Platform Transaction Taxes and Freemium Pricing

Anna D'Annunzio[1] Antonio Russo[2]

[1]Toulouse Business School

[2]Institut Mines-Télécom Business School

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Introduction

- Marketplace platforms charge transaction taxes
  - Amazon, eBay, Google Play, Apple App Store...
  - Typically ad valorem (15-30% on Google Play & App Store)

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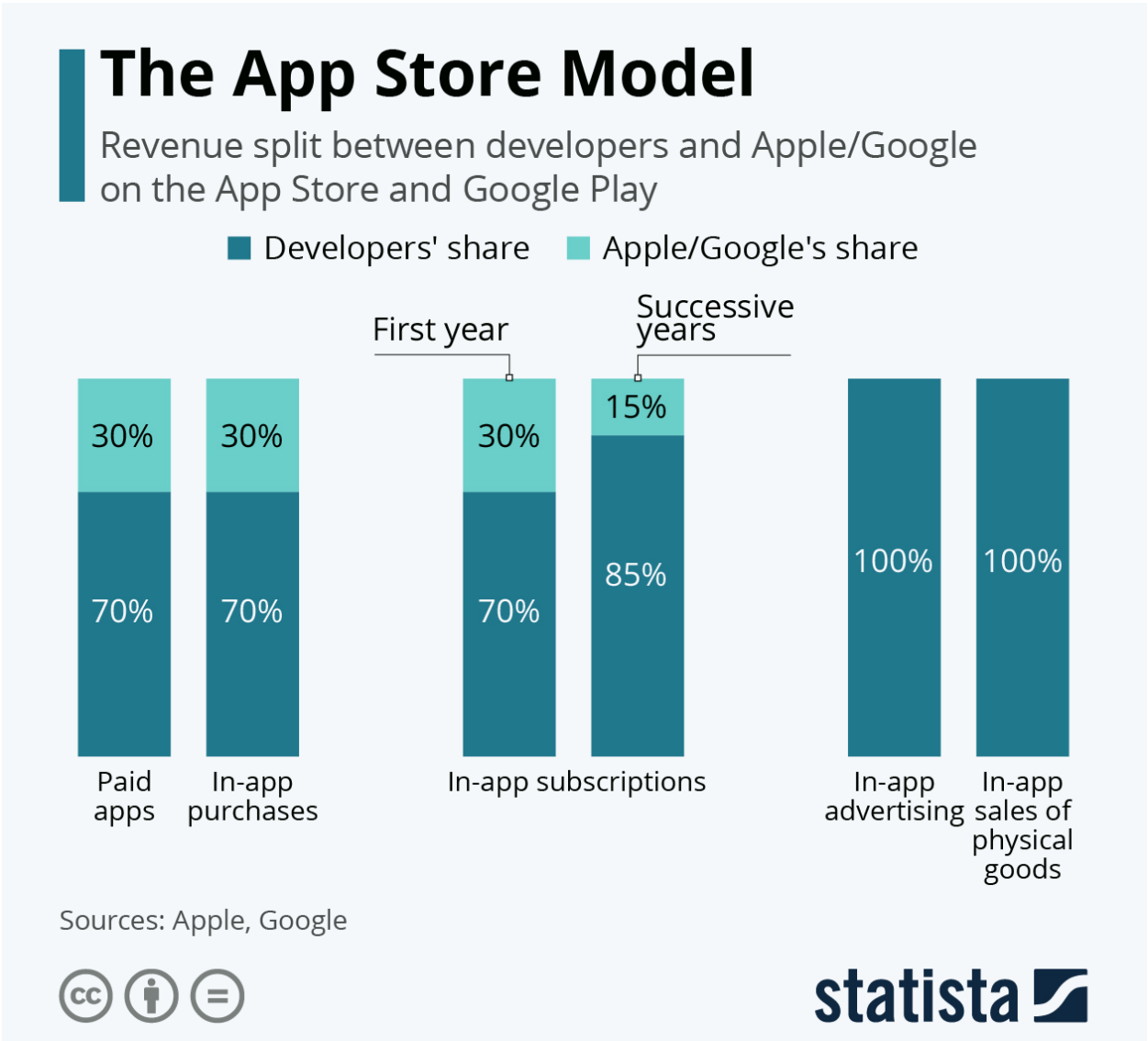
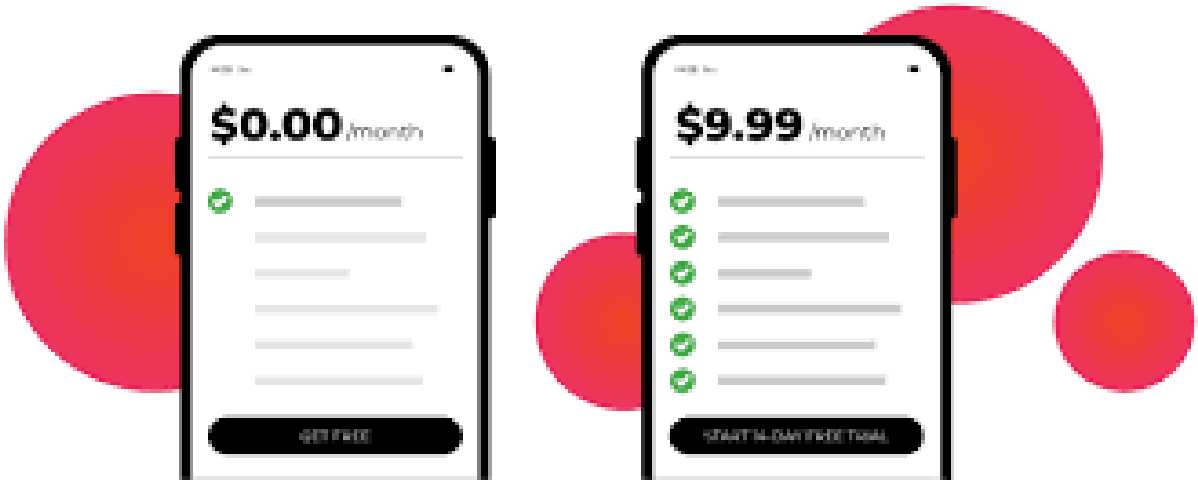


