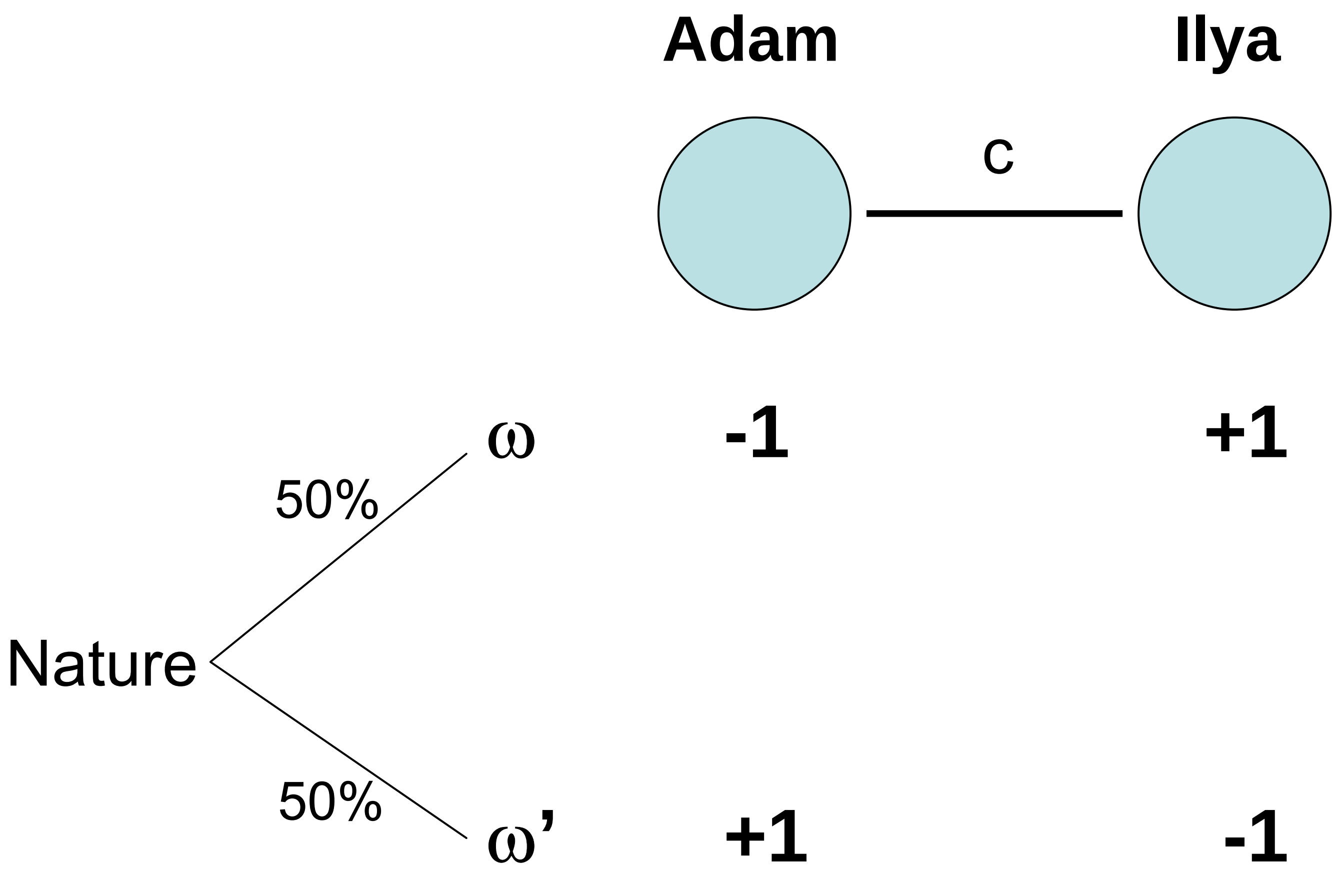


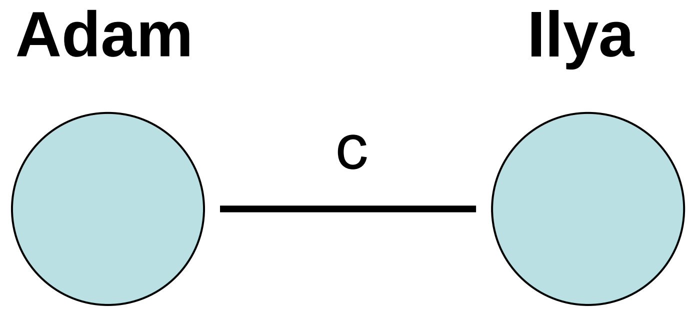
Risksharing with informal enforcement

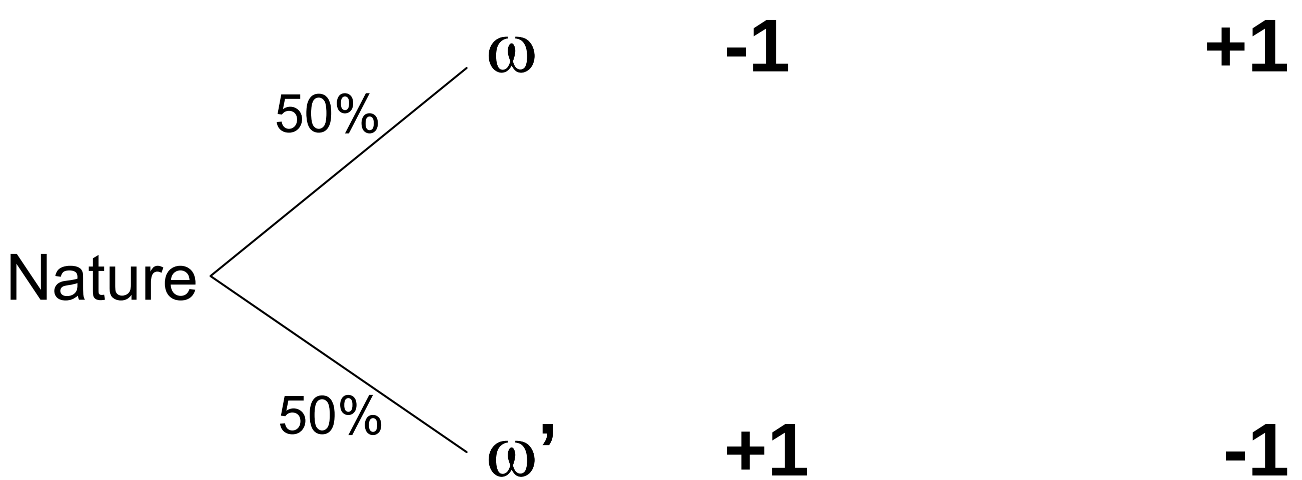


Risksharing with informal enforcement

Key condition:

