Farrell and Saloner (1986)

- Suppose a durable good exhibits positive network effect, and transition to new standard is graduate, what are its implications on efficiency of adoption of new technology?
- Both excess inertia (in which consumers fail to efficiently adopt a new technology) and excess momentum (in which consumers inefficiently adopt a new technology) can occur.
- Tactics to compete include preannouncement and predatory pricing.

Model

- Continuous time. Continuous inflow of new users, continuous time.
- Before T^*, only technology U is available. At T^*, a new technology V arrives.
- Those who had adopted U before T^*cannot switch. Only newly arrived consumers can choose.
- Consumers arrive at a rate $n(t) \geq 0$, and $N(t) \equiv \int_0^t n(t')dt'$.
- $u(x)$: utility of consuming U when the measure of size of U is x. $u'(x) > 0$. $v(x)$ is the corresponding utility of using V.

- First consider two extreme cases: (1) Nobody from T^* on adopts V; and (2) everybody does so.
- A user adopting U at time T, when everyone that follows also does so, has a utility of

$$\bar{u}(T) \equiv \int_T^\infty u(N(t))e^{-r(t-T)}dt;$$

  where r is discount rate.
- If a user at T is the last one to adopt U, his utility is

$$\tilde{u}(T) \equiv u(N(t)) \int_T^\infty e^{-r(t-T)} = u(N(T))/r.$$

- If a user adopts V at $T \geq T^*$ when everyone that follows also does so, his utility is

$$\bar{v}(T) = \int_T^\infty v(N(t) - N(T^*))e^{-r(t-T)}dt, \quad T \geq T^*.$$

- $\tilde{v}(T)$ can be defined analogously.
- A linear example:

$$n(t) = 1, \; N(t) = t, \; u(x) = a + bx, \; v(x) = c + dx = c + d(t - T^*).$$

In this case

$$\bar{u}(T)(a + bT)/r + b/r^2.$$

$$\tilde{u}(T) = (a + bT)/r, \quad \bar{v}(T) = (c + d(T - T^*))/r + b/r^2.$$

- The linear case illustrated:

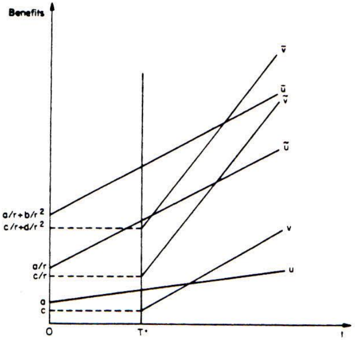


FIGURE 1: THE LINEAR EXAMPLE

- In linear case V can be superior to U in either of two ways: It might offer higher network-independent benefits ($c > a$), or it might have higher network-generated benefit ($d > b$).
- We only have to consider the two extreme cases listed above, because of bandwagon effect.
- Adoption of V is SPE if $\bar{v}(T^*) \geq \tilde{u}(T^*)$.
- If $\bar{v}(T^*) < \tilde{u}(T^*)$ the dominant strategy for users close to T^* is to choose U, and U will stay forever.

- If $\bar{u}(T^*) \geq \tilde{v}(T^*)$, non-adoption is SPE.
- If $\bar{u}(T^*) < \tilde{v}(T^*)$ it is dominant strategy for early choosers, and thus all that follow, to adopt V.
- Adoption is SPE if $\bar{v}(T^*) \geq \tilde{u}(T^*)$. Nonadoption is SPE if $\bar{u}(T^*) \geq \tilde{v}(T^*)$.

  They may hold simultaneous, so that there are multiple equilibria.
- If V is adopted, each user for whom $\bar{v}(T) > \bar{u}(T)$ gains $\bar{v}(T) - \bar{u}(T)$.
- Two groups of losers:

  (a) Early adopters lose $\bar{u}(T) - \bar{v}(T)$.

  (b) Old users.
- Present value of welfare change in linear case is

$$G \equiv \int_T^\infty [\bar{v}(t) - \bar{u}(t)] e^{-r(t-T^*)} dt - bT^*/r^2.$$

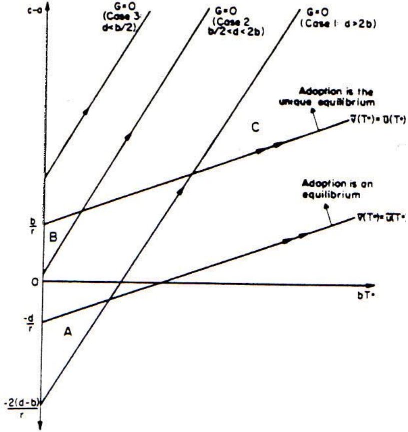
- The first term is change in welfare for those arrive after T^*. The 2nd term is loss to the installed base.
- In linear case, G can be calculated to equal to

$$[2(d-b) - 2rbT^* + r(c-a)]/r^3.$$

- Adoption is an equilibrium if $\bar{u}(T^*) \geq \tilde{u}(T^*)$, that is

$$r(c-a) - rbT^* \geq -d.$$

- Adoption is unique equilibrium if $\tilde{v}(T^*) > \tilde{u}(T^*)$, that is, $r(c-a) - rb > b$.



- There can be excess inertia and excess momentum, depending on the relative importance of installed base, network independent utility, and network-dependent utility.
- Competitive tactics implied by above theory: Preannouncement and predatory pricing.

Preannouncement

- Suppose new product is announced at $T^* - \tau$, and consumers in $[T^* - \tau, T^*]$ can pre-adopt V.
- If all adopt V after time $T^* - \tau$, the utility of user arriving at $t \geq T^*$ is $\bar{v}(t + \tau)$.
- If $\tilde{v}(T^*) < \tilde{u}(T^*)$ and $\tilde{v}(T^* + \tau - t')\bar{e}^{-rt'} > \bar{u}(T^* - t')$ for all $t' \in [0, \tau]$, then

  (1) Non-adoption is unique equilibrium without preannouncement.

  (2) Adoption is equilibrium with pre-announcement.
- Preannouncement can reduce welfare.

Predatory pricing

- By charging lower price, the manufacturer of U can prevent the potentially early users of V from adopting it, and drive out then new technology from market, even if it is efficient to adopt V.
- Suppose U is monopolistically supplied and V is competitively supplied.

- A low price of U starting at time T^* can induce users to adopt U (when otherwise they should adopt V). If installed base of V is built up, then V will never be adopted.