Introduction

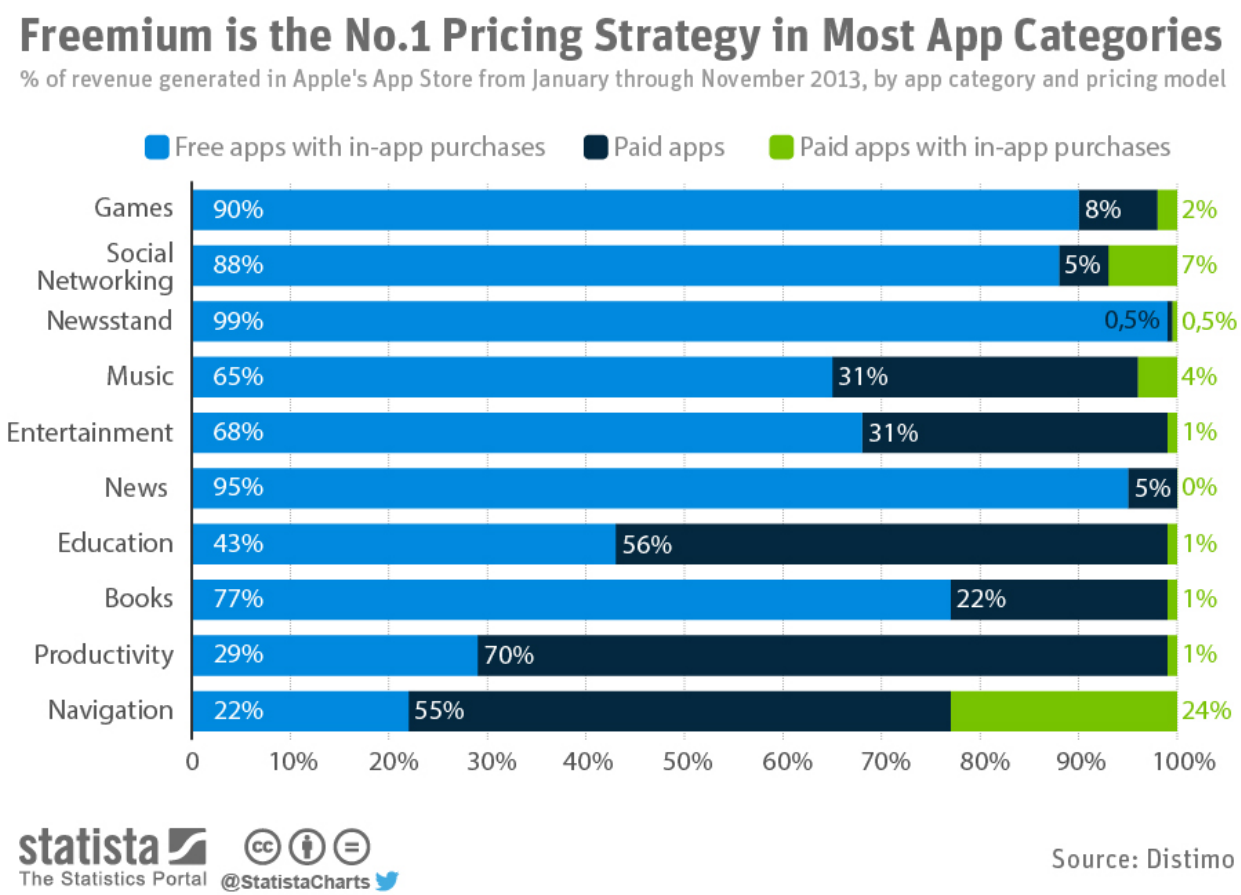
- Marketplace platforms charge transaction taxes
  - Amazon, eBay, Google Play, Apple App Store...
  - Typically ad valorem (15-30% on Google Play & App Store)
- Part of the "Agency Model" of vertical relations (Johnson, 2017; Foros et al., 2017)
- Controversial:
  - sellers complain about them, may also harm consumers
  - competition authorities investigations (ACM, 2019)

Introduction

- Effects of taxes in digital marketplaces not obvious
  - Sellers adopt sophisticated pricing strategies (price discrimination, freemium)



Introduction



Introduction

- Effects of taxes in digital marketplaces not obvious
  - Sellers adopt sophisticated pricing strategies (price discrimination, freemium)
- One of several sources of revenue for platforms (devices, ads, seller fixed fees, etc.)
  - Why tax transactions? Interaction with other revenue sources?
- Hybrid marketplace platforms sell their own products
  - Transaction taxes anti-competitive?

This paper

- Study effects of transaction tax in "freemium markets" (apps)
  - de facto target top version, base version exempt because free
  - reduce distortions, increase consumer surplus and welfare
  - can increase participation by sellers and consumers
- Analysis of vertical structures
  - vertical separation (agency) welfare-dominates integration
  - ad valorem fees welfare-dominate per unit

This paper

- Implications for design of taxes (and other sources of revenue) by platforms
  - transaction taxes *complementary* to
    - access (device) prices and revenue from ads
  - but substitute to access prices to sellers
  - Hybrid platforms may prefer *lower* tax
    - Tax makes third-party products *more* competitive

Previous Literature

- Indirect taxation in imperfectly competitive markets
  - Cremer and Thisse (1994) taxation can increase welfare in a vertically differentiated oligopoly
- Price discrimination by platforms
  - Lin (2020) and Jeon et al. (2022): second-degree
  - Wang and Wright (2017), de Corniere et al. (2023): third degree
  - We study taxes+discrimination *by sellers*

Previous Literature

- Agency model and digital marketplace platforms Johnson (2017); Foros et al. (2017)
  - Interaction with access/ads revenue Etro (2021); Gaudin and White (2021)
  - No price discrimination and freemium
- Hybrid marketplace platforms Hagiu et al. (2020, 2022), Anderson and Bedre-Defolie (2021), Tremblay (2022)
  - Ignore freemium pricing and transaction taxes in that context