Transfer $\leq$ link capacity





Risksharing with informal enforcement

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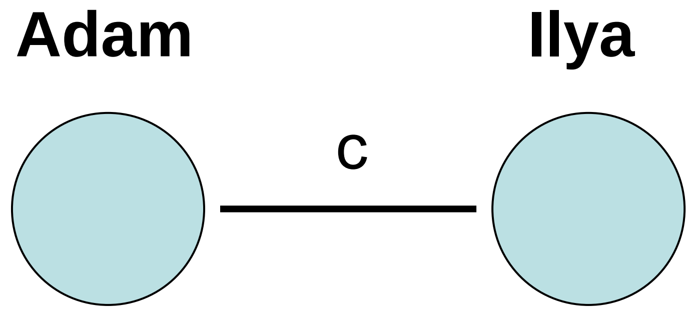
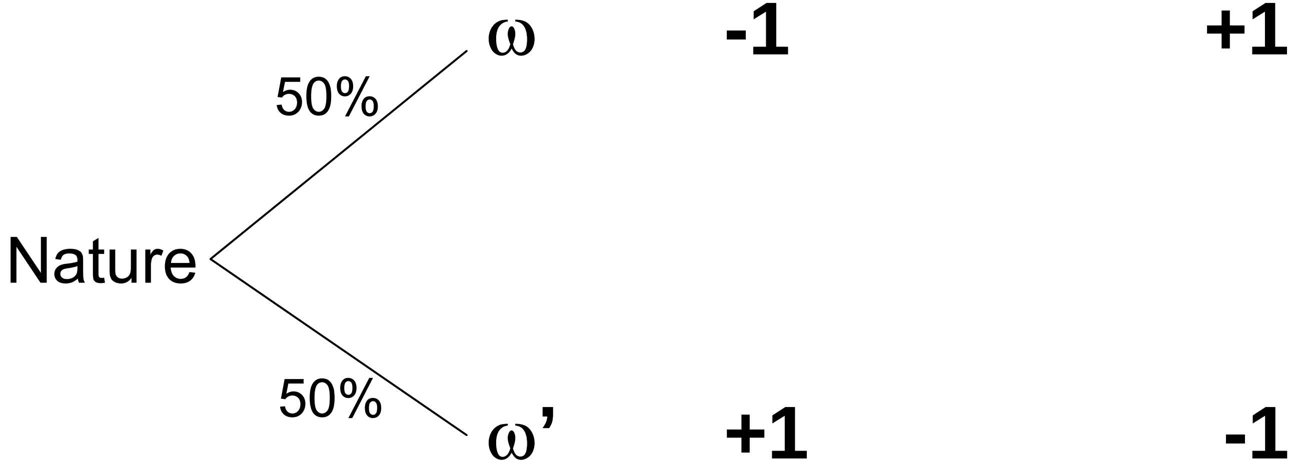
Suppose c<1, then….





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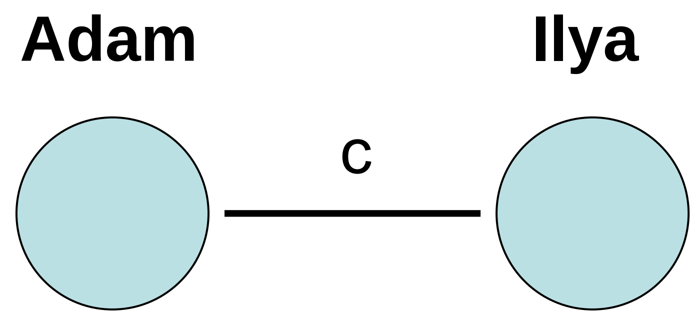

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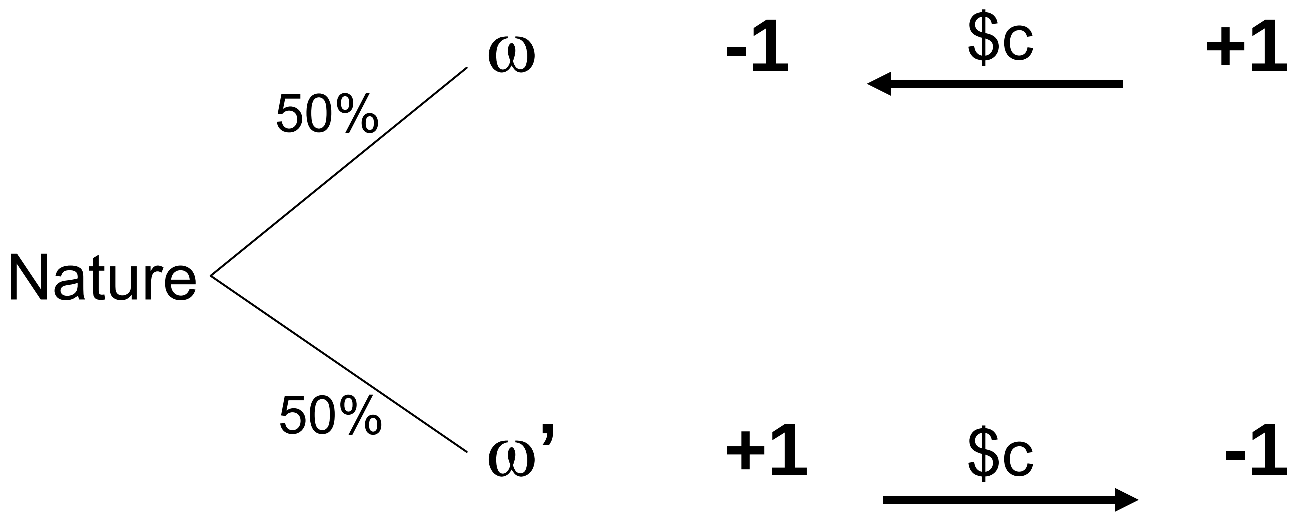

Risksharing with informal enforcement

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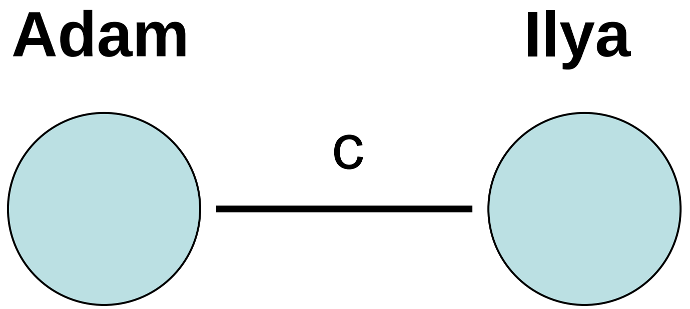
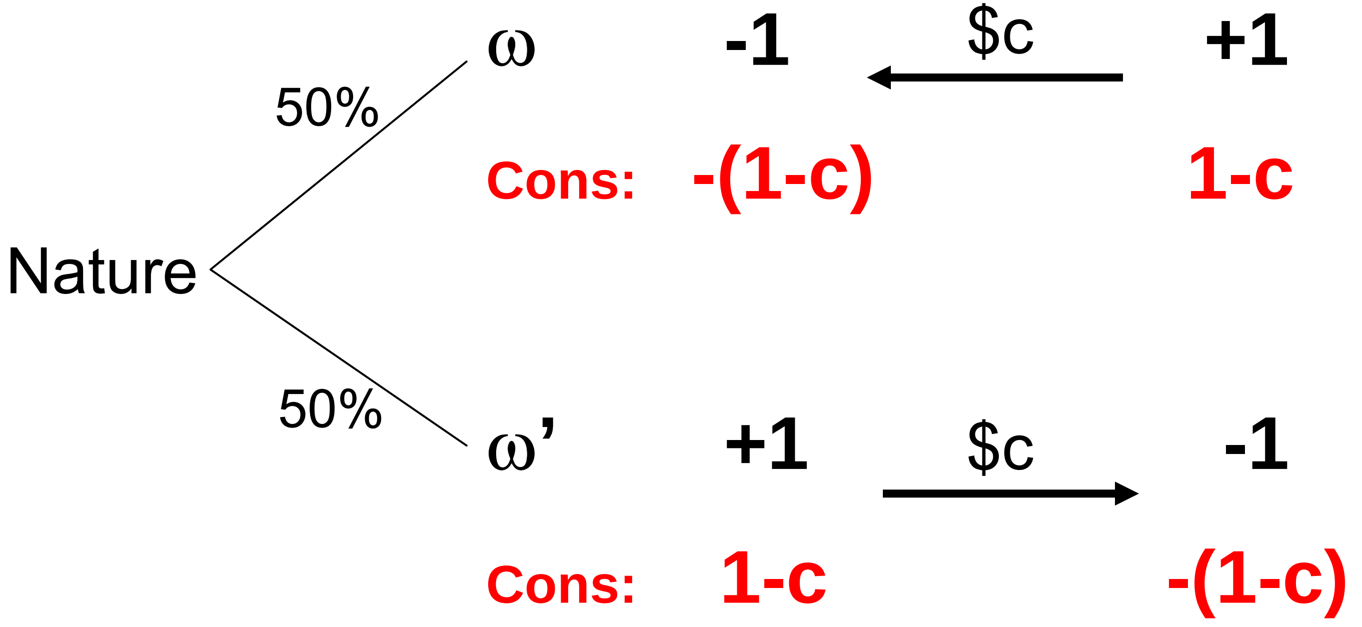




General model

- Consider N agents organized in exogenous social network $G = (W, L)$.

- A link represents friendship or business relationship between parties.

- Strength of relationships measured by non-negative capacity $c : W \times W \rightarrow \mathbb{R}$.

