Addiction to a Network

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Overview

- Psychological literature:
  - Peer pressure important cause for addiction
    - Cigarettes, alcohol, drugs, obesity
    - Facebook, Instagram, Tiktok, etc.
      - Fear of missing out
- Dynamic rational addiction to a harmful product
- Informed individuals
- Connected to a network of users
- Accumulated stock of consumption:
  - Harms each individual
  - Imposes peer pressure on her
- The question: will individual try to counteract?

Main Findings

- When harm is concave in aggregate stock:
  - Increase in network/usage/influence intensifies addiction
- When harm is sufficiently convex:
  - Increase in network/usage/influence mitigates addiction
- "Rehabilitation" (disconnection from the network)
  - Can prevent addiction if implemented early enough
- Social media platforms' practices:
  - "People you may know"
  - Infinite scrolling
  - Likes or push alerts and notifications
    - All intensify addiction
      - Supports regulation
      - notification/defaults insufficient

Model

- *n* individuals *i=1,2,...,n* who form a network.
- In each period, individual *i* can consume two products:
  - *c*-non addictive
  - *a*-addictive
- Connected to network at time *t=0*

$$u(c_t^i, a_t^i, s_t^i)$$

$$s_{t+1}^i = \delta s_t^i + \sum_{j=1}^{n} \gamma_{ij} a_t^j$$

- Cannot choose not to be in the network

Model-continued

- Network inflicts peer pressure:
  - $u_{13} < 0$
- Aggregate stock harms individual:
  - $u_3 < 0$
- Fixed income per-period, y.
- Discount factor $\beta \in (0, 1)$
- *i*'s problem is:

$$max \left\{ (1-\beta) \sum_{t=0}^{\infty} \beta^t u(c_t^i, a_t^i, s_t^i) \right\}$$

Model-continued

- Main focus: $u_{33} > 0$
  - (Harm concave in aggregate stock)
    - Reinforces peer pressure
- If harm sufficiently convex:
    - Larger network mitigates addiction

Constant network

- Large network
  - Does not take account of her influence
  - Takes others' consumption as given
  - Others are in a steady state

    → Contribute constant aggregate stock each period

Critical levels and steady states

- As without a network
  - Initial state below critical level:
    - Converges to a low steady state
  - Initial state above critical level:
    - Converges to a higher steady state

Turning an abstainer into an addict-constant network

- Two mechanisms:
  1. The larger the network, L_j, the lower is the critical level

$$s_j^0 > s_c(L_j)$$

  2. $L_j > (1-\delta)s_c$

→ Initiation does not require stressful event

– Unlike current rational addiction models

Strategic players-existence of equilibria

- Open Loop Equilibrium ("OLE"):
  - Individual assumed not to observe others' deviations
  - Strategy not path-dependent

- Tarski's fixed-point theorem
  - Prove existence
    - For any initial stock and any influence matrix
      - Reaction functions exist and are:
        - » Upward-sloping-if harm concave
        - » Downward-sloping-if harm sufficiently convex

Consumption-less and full-consumption equilibria

- A consumption-less equilibrium always exists

- For large enough network:
  - Only consumption-less and a full consumption

→ Regulation can ban infinite scrolling
  - Increases “full consumption”

→ Coordination problem:

→Guidance, alcoholics anonymous, weight loss, …

Comparative statics

- Consider an intermediate-consumption OLE.
- All following changes yield new OLE
  - In which all consume more:

(i) Increase in γ_{ij}

(ii) Addition of a network member *i*

(iii) Increase in an individual's initial stock

- And vice versa when harm sufficiently convex

Policy implications of comparative statics

- “People you may know”, “you have a friend request”
- AI enhancing influence:
  - Feed’s content
  - “Top fan badges”
- Inflating users' initial stock:
  - Restoring content even if disconnected
  - Encouraging new users to share previous content
- By revealed preference:
  - Harm is not sufficiently convex

Rotten apple can spoil the barrel

- Characterize equilibria where rotten apple joins
- Suppose network was consumption-less
- New equilibrium with cascade →
- Optimal response to changing network:
  - Between response to constant networks
- Rotten apple *i*
  - Minimum per period stock *j* is exposed to:

$$L_j \equiv \gamma_{ji} \inf a_t^i$$

    - *j*'s best-response to changing network larger:
      - Critical level reduced: $s_j^0 > s_c(L_j)$
      - Or $L_j > (1-\delta)s_c$

Rotten apple can spoil the barrel-continued

- Aggregate stock contributed by *i* and *j*
  - Forms a changing network remaining individuals are exposed to
    - And so forth
      - By our existence result-new equilibrium with consumption

Timeliness of rehab

- Particularly with respect to smoking, alcohol, drugs, obesity
- Current rational addiction literature cannot explain
- In our framework, becomes meaningful
  - E.g., adolescent disconnected from gang
- If implemented before period:

$$t_c = \frac{\ln\left(1 - \frac{s_c(1-\delta)}{y\sum_{j=1}^{n}\gamma_{ji}}\right)}{\ln\delta} - 1$$

→ It is effective

Thank you!