A simple model

- Monopolist seller, two consumer types $i = H, L$. $v \in (0,1)$ share of type-H
  - one version for each type
- Type i gets net utility

$$U_i(p,q) \equiv u(q,\theta_i) - p,\ i = H, L,$$

where $\theta_H > \theta_L$, $\frac{\partial u}{\partial q} > 0$, $\frac{\partial^2 u}{\partial q^2} < 0$, $\frac{\partial u}{\partial \theta} > 0$ and $\frac{\partial^2 u}{\partial q \partial \theta} > 0$

- θ_i private information
- Seller must choose price and q_i quality (or quantity, size) in each version

A simple model

- One version (p_i, q_i) per consumer type. Seller's problem

$$\begin{aligned} \max_{q_H, p_H, q_L, p_L} \quad & \pi = v\left(\left(1 - \boldsymbol{t_H}\right) p_H - c q_H\right) + (1 - v)\left(p_L - c q_L\right), \\ s.t. \quad & u\left(q_H, \theta_H\right) - p_H \geq u\left(q_L, \theta_H\right) - p_L, \\ & u\left(q_L, \theta_L\right) - p_L \geq u\left(q_H, \theta_L\right) - p_H, \\ & u\left(q_H, \theta_H\right) - p_H \geq 0, \\ & u\left(q_L, \theta_L\right) - p_L \geq 0, \end{aligned}$$

- Welfare ($CS + \pi +$ tax revenue)

$$W = v\left(u_H - c q_H\right) + (1 - v)\left(u_L - c q_L\right).$$

Equilibrium

- IC_H and PC_L bind so we get

$$p_H = u_H - \underbrace{(u_{HL} - u_L)}_{\text{Information Rent}}, \quad p_L = u_L,$$

where $u_i \equiv u(q_i, \theta_i)$ and $u_{HL} \equiv u(q_L, \theta_H)$

- Consumer surplus

$$CS_H = u_{HL} - u_L, \qquad CS_L = 0.$$

Equilibrium

- Profit

$$\pi = v\left(\left(1-t_H\right)\left(u_H - u_{HL} + u_L\right) - cq_H\right) + \left(1-v\right)\left(u_L - cq_L\right)$$

- Without tax, equilibrium q_i^e satisfy

$$\frac{\partial \pi}{\partial q_H} = v\left(\frac{\partial u_H}{\partial q_H} - c\right) = 0,$$

$$\frac{\partial \pi}{\partial q_L} = v\left(-\frac{\partial u_{HL}}{\partial q_L} + \frac{\partial u_L}{\partial q_L}\right) + \left(1-v\right)\left(\frac{\partial u_L}{\partial q_L} - c\right) = 0.$$

- No distortion on q_H^e, distortion (downward) on q_L^e.

Effects of tax

- With tax, q_i^e, satisfy

$$\frac{\partial \pi}{\partial q_H} = v\left(\frac{\partial u_H}{\partial q_H}(1-t_H) - c\right) = 0,$$

$$\frac{\partial \pi}{\partial q_L} = v\left(-\frac{\partial u_{HL}}{\partial q_L} + \frac{\partial u_L}{\partial q_L}\right)(1-t_H) + (1-v)\left(\frac{\partial u_L}{\partial q_L} - c\right) = 0.$$

- Tax makes info rent less important

Effects of tax

- Effects on quality

$$\frac{\partial q_H^e}{\partial t_H} < 0, \quad \frac{\partial q_L^e}{\partial t_H} > 0$$

- Intuition: extracting revenue from H-types *less* profitable relative to L, less incentive to distort q_L^e
  - Second order distortion on q_H^e
- Specular effects on prices

$$\frac{\partial p_H^e}{\partial t_H} < 0, \quad \frac{\partial p_L^e}{\partial t_H} > 0.$$