  – Assume that $c(i, j) = c(j, i)$ and that $c(i, j) = 0$ if $(i, j) \notin L$.

Endowments and transfers

- A state of the world is characterized by a realization of agents' endowments: $\{e_i\}_{i \in W}$
  - Endowments have a commonly known prior distribution.
  - All endowment realizations in product set of supports have positive probability.
- To share risk, agents ex ante agree on a set of transfers t_{ij} for all i, $j \in W$ and for each state of the world.
  - Here t_{ij} is the net transfer to be paid by i to j.
  - By definition, $t_{ij} = -t_{ji}$.

Contract enforcement

- After endowment realization, agents are expected to make promised transfers.

- If agent i fails to make promised transfer t_{ij}, he loses (i, j) link.

- These links disappear exogenously: friendly feelings no longer exist when somebody breaks a promise.

  – Can be microfounded: if j fails to receive t_{ij} payment, he concludes that j is no longer a friend, and stops interacting with him.

Incentive compatible transfers

- Transfer arrangement is incentive compatible if agents make promised transfers for all realizations of uncertainty.
  - Better to pay transfer than to lose friend.

- **Proposition**: Arrangement is incentive compatible iff capacity constraint holds:

$$t_{ij} \leq c(i,j).$$

- Promised transfers should never exceed friendship value.

2. Model Analysis: Limits to risksharing

- **Key point:** one network statistic seems to govern limits to risksharing in many environments.

- For any subset of agents F, define *perimeter-to-area ratio* of F as

$$a[F] = \frac{c[F]}{|F|}$$

  where $c[F] = \sum_{i \in F,\ j \notin F} c(i,j)$ is the total capacity leaving F.

- Captures ability of set in offloading shocks relative to number of agents in set.

- For cubes of side n in the k-dimensional grid, $a[F] = O\left(n^{-1}\right)$.

Limits to risksharing

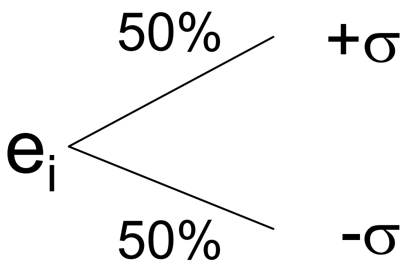
- Let σ_i be the standard deviation of e_i, and let $\sigma = \min[\sigma_i]$.

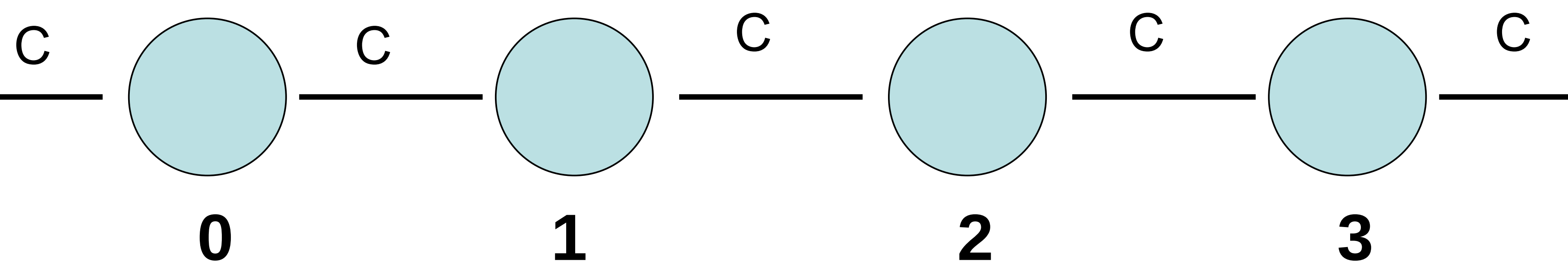
- **Proposition.** If $a[F] < \sigma$ for some F with $|F| \leq N/2$, then no IC insurance arrangement is unconstrained Pareto-optimal, and there is an agent in F who is not fully insured.

  – If perimeter/area is not big enough, first best insurance cannot be obtained.

- Intuition: shocks accumulate over agents in F; if perimeter is small, some accumulated shocks cannot fully leave F.

Infinite line network





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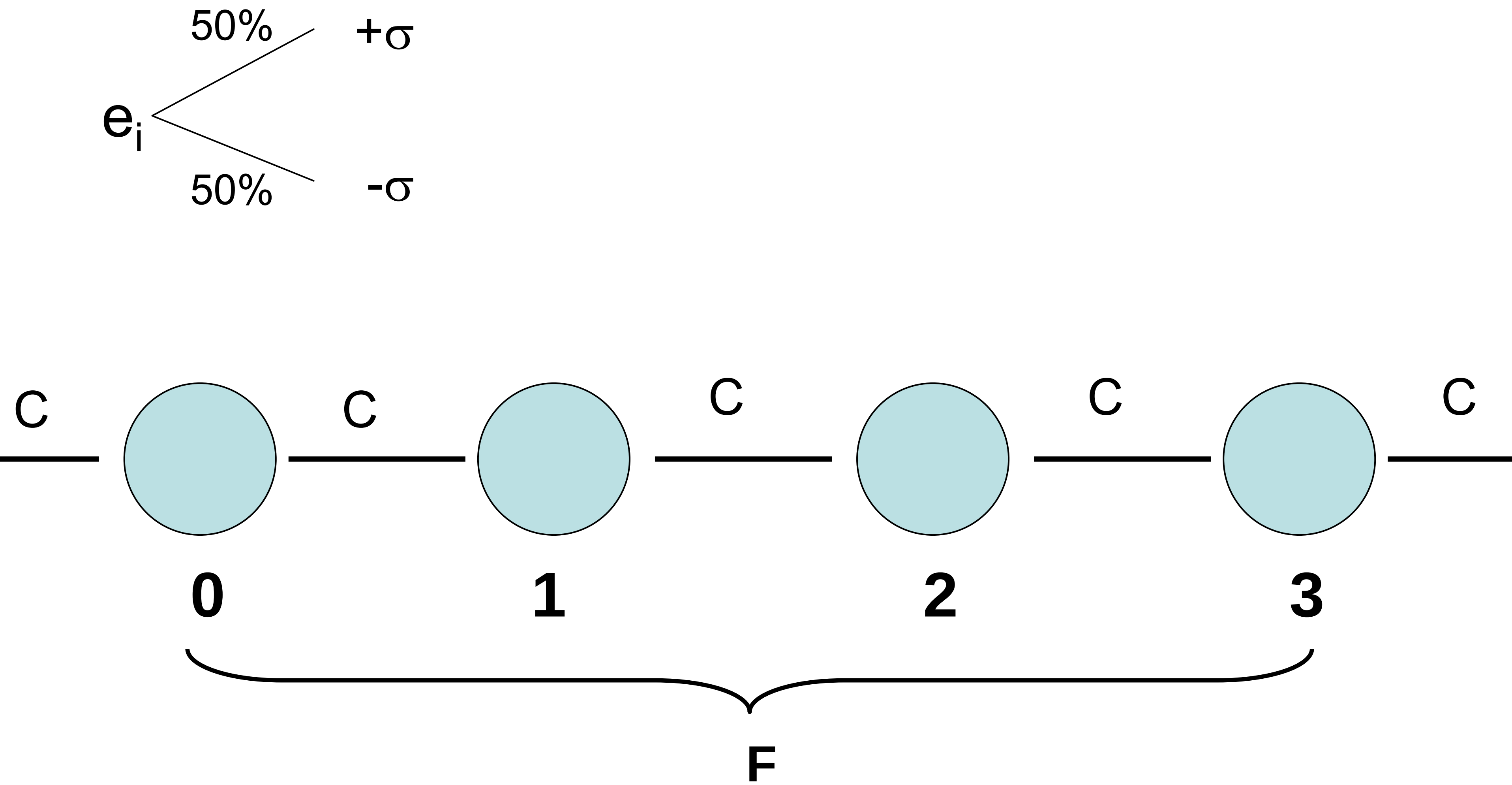

