Commission Fee Structure and Innovation in Digital Platforms

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Abstract

This paper quantifies the welfare effects of regulating commission fees in digital platforms, focusing on third-party app developers' innovation and pricing decisions. I employ a comprehensive dataset of music apps within the Apple iOS store in the United States to estimate app users' demand and app developers' cost parameters. The paper reveals key findings with three policy counterfactual simulations where I sequentially solve for optimal innovation and pricing decisions. First, a cap on commission fees promotes innovative efforts by third-party app developers and improves social welfare. Second, when the platform adds a unit fee scheme under the fee cap, developers partly pass unit fees on to app users by increasing in-app purchase prices. Third, a hypothetical buy-out of a streaming app by the platform leads to a significant decrease in the innovative efforts and market share of the acquired app. Notably, welfare analysis without quality adjustment is predicted to underestimate the impact of fee cap on social welfare by 0.91% - 2.06% points compared to the full-stage model estimates.

Outline

- **Motivation:** There are ongoing legal investigations on the excessive fee rate imposed by the dominant digital platforms (e.g., *Apple* and *Google*) on the third-party app developers, of which concerns initially raised by *Spotify* in 2019. While evaluating policy impact through equilibrium price changes has been standard (e.g., Sullivan (2024)), assessing quality adjustments is becoming equally crucial for welfare analysis, particularly in antitrust cases (Khan, 2016).
- **Research Questions**: What are the market outcomes and welfare consequences of regulating the commission fee in the digital platforms?
- **Methodology:** Two-stage structural model of the mobile app marketplace where app developers first choose **innovative effort** and decide on the **in-app purchase price** (henceforth IAP) in the second stage. Innovative effort is a proxy for the app quality improvements that continuously increases in the number of app updates and its frequency.
- **Data:** Individual music apps in Apple's iOS App Store in the United States from October 2018 to February 2024. From *App Annie*, I gathered app-month level information on the number of active users, app rating, in-store revenue, number of downloads, and app launched date. I then gained app update information from *App Figures*.
- **Policy Implications**
  - Regulating commission fees at lower rates could enhance developer welfare and incentivize their innovation, improving social welfare.
  - From a distributional perspective, a fee cap benefits third-party app developers at the expense of the platform and consumer surplus.
  - Analysis only with the price competition is predicted to yield biased policy implications, underestimating the welfare effects of fee caps.

Model

Consumer Side (Nested Logit Model)

Consumer i gains utility u_{ijt} when using an app from developer $j \in \{1,2,3,\cdots,N,m\}$ in group g at month t :

$$u_{ijt} = \alpha\rho_{jt} + \beta b_{jt} + X_{jt}\lambda + \xi_{jt} + \varsigma_{ig} + (1-\sigma)\epsilon_{ijt}$$

where ρ_{jt} is innovative effort, b_{jt} is IAP, X_{jt} is a vector of observable app characteristics, ξ_{jt} is unobservable app quality, ς_{ig} is a mean utility within a nested group, σ is a nesting parameter, and ϵ_{ijt} is a preference shock that follows T1EV.

Developer Side (Two-stage; solved by backward induction)

2nd stage profit: $\pi_j^S = \left(b_j(1-f) + \phi_j\right)Ms_j(\vec{\rho})$), where f is a commission fee collected by the platform from third-party app developers. ϕ_j is net ancillary benefit (ancillary benefits (e.g., advertising revenue) – marginal cost). M is market size and $s_j(\vec{\rho})$ is market share.

2nd stage F.O.C: $\left(b_j + \frac{\phi_j}{1-f}\right)\frac{\partial s_j}{\partial b_j} + s_j \equiv 0.$

1st stage profit: $\pi_j^F(\vec{\rho}) = \pi_j^S\left(\overrightarrow{b^*}(\vec{\rho}); \vec{\rho}\right) - C(\rho_j)$, where $C'(\rho_j) = \gamma_0 + \gamma_1\rho_j + \upsilon_j$.

1st stage F.O.C: $\frac{\partial \pi_j^S}{\partial \rho_j} + \Sigma_{k=1}^m \frac{\partial \pi_j^S}{\partial b_k}\frac{\partial b_k^*}{\partial \rho_j} \equiv \gamma_0 + \gamma_1\rho_j + \upsilon_j.$

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Empirical Analysis

Demand-side estimation equation:

$$\ln(s_{jt}) - \ln(s_{0t}) = \alpha\rho_{jt} + \beta b_{jt} + X_{jt}\lambda + \omega pop_{jt-1} + \sigma\ln(s_{j|gt}) + \mu_t + \theta_j + \xi_{jt}.$$

Supply-side estimation equation:

$$\frac{\partial \pi_j^S}{\partial \rho_j} + \Sigma_{k=1}^m \frac{\partial \pi_j^S}{\partial b_k}\frac{\partial b_k^*}{\partial \rho_j} \equiv \gamma_0 + \gamma_1\rho_j + \upsilon_j.$$

Endogeneity raised from $cov(\rho_{jt}, \xi_{jt}) \neq 0$ and $cov(b_{jt}, \xi_{jt}) > 0$.