Effects of tax

- Tax *increases* consumer surplus and welfare

$$\frac{\partial CS_H^e}{\partial t_H} = \frac{\partial u_{HL}}{\partial q_L} - \frac{\partial u_L}{\partial q_L} > 0, \qquad \frac{\partial CS_L^e}{\partial t_H} = 0.$$

$$\left.\frac{\partial W}{\partial t_H}\right|_{t_H=0} = v\frac{\partial q_L^e}{\partial t_H}\left(\frac{\partial u_{HL}}{\partial q_L} - \frac{\partial u_L}{\partial q_L}\right) > 0$$

- Intuition: info rent increases + less distortion overall

Effects of (targeted) ad valorem tax

Proposition

Introducing an ad valorem tax targeting the H-version

- *Reduces price of such version, increases quality of L-version.*
- *Increases consumer surplus*
- *Increases welfare*
- *Can increase participation by sellers and consumers*

- Robust to competition and more than two types

Freemium pricing and apps

- Market for digital apps characterized by
  - Major platforms (Google, Apple) hosting marketplaces and charging transaction tax
  - *Freemium*: app sellers (developers) provide free basic version (ads)
  - Even if tax not differentiated by version, free version exempt

Adapt the model

- Seller can charge a monetary price, p_i, a non-monetary price, x_i, or both, for each version
  - x_i volume of ads on that version or personal data collected
  - revenue r_i per unit (advertising rate, price of data)
- Utility

$$U_i(p, q, x) = u(q, \theta_i) - p - \alpha_i x,\ i = H, L.$$

Adapt the model

- Seller's problem

$$\max_{q_H, p_H, x_H, q_L, p_L, x_L} \quad \pi = v\left((1-t)\,p_H + r_H x_H - c q_H\right) + \\ + (1-v)\left((1-t)\,p_L + r_L x_L - c q_L\right)$$

$$s.t. \quad u_H - p_H - \alpha_H x_H \geq u_{HL} - p_L - \alpha_H x_L,$$

$$u_L - p_L - \alpha_L x_L \geq u_{LH} - p_H - \alpha_L x_H,$$

$$u_H - p_H - \alpha_H x_H \geq 0,$$

$$u_L - p_L - \alpha_L x_L \geq 0.$$

Adapt the model

- Freemium ($x_L = \frac{u_L}{\alpha_L}$, $x_H = 0$) iff

$$\alpha_L - \frac{v}{1-v}(\alpha_H - \alpha_L) \leq \frac{r_L}{(1-t)}, \text{ and } \alpha_H > \frac{r_H}{(1-t)}$$

- Then seller's profit is

$$\pi = v\left((1-t)\left(u_H - u_{HL} + \frac{\alpha_H}{\alpha_L}u_L\right) - cq_H\right) + (1-v)\left(\frac{u_L r_L}{\alpha_L} - cq_L\right)$$

- Tax targets top version only (not the free one)
- Effects characterized above still apply

Transaction tax with freemium sellers

Proposition

In a market with freemium pricing, introducing a transaction tax

- *Increases quality of the base version, make it more ad (or data) intensive*
- *Reduce price of top version*
- *Increase consumer surplus & welfare*
- *Increase number of sellers and consumers on the platform*

Caveat

- This result does not imply that, in equilibrium, platform sets tax at optimal level
- Tax maximises tvp_H, not welfare
- Our result only indicates that a positive tax may be desirable
  - But optimal level may well be smaller than current one

Integration vs. Separation

- Agency model: vertical structure with two monopolists
- Suppose seller and platform are integrated
  - Maximize seller profit "gross of tax" ($t = 0$), so *lower* welfare
- Separation can dominate integration in our setting
  - with freemium, tax makes market *more* efficient

Taxes and other revenue sources

- Platforms have multiple revenue sources
  - Devices (access): phones, tablets, operating systems
  - Advertising: collect percentage of ad revenue as intermediaries
- How do these interact with transaction taxes?