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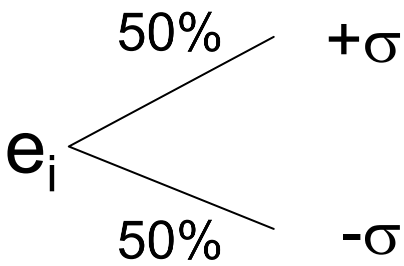
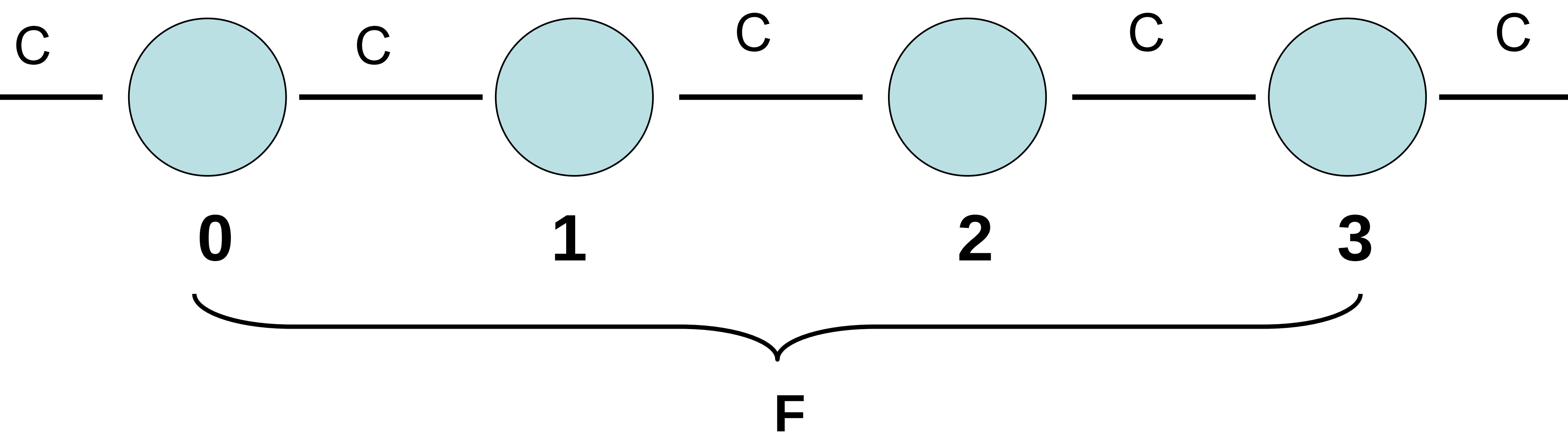
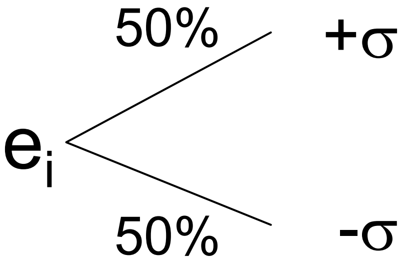
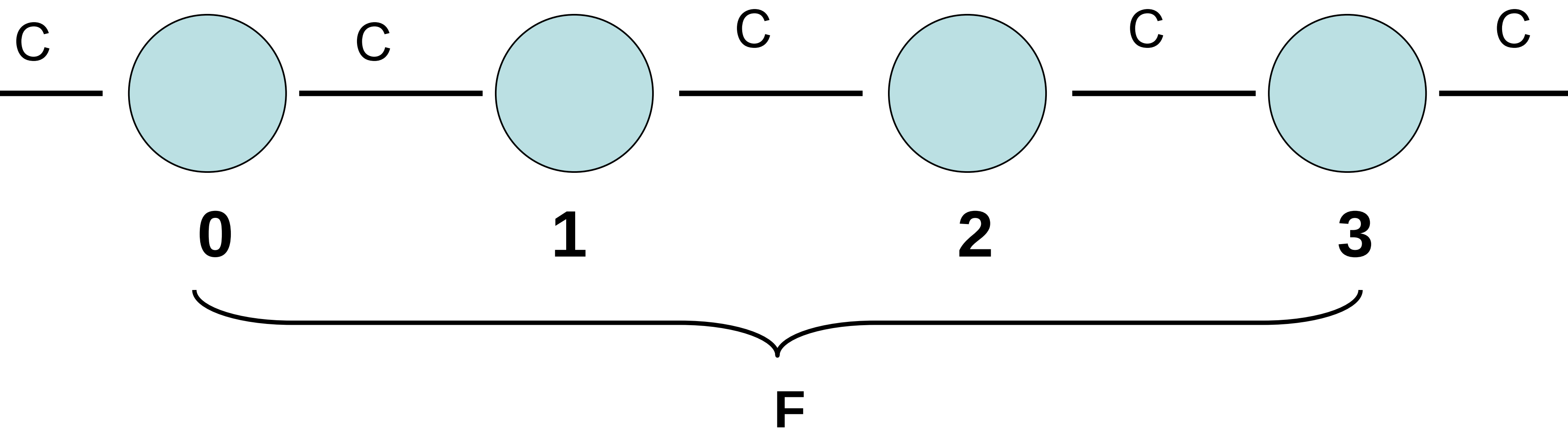




