Pricing a Bestseller: Sales and Visibility in the Marketplace for Mobile Apps

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ABSTRACT

The growth of mobile applications on smartphones and tablets ("apps") ranks as one of the most astonishing technological developments in recent past. Over 700,000 apps are available for immediate download from app markets (e.g., App Store and Google Play). These marketplaces are a significant disruptive change in the way content is created and consumed. On the supply side, they provide content creators direct, instantaneous, and popular distribution systems where they can implement their own marketing and pricing policies, cutting out middlemen.

Taking a combined data-driven and structural analysis approach, this paper focuses on the relationship between pricing decisions and marketplace visibility. Our aim is to empower content creators by offering strategic guidance on how to leverage the marketplaces' flexibility. Specifically, the market platforms feature "top-ranked" charts that list apps by number of downloads. A high position in these charts is followed by a remarkable boost in demand, according to industry sources. We call the effect of top-rank position on future sales an indirect effect. First, we postulate a reduced form model to estimate the magnitude of this indirect effect. Our results show that it is statistically significant and substantial. Second, we study app pricing decisions in a model that incorporates our earlier findings. Surprisingly, we find that accounting for the indirect effect may give rise to optimal price cycles, where the seller alternates between a high price to boost revenue and a low one to enhance visibility. We find evidence supporting this pricing behavior in practice.

1. EMPIRICAL MODEL

Top-ranked lists capture the popularity of different apps based on their recent demand, rewarding popular apps with salient market visibility and a trendy appeal. However, as much as ranking lists reflect underlying demand patterns, they may also set them by increasing the demand of already top-ranked apps over less popular ones. In the presence of this indirect feedback, the demand for a particular app will be a function of not only its attributes (e.g., functionality, graphics, etc.) and price, but also of its rank position.

Ranks change over time for two reasons: (a) reflecting *organic* variations in the demand for the app itself, and (b) reflecting *exogenous* variations in the demand for other apps. The latter can be used as a rank shifter that isolates the indirect effect from the direct one.

We identify such exogenous variations using the concept of a *swap*. We say that two apps swap at time t if the order of their rank positions reverses going from that period to the next. A swap indicates an organic change in demand: either the demand of the initially less popular app increases or that of the more popular app decreases (or both). In contrast, a rank change without a swap of a block of apps is indicative of an exogenous variation. We carry our estimation over the set of no-swaps to capture the indirect effect.

Our results establish that the indirect effect exists and is significant for rank positions 1 to 20 in the overall top-paid chart. To illustrate, we find that the indirect effect of dropping one position among the top 5 is a 5.4% decrease in downloads on average (95% confidence interval is 2.6-8.2%). This estimate uses estimates in [1] that relate rank positions to revenues. Additional regularities in our estimates further support our findings.

2. STRUCTURAL MODEL

Motivated our findings, we propose a stylized dynamic model for a developer seeking to maximize her expected discounted revenues. To account for the indirect effect, we suppose that sales at the present period are positively affected by those in the previous one. The developer can adjust her price dynamically. Surprisingly, we find that this simple deterministic setting can give rise to optimal price cycles. Intuitively, the developer alternates between