Identification strategy:

1) BLP instruments: i) app rating, ii) the cumulative number of app downloads in the same group, and iii) the difference between the number of app updates in the same group.
2) Cost shifters: i) app developer's total app count in the App Store and ii) the number of consumer privacy agreements collected by the developer.

Variable	Parameter	Nested Logit (IV)
Innovative effort	α	0.360**
IAP ($)	β	-1.199***
Nesting parameter	σ	0.287*
App age	λ_1	-0.006*
App rating	λ_2	0.284***
Popularity	ω	0.086***
Year-Month Fixed Effects	μ_t	Y
App Fixed Effects	θ_j	Y
Observations		4,745
F-statistics (price)		106.999***
F-statistics (effort)		17.049***
F-statistics (nesting)		638.640***
Wu-Hausman statistic		409.43**
Sargan statistic		0.873

Table 1. Demand parameter estimates

Cost coefficients	Estimates
γ_0	258,689***
γ_1	1,329,495***

Table 2. Supply parameter estimates

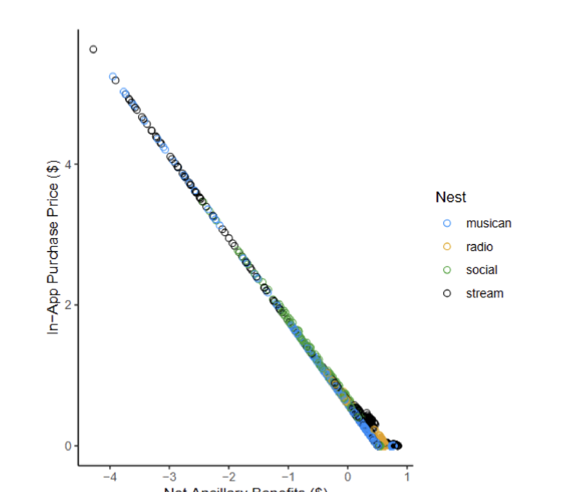

Figure 1. IAP and net ancillary benefits

Scenario	IAP (b_j)	Effort (ρ_j)	Consumer	Developer	Platform	Social Welfare	HHI
Panel A. With ρ adjustments							
Factual (f=15%)	0.41	0.60	234.5M	94.7M	6.9M	336.1M	2198
f=1%	11.84%	16.02%	-1.95%	14.22%	-91.65%	0.78%	2124
f=10%	4.16%	10.50%	-0.06%	3.66%	-27.43%	0.43%	2158
f=20%	-4.77%	-1.01%	1.57%	-5.69%	20.96%	-0.08%	2216
f=30%	-14.71%	-3.00%	5.11%	-15.44%	39.22%	0.02%	2287
f=10% & Unit fees	16.86%	10.50%	-3.26%	0.48%	21.47%	-1.70%	2086
Panel B. Without ρ adjustments							
Factual (f=15%)	0.39	0.48	218.1M	88.7M	5.1M	311.9M	1721
f=1%	11.67%	0.00%	-4.30%	11.38%	-91.57%	-1.28%	1578
f=10%	4.54%	0.00%	-1.69%	4.01%	-26.28%	-0.48%	1665
f=20%	-4.88%	0.00%	1.85%	-3.88%	17.60%	0.48%	1783
f=30%	-14.37%	0.00%	5.45%	-10.71%	30.76%	1.27%	1896
f=10% & Unit fees	18.10%	0.00%	-5.02%	0.86%	26.78%	-2.83%	1600

Table 3. Results for Counterfactual Studies at Market-level (Fee Adjustments)

Discussion

1. Fee caps are predicted to **increase** innovative efforts, while developers are **less** inclined to invest in innovation under higher commission fees (20% or 30%).
2. The average in-app purchase price (IAP) **rises under a fee cap**, attributed to the unique revenue structure in the mobile app marketplace: the **positive net ancillary benefits** for app developers. Their optimal strategy under high fees is to offer free services, maximizing market share, and leverage non-price revenue streams, offsetting the impact of platform fees.
3. The implementation of a commission fee cap is predicted to **enhance** the total welfare, predominantly benefiting app developers **at the expense** of platform and consumer surplus.
4. Treating innovative effort as an **exogenous** variable yields an **underestimation** of the fee cap's impact on social welfare by 0.91% - 2.06% points.
5. App developers partially pass unit fees to consumers by increasing prices.
6. Discussions on **vertical integration** of the platform are on the paper (Scan QR!).

Conclusions

Punchline of this paper

Highlights the importance of considering quality changes along with price fluctuations when evaluating regulatory intervention in digital platforms.

Future works

1) Investigate platform's optimization, 2) BLP estimation, and 3) entry decisions for the consumer side.

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