$e_0 = +\sigma$

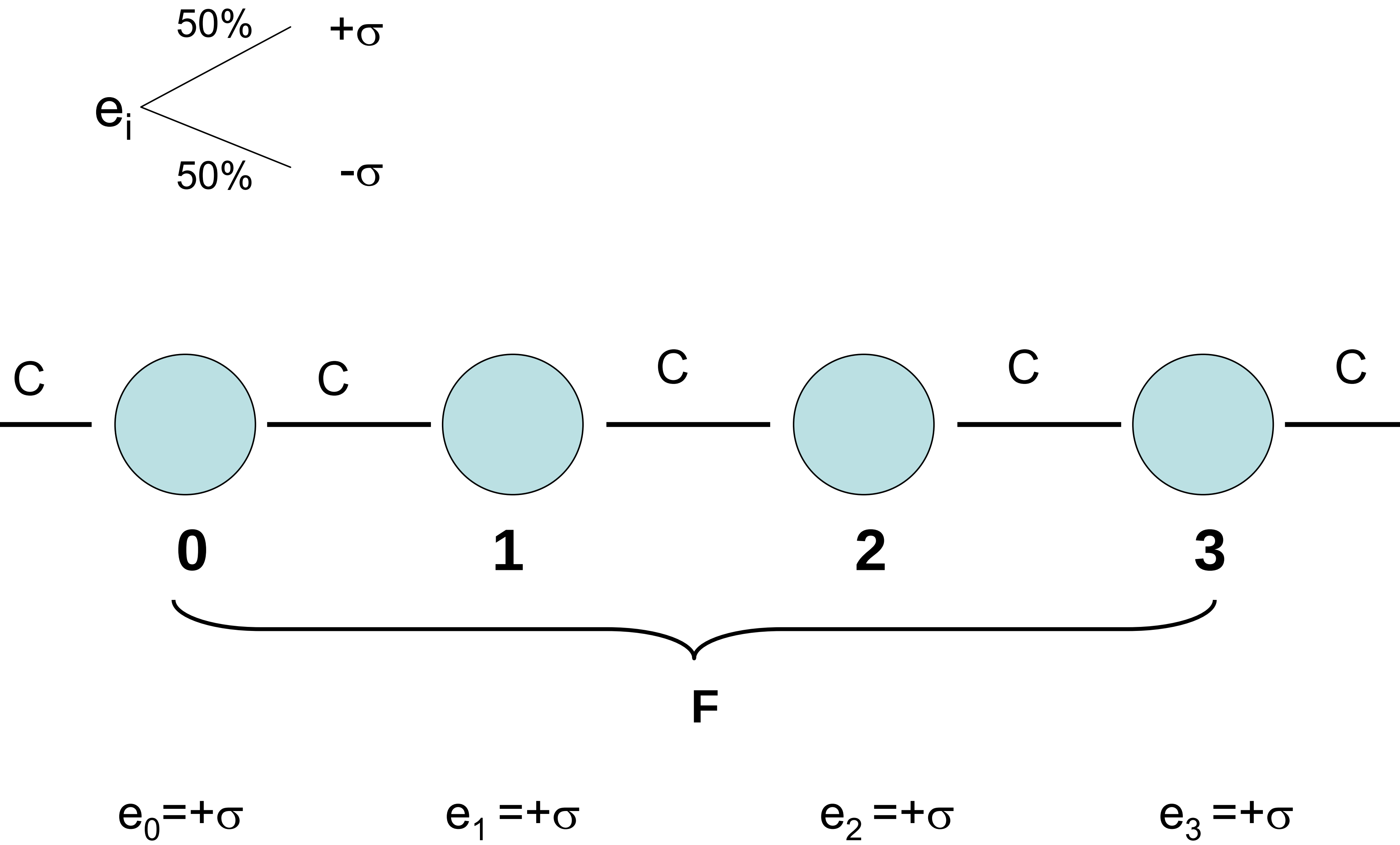
Infinite line network



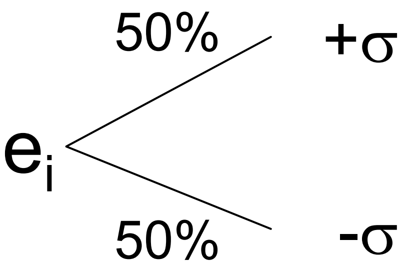


$e_0 = +\sigma$ $e_1 = +\sigma$

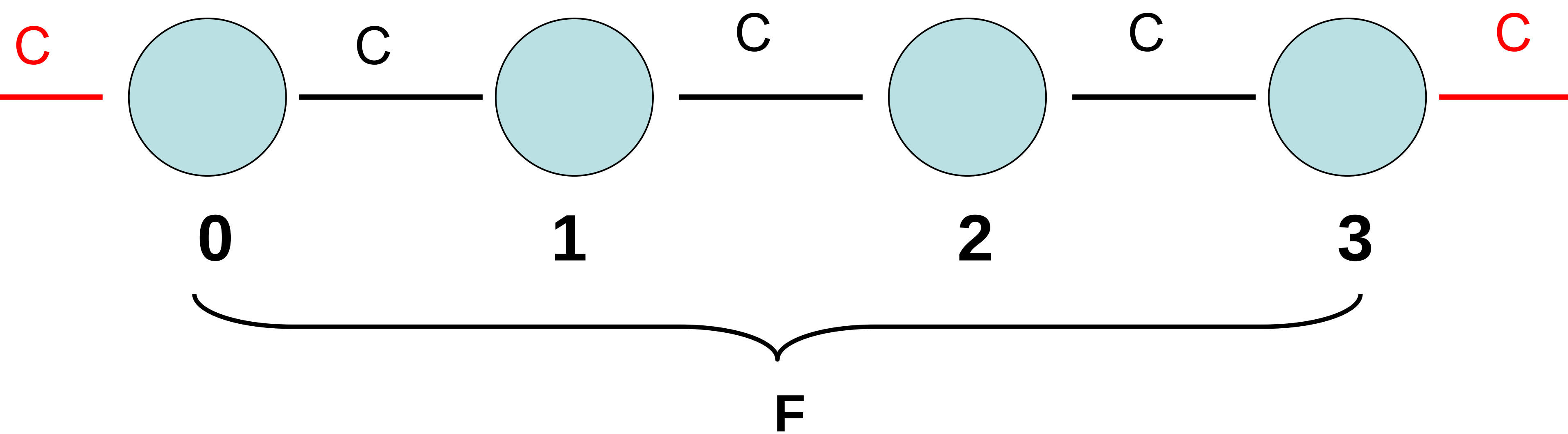
Infinite line network



Infinite line network



$|F|\cdot\sigma \leq c[F]$



$e_0=+\sigma$ $e_1=+\sigma$ $e_2=+\sigma$ $e_3=+\sigma$

Imperfect risksharing: a measure of dispersion

- When Pareto-optimality fails, what degree of risksharing can be achieved?

- First need to develop some measure of the degree of risksharing.

- Define *cross-sectional dispersion of consumption* as square root of expected cross-sectional variance:

$$DISP = \mathsf{E}\left[\frac{1}{N}\sum (x_i - \overline{x})^2\right]^{1/2}.$$

  - With i.i.d. shocks and no sharing (autarky), $DISP = \sigma$;

  - In equal sharing $DISP = 0$.

Imperfect risksharing: a characterization result

- Let e_i be i.d.d. coin flips assuming values σ and $-\sigma$ with equal probabilities, and assume

$$(1/N)\sum e_i = 0.$$

  – Then $DISP = \sigma$ in autarky.

- **Proposition** [Perimeter/area ratio and degree of risksharing]

  (i) If $a[F] \geq k$ for all F with $|F| \leq N/2$, then there exists an IC allocation where $DISP = \sigma - k$.

  (ii) There exist networks and endowment distributions where this is sharp: $DISP \geq \sigma - k$ for all IC arrangements.

Imperfect risksharing: proof outline

- Fix network where $a\left[F\right] \geq k$ for all F with $|F| \leq N/2$.

- In any endowment realization (e_i) there are $N/2$ people with $+\sigma$ and $N/2$ people with $-\sigma$.

  – Need to transfer \$$k$ from $+\sigma$ guys to $-\sigma$ guys.

- This is a flow problem $\Longrightarrow$ feasible if min cut $\geq$ desired flow.

  – Perimeter/area inequality bounds are exactly what is needed to ensure this.

Limits to risksharing: correlated shocks

- Suppose that agents are partitioned into disjoint sets (villages) F_m, $m = 1, 2, \ldots, M$.

- Agents experience both village-specific and idiosyncratic shocks:

$$e_i = s_m + \varepsilon_i$$

  where s_m is common shock for village m and ε is i.i.d.

- To measure risksharing across villages, regress village per capita consumption on village-specific shock:

$$y_m = \alpha_m + \beta_m \cdot s_m + \nu_m.$$

- In full risksharing, $\beta_m = O\left(1/N\right) \approx 0$; with no risksharing, $\beta_m = 1$.

Correlated shocks continued

- High risksharing across villages means β close to zero; low risksharing means β close to 1.
- **Proposition.** We have
$$1 - \frac{a\left[F_m\right]}{\sigma_{s_m}} \leq \beta_m \leq 1 + \frac{a\left[F_m\right]}{\sigma_{s_m}}.$$
- When the perimeter/area ratio $a\left[F_m\right]$ of a village is small, β is close to one.
- Village-specific shock cannot leave F_m through thin perimeter.

Limits to risksharing: summary

- Perimeter-to-area ratio relative to σ governs limits to risksharing:

  1. When ratio small, full risksharing cannot be achieved;
  2. Ratio governs magnitude of cross-sectional cons dispersion;
  3. Ratio limits degree to which village-specific shocks can be shared.

- Consistent with evidence on limited risksharing:

  – Cochrane (1991): Large shocks (long unemployment spell, illness) are not fully insured.

  – Townsend (1994): More insurance within than across villages.

2B Constrained efficient allocations

- Can we learn more by focusing on “second best” arrangements?

- A risksharing arrangement is constrained efficient if it is Pareto-optimal subject to the IC constraints.

- Our approach:

  1. Second best arrangements are equivalent to solution of social planner’s problem with a set of weights.

  2. Use FOC of planner’s problem to characterize second-best allocations.

FOC of planner's problem

- Assume all planner weights are equal.

- FOC with no IC constraints would be: $U_i' = U_j'$ for all i, j.

- FOC with IC constraints: if $U_i' < U_j'$ then $t_{ij} = c(i, j)$.

- Intuition:

  1. If marginal utility is not equalized, planner's objective can be improved by transferring a small amount from i to j.

  2. This is not possible $\Longrightarrow$ IC constraint must hold with equality.

Endogenous risksharing “islands”

- Fix endowment realization $\{e_i\}_{i \in W}$.

- FOC can be used to partition network into connected components, such that

  1. Within a component, marginal utility is equalized;

  2. Across components, marginal utility differs and connecting links operate at full capacity.

- Shock are fully shared within an “island” but imperfectly shared across islands.

Example: Circle network

- Consider N agents organized in a circle w/ all link capacities $= c$.

