A Theory of Digital Ecosystems

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Today: develop a theory of ecosystems connecting both observations.

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Google Search → YouTube* / Google Flights* / Google Maps* / ...

Shazam* → Apple Music* / Google's alternative → YouTube*

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- Apple Maps became the dominant iPhone maps application.

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- Default position at crucial (new) access points is auctioned off.
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III. Implications for regulating digital ecosystems:

- Ecosystems consolidate — and steer users to — good services.
- But: often reduced entry (for buyout) and innovation incentives.

Model

Basic setup

There are two markets $s \in \{a, b\}$.

- "Access point" a (e.g., search) and "follow-on" b (e.g., flights).
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Firms can be (weakly) ranked in terms of the quality they offer.

- All else equal, we assume a better firm has a higher market share.

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$\rightarrow$ Ecosystems can steer consumers across markets (via defaults).

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Today: I'll impose this assumption throughout to simplify exposition.

Preliminaries

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Lemma (Default Advantage and Externalities**)**

I. If i is better than i', then $\alpha_i^s > \alpha_{i'}^s > 0$.

II. If i is j's strongest competitor, then $\eta_{ji}^s < 0$.

Emergence of Ecosystems

Cross-market leverage increases the incentive to grow

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If being taken over, the demand of the target t increases to

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- Larger increase when G has more demand in market a.

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This also means that G gets a discount on the takeover price.

Takeover of the market leader in equilibrium

When taking over t, firm G's net profit in market b is given by

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- Discount makes takeover preferable to self-development. ▸ Details

Endogenizing the acquirer and the emergence of ecosystems

Now every firm in markets *a* and *b* can "apply" to be the acquirer.

- The selected acquirer plays the same takeover game as before.

The firm that generates the highest takeover profits is selected.

- Reduced form for most willing to bear the costs.

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Proposition (Forward-Integration by Market Leaders**)**

The market leader at the access point *a* earns most from a takeover.

Four lessons on ecosystem growth

1. Lesson: market leaders at access points grow through takeovers.
   - Examples: Google – YouTube, ITA Sofware (Flights), Where 2 Technologies (Maps); Microsoft – Hotmail, Skype, LinkedIn; Meta – WhatsApp, Instagram; …
   - Eisfeld (2024): digital firms tend to pay less than financial firms.

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3. Lesson: grow through self-development if takeover not possible.
   - Default advantage increases profits from self-development.
   - Examples: Google – Gmail; Microsoft – Edge; Uber – UberEats; ...
4. Lesson: possibly backward-integration by existing ecosystems.
   - Backward integration generates strictly positive profits.
   - Examples: Google – Fitbit; Meta – Oculus VR.

Access-Point Markets

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Proposition (Benchmark: Efficient Default**)**
With only single-market firms, the best product becomes default in *a*.

- Complementarity: firm with best product values default most.

Ecosystems have a huge valuation for the default at access points

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Losing consumers to another ecosystem is particularly bad.

- Helps to justify Google's huge payment for the search default.

Welfare and Policy

Policy: motivation and basic assumptions

Variety of recent laws with the aim to curb the power of “big tech”

- DMA 6(5), 6(6): limits to self-preferencing (leverage policies).
- DMA 6(3), 6(4): easy-to-change defaults (access-point policies).

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Valuable services: consumers benefit from finding best provider.

- E.g., search, maps, audible, ...
- Arguably not social media (Allcott et al 2020, Bursztyn et al 2023)

Forced choice not optimal: consumers benefit from a better default.

- Seems plausible in online setting with many low-stake decisions.
- Rules out some "as-if swicthing costs" (Goldin and Reck 2022).

Short-run (convenience) benefit vs. long-run harm

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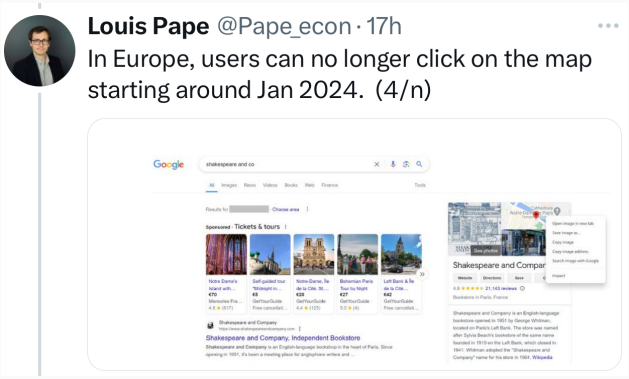