Devices

- Suppose consumers need device to access marketplace (stage 1)
  - Utility d, price p_D
- After buying device, consumers observe products (apps) on marketplace
  - Platform sets $p_D = d + v\left(u^e_{HL} - \frac{\alpha_H}{\alpha_L} u^e_L\right)$.
- Tax maximizes $\pi_P = d + v\left(u^e_{HL} - \frac{\alpha_H}{\alpha_L} u^e_L\right) + tvp^e_H$.
  - Note that $\left(\frac{\partial u_{HL}}{\partial q_L} - \frac{\alpha_H}{\alpha_L}\frac{\partial u_L}{\partial q_L}\right)\frac{\partial q_L}{\partial t} > 0$,

Transaction tax and device sales

Proposition

With freemium sellers, if the platform charges consumers for access (device), it sets a higher transaction tax than without this source of revenue.

Ad intermediation

- Suppose platform obtains a revenue r_P for every ad shown on the seller's app
- Given $x_L^e = \frac{u_L^e}{\alpha_L}$, profit is

$$\pi_P = r_P (1 - v) \left(\frac{u_L^e}{\alpha_L} \right) + tvp_H^e$$

- Note that $\frac{\partial u_L}{\partial q_L} \frac{\partial q_L}{\partial t} > 0$

Proposition

Proposition

With freemium sellers, if the platform captures some revenue from advertising, it sets a higher transaction tax than without this source of revenue.

Hybrid platform

- Often, platforms sell their own products that compete with third-party ones on the markeplace
  - Apps in music & video streaming, office utilities, games, etc.
- But only third-party products subject to the tax
  - Anti-competitive? Tax may force suppliers to raise prices

Hybrid platform

- Assume platform provides own product: sets p_i^P, x_i^P and q_i^P, in addition to t
  - Still freemium
  - Tax only applies to third-party product
- A share $s \in (0,1)$ of consumers buy only third-party product (captive)
- Platform makes its own product prominent
  - Consumers must search to observe third-party product

Hybrid platform

- Platform earns the following profit

$$\begin{aligned}\pi_P &= (1-s)\left(v\left(u_H^P - CS_H^e - cq_H^P\right) + (1-v)\left(u_L^P r_L/\alpha_L - cq_L^P\right)\right) \\ &\quad + t\left(svp_H^e\right),\end{aligned}$$

  where $CS_H^e = u_{HL}^e - u_L^e$ is the surplus from the third-party product

- Recall that this surplus *increases* with t
  - Tax makes third-party product *more attractive* to consumers
  - Increases competitive pressure on platform's product

Proposition

Proposition

If the seller adopts the freemium model, a hybrid platform sets at a transaction tax is lower than a pure marketplace platform would choose.

Alternative distribution channels

- In response to the EU's DMA, Apple recently took some measures to enable app developers to distribute their apps independently and use independent payment channels (to EU consumers)
  - But if they have a large number of downloads, they need to pay a per-installation fee of 0.5 Euros
  - And if they also want to be present in App Store, they pay a reduced transaction tax (10-20 percent versus 30 percent)
  - Or they can just remain in the current regime

Alternative distribution channels

- Suppose the seller can make its product(s) available outside the platform
  - Share $b \in (0,1)$ of consumers always use platform
  - Share $1-b$ willing to go outside platform, but at cost $\gamma \geq 0$ (time, data, etc.)
  - If distribute outside platform, no transaction tax

Alternative distribution channels

- Under similar parameter values as before seller sets
  - $x_L = \frac{u_L r_L}{\alpha_L}$ and $p_H = u_H - u_{HL} + \frac{\alpha_H}{\alpha_L} u_L$ on platform
  - $p_H^o = p_H - \gamma$ outside platform (only H version)
- Hence, profit is

$$\begin{aligned}\pi \quad = \quad & v\left(b(1-t)\left(u_H - u_{HL} + \frac{\alpha_H}{\alpha_L}u_L\right)\right) + \\ & v\left((1-b)\left(u_H - u_{HL} + \frac{\alpha_H}{\alpha_L}u_L - \gamma\right) - cq_H\right) + \\ & + (1-v)\left(r_L u_L/\alpha_L - cq_L\right)\end{aligned}$$

- So effect of t is similar to baseline model

Concluding remarks

- We demonstrated that effect of transaction taxes in freemium markets is not standard
  - Increase consumer surplus, welfare
  - Attract more consumers and sellers
  - Complementary to other sources of revenue
  - Not necessarily anticompetitive
- Next steps?

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