- Suppose that e_i are identically distributed:

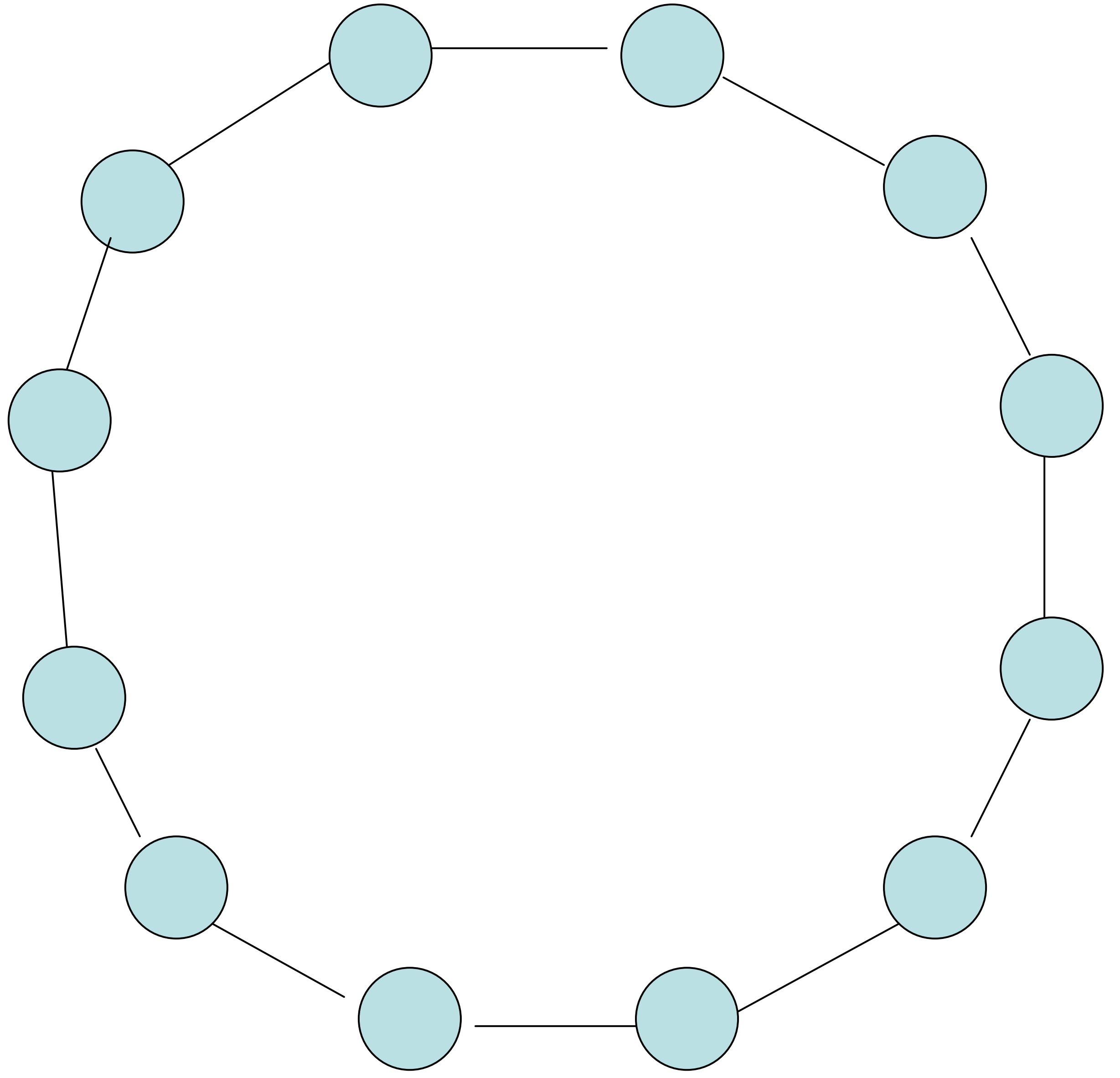
$$e_i = \begin{cases} -K & \text{with prob } p \\ 0 & \text{with prob } 1-p \end{cases}$$

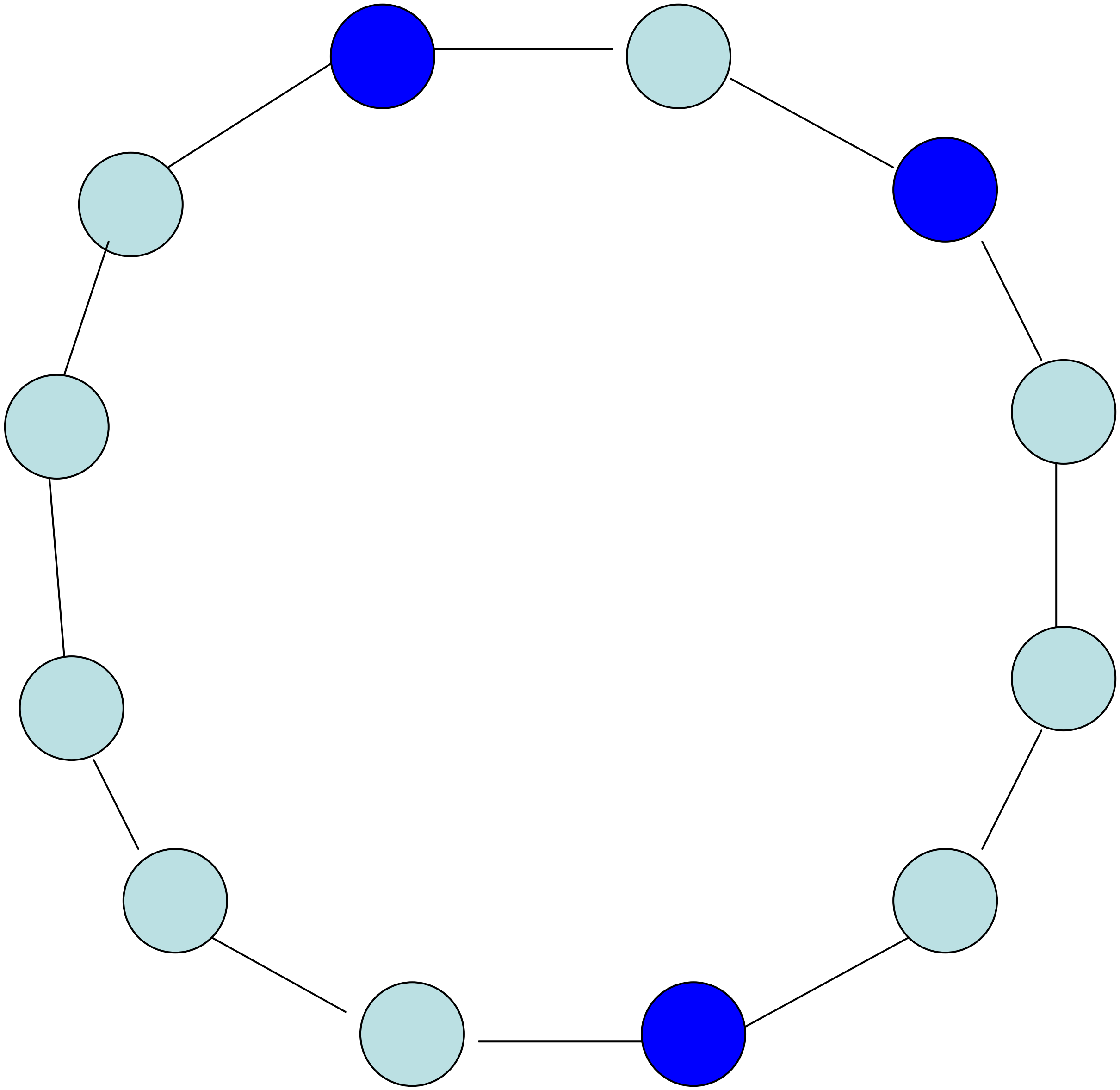
  where $K > 4c$.