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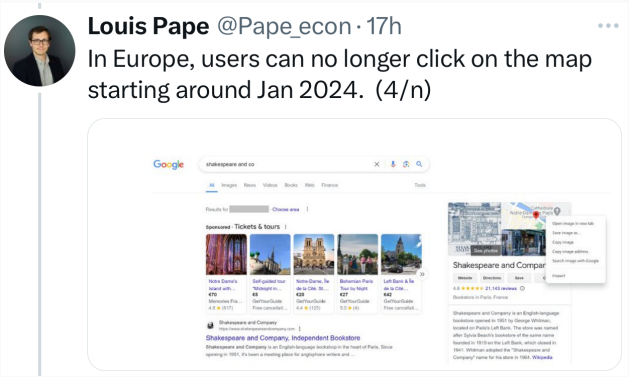

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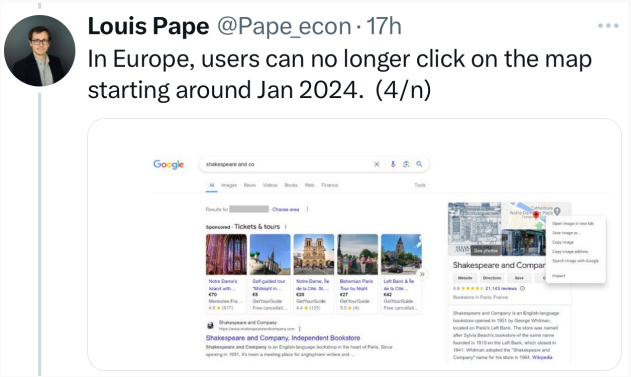

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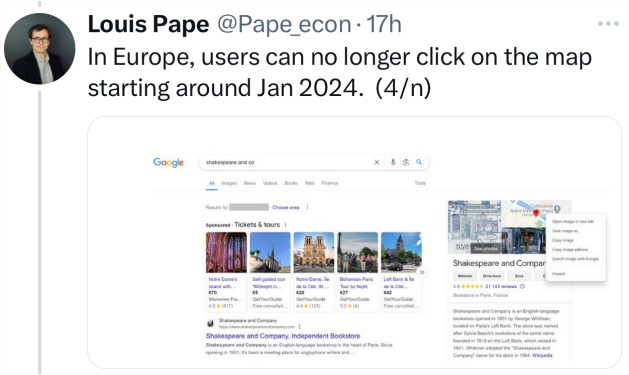

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Both leverage and access-point policies increase incentives for entry.

- Double dividend: (good) entry in *a* raises entry incentives in *b*.

Some concluding remarks

Using data across services may improve products (true synergies).

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Obvious (final) question: why don't we see offline ecosystems?

- Some do exist: e.g., tropical hotels offering many services.
- But steering might often be harder in offline settings than online.

▸ Related Literature

Competition does not necessarily help and may hurt targets

Suppose that $A \geq 2$ firms in market a can make a takeover.

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Look for subgame perfect equilibrium in which bidders bid cautiously.

▸ Details

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Proposition (Takeover Discounts with Competition**)**

All acquirers up to the one with the n^b-highest default setting power, but no other potential acquirer, complete a takeover and pay $f^* < V^b$.

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- Thus, the default advantage α^b to any firm in b is equal to minus the sum of the default externality to others: $\alpha^b - (n^b - 1)|\eta^b| = 0$.
- Competition means targets get $q_{n^b+1}^a \alpha^b$, but suffer $(n^b - 1)|\eta^b|$ times the higher default setting power of the rivals.

Back

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2. Require bidders to play iteratively weakly undominated strategies in that reduced game.

Back to Takeover Game

Takeovers are more profitable than self-development

Suppose G could hire a team and self-develop service b at c, or let the team start a company offering the service and take over the company.

- Maybe weird, but fair comparison because number of firms fixed.

Firm G prefers the takeover if c is above the takeover price.

Hence, G may use a takeover even if c is well below the extra profits.

- Note: this would never happen without cross-market leverage.

Even if G makes a takeover in equilibrium, its option to self-develop the product remains relevant $\longrightarrow$ threatening outside option.

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Literature on ecosystems.

- Mostly informal (e.g., Eisenmann et al 2011, Condorelli & Padilla 2020).
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"Default effects" in a single digital market (e.g., Chen & Schwartz 2023, Ostrovsky 2023, Hovenkamp 2023, Decarolis et al 2022, Denicoló and Polo 2024).

- Some analogs of our efficient default with single-market firms.

Literature on digital markets (e.g., Jeon et al 2023, Teh and Wright 2020, Hidir and Vellodi 2020, Heidhues et al 2023, Bryan and Hovenkamp 2020, ...).

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