Strategic Complementarities in a Dynamic Model of Technology Adoption: P2P Digital Payments

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Discussed by Mathieu Taschereau-Dumouchel

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Motivation

- Technology adoption often follows a logistic curve (Griliches 1957, Stokey 2020)

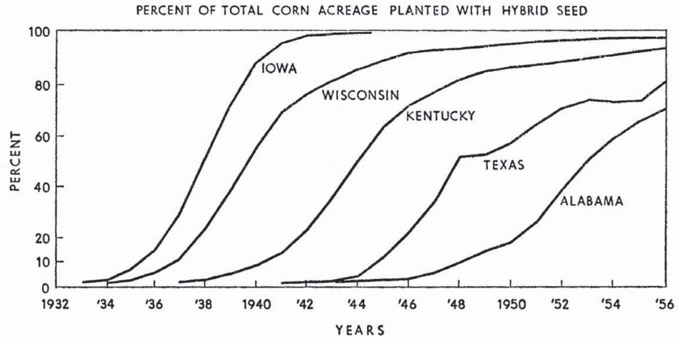

FIGURE 1.—Percentage of Total Corn Acreage Planted with Hybrid Seed. Source: U.S.D.A., *Agricultural Statistics*, various years.

- One story: learning takes time
- This paper: complementarities between agents

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  - N_0 initial number of adopters
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- Technology
  - Flow benefit of technology at $t = 1$

$$x_1 \left(\theta_0 + \theta_n N_1\right)$$

  - Flow benefit of technology at $t = 2$

$$\underbrace{\frac{1}{1-\beta}}_{z} x_2 \left(\theta_0 + \theta_n N_2\right)$$

  - Benefit increases with the number of adopters

Optimization and aggregation

Problem at $t = 2$ is

$$V(x_2, N_2) = \max\{zx_2(\theta_0 + \theta_n N_2) - c, 0\} \Leftrightarrow \text{adopt if } x_2 \geq \bar{x}_2 = \frac{c}{z(\theta_0 + \theta_n N_2)}$$

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$$\max\{x_1(\theta_0 + \theta_n N_1) - c + \beta E_x[zx(\theta_0 + \theta_n N_2)], \beta E_x[V(x, N_2)]\}$$

- Threshold strategy: adopt if $x_1 \geq \bar{x}_1$

$$\bar{x}_1 = \frac{c}{\theta_0 + \theta_n N_1}\left((1-\beta) + \frac{1}{2}\beta\frac{c}{z(\theta_0 + \theta_n N_2)}\right)$$

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$$N_1 = (1-\kappa)N_0 + (1-(1-\kappa)N_0)(1-\bar{x}_1)$$
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Note monotonicity $\Rightarrow$ Tarski's

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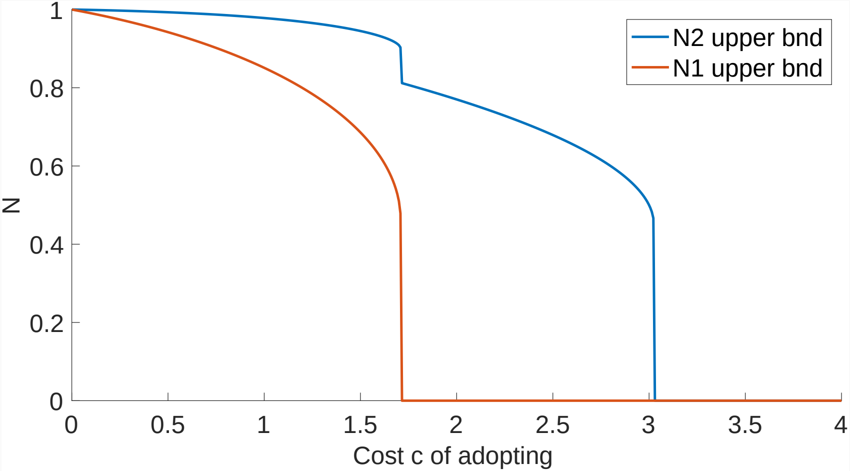
    - Not with $z = (1-\beta)^{-1}$! (note different exercise than the paper)
- Other equilibria? (take $N_0 \to 0$)
    - Yes! Use Tarski's to find upper and lower bounds of equilibrium set
    - Since equations are quadratic here, there is at most two equilibria (I think...)