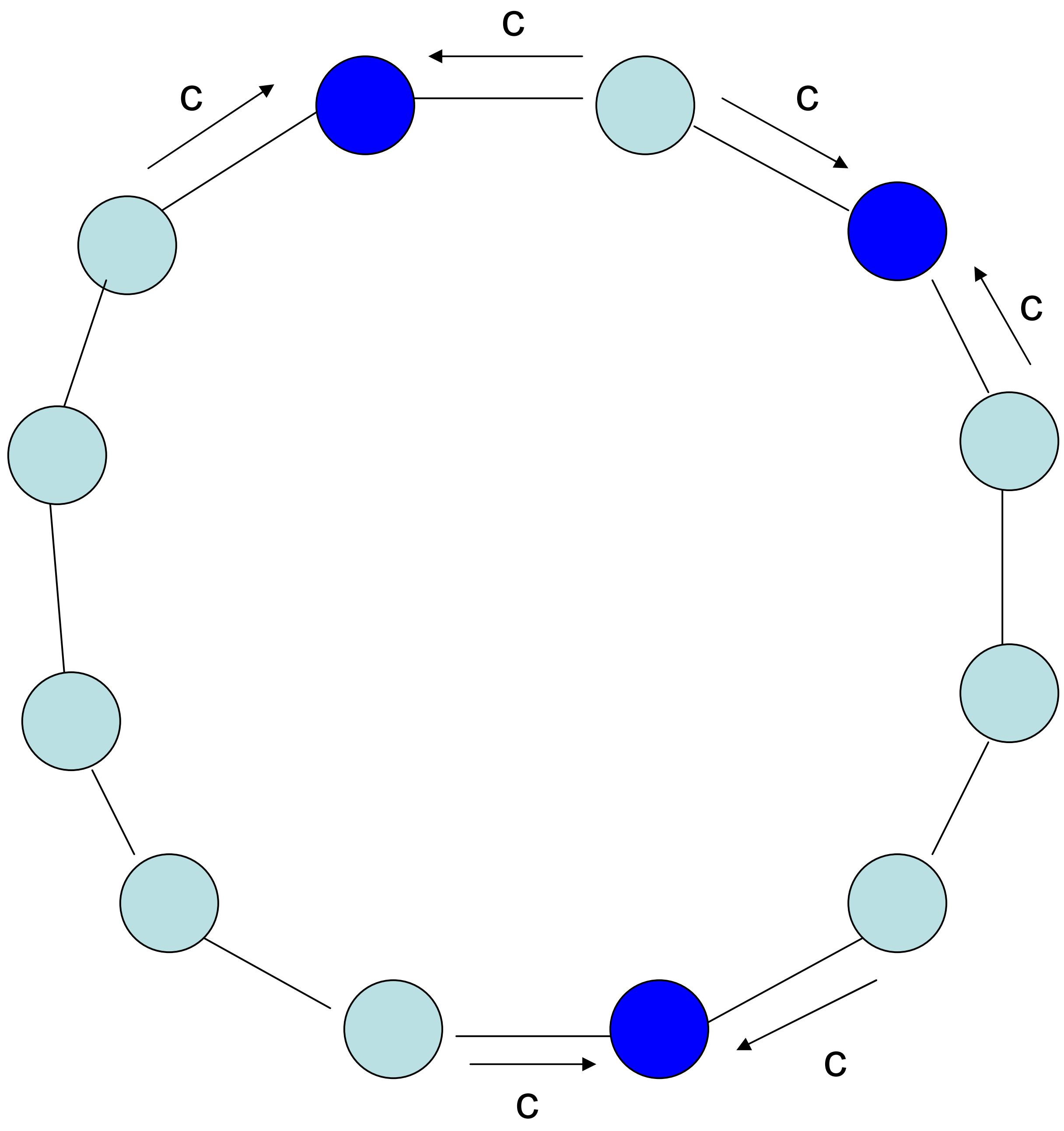
  - K represents adverse shocks such as unemployment or illness.

- Focus on efficient arrangement with equal planner weights.

  - If i and j are in the same equivalence class $\Longrightarrow x_i = x_j$.



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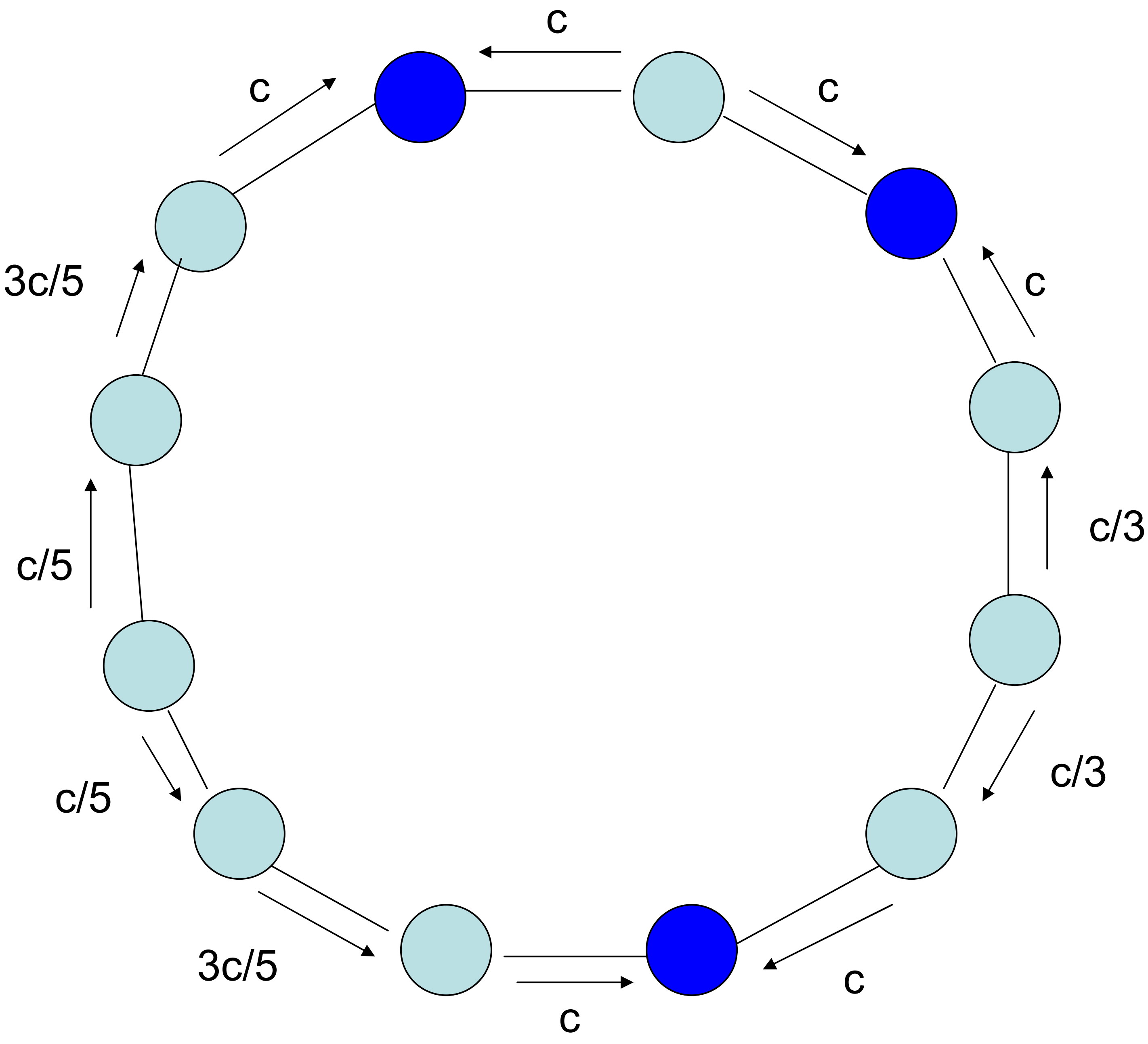
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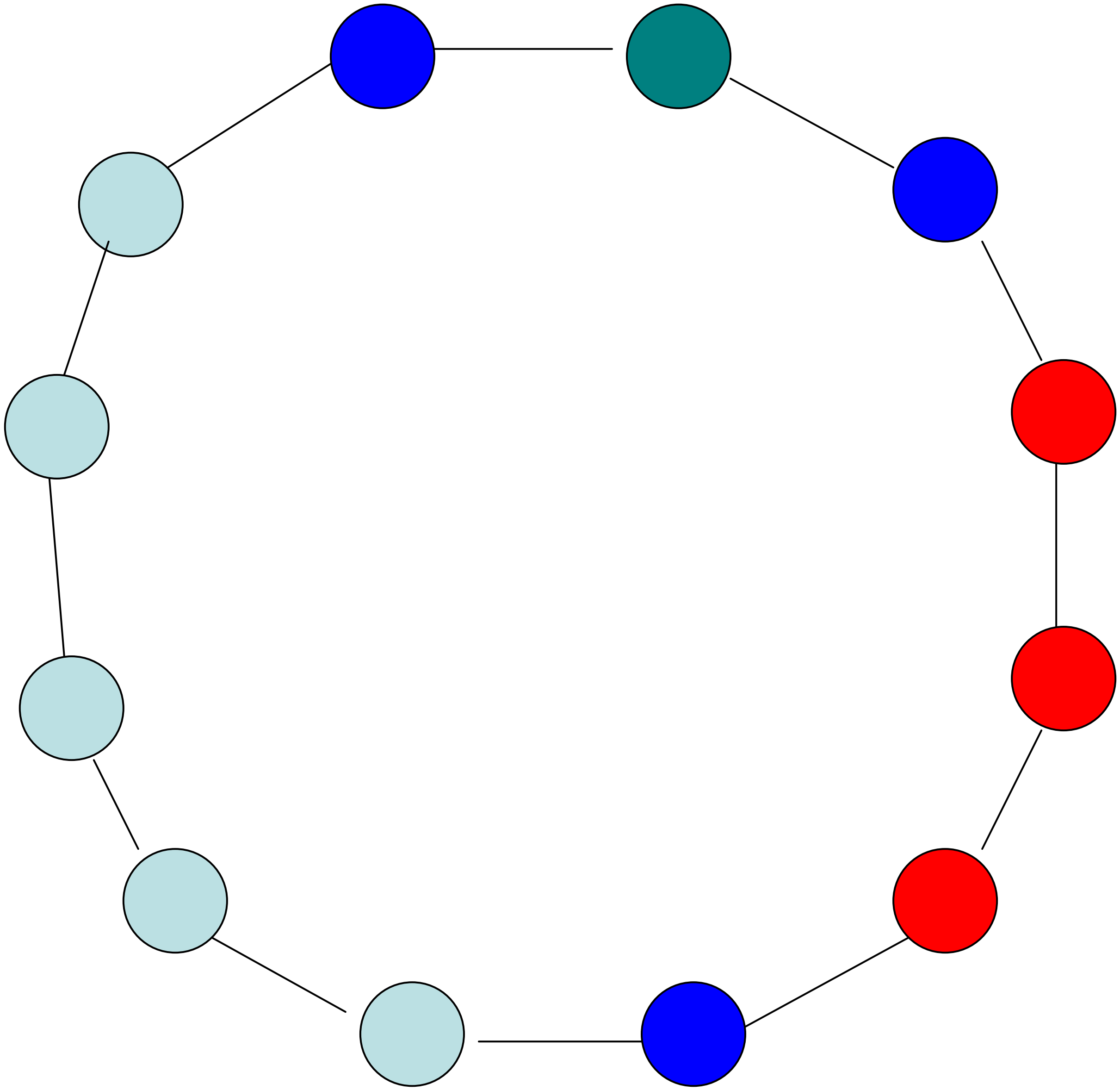