Equilibrium upper bound

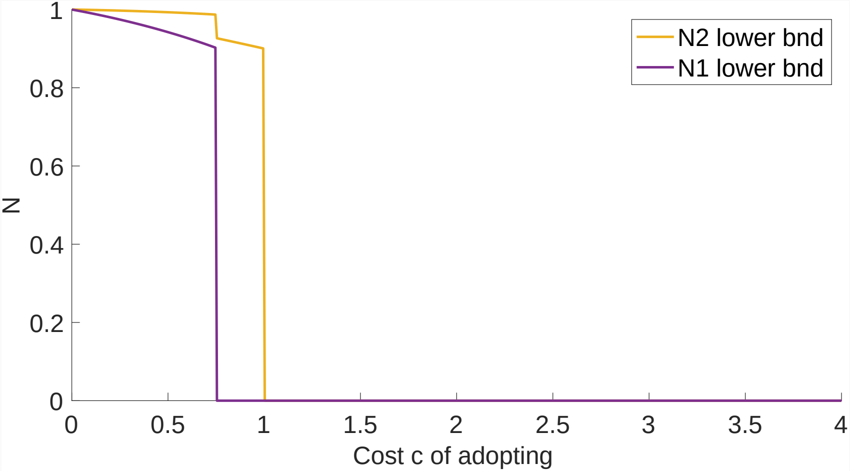
$(N_1, N_2) = (1, 1) \to (\bar{x}_1, \bar{x}_2) \to (N_1, N_2) \to \dots$



Notice: Gradual adoption

Equilibrium lower bound

$(N_1, N_2) = (0, 0) \to (\bar{x}_1, \bar{x}_2) \to (N_1, N_2) \to \dots$



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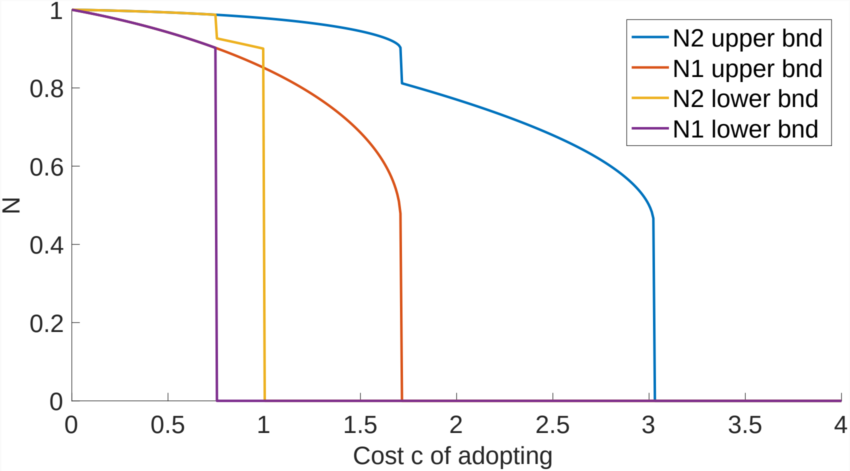
Both upper and lower bounds



Notice: Unique equilibrium for very low or very high c; multiple equilibria elsewhere.

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2. Planner's solution and optimal policy
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Very impressive piece of work!

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One nice feature of the model is the gradual adoption of the technology

- Alternative to learning

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Intuitively, complementarities might speed things up? Two effects:

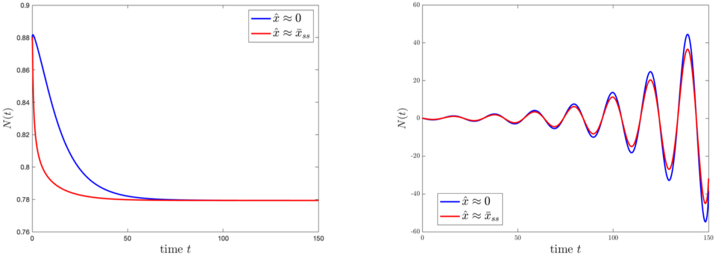
- Static: I am more likely to adopt today if others adopt
- Dynamic: if others adopt in the future I might as well delay

Why is the low-adoption steady state unstable?

The low non-stochastic equilibrium is unstable

- Small perturbation in the steady state distribution leads to explosive oscillations

Figure 2: Perturbation of Stationary Equilbria



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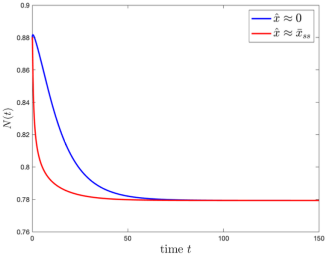

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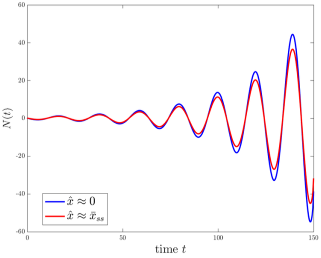

(b) Low Adoption SS

- Formal result?
- Does instability depends on the parameters?
- Intuition?

The role of substitutabilities

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Can the model handle substitutabilities?

- For small amounts Tarski's should still hold
- Might slow down/speed up adoption?
- Broader applications to other technologies

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Interesting policy implications

- Subsidize centrally located agents to adopt?

Look at diffusion patterns in the network data

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Great paper!