Local sharing

- Island result suggests that socially closer agents share more risk with each other.

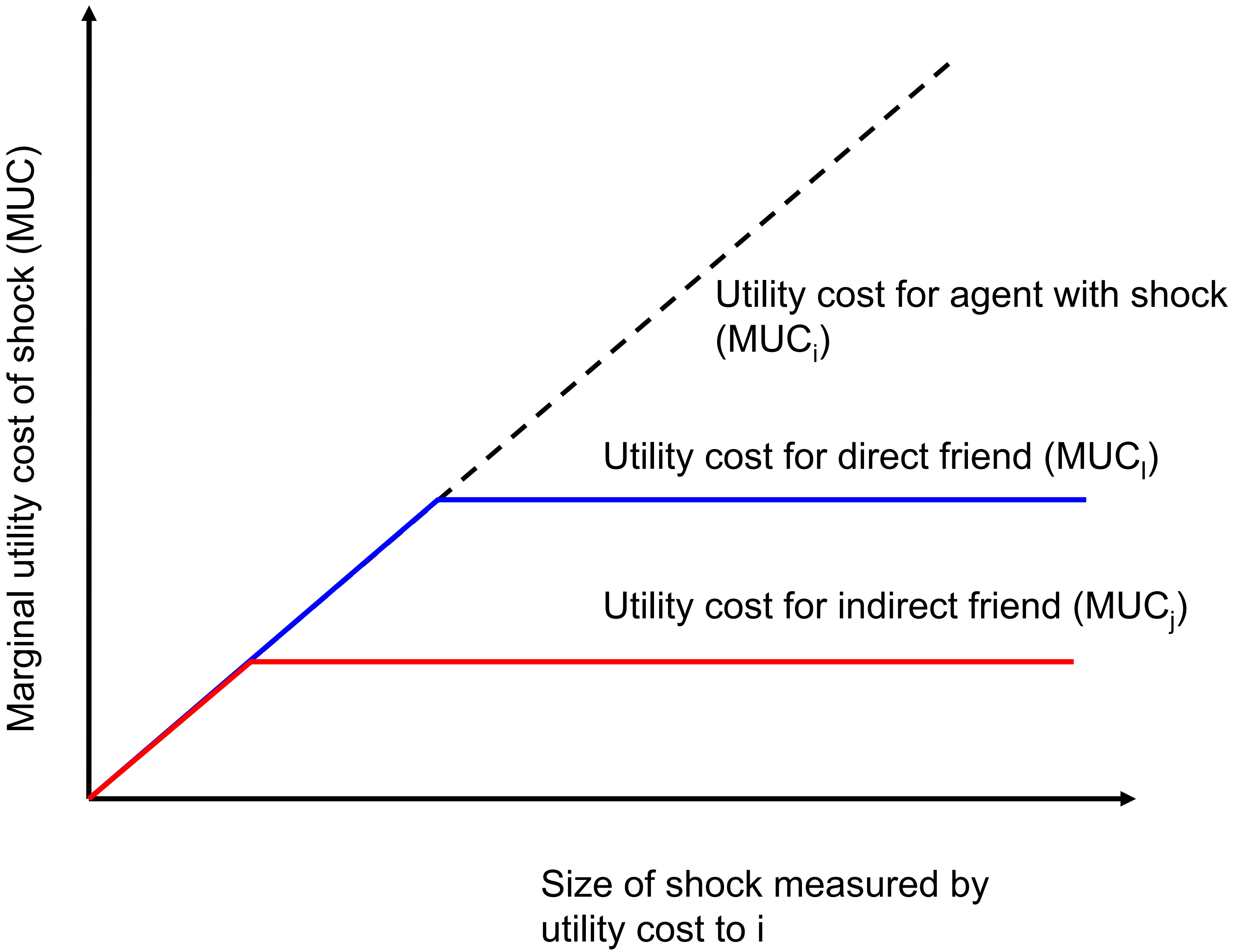
- To formalize this, fix realization $e = (e_i)$ and define "bad shock" e' such that $e'_i < e_i$ and $e'_j = e_j$ for all $j \neq i$.

  – (e') is an idiosyncratic negative shock to i.

- Measure impact of shock on agent j by marginal utility cost

$$MUC_j = \frac{U'_i\,(e')}{U'_i\,(e)}$$

where larger MUC_j corresponds to a more painful shock.


Marginal utility cost of shock (MUC)
Utility cost for agent with shock (MUC_i)
Utility cost for direct friend (MUC_l)
Utility cost for indirect friend (MUC_j)
Size of shock measured by utility cost to i

Conclusion

- We developed a model of informal risksharing in social networks, where enforcement is provided by the "collateral value" of social links.

- Perimeter/area ratio governs limits to risksharing in many environments.

- In second best arrangements, agents organize in endogenous groups to share endowment shocks.
  - Socially close agents share more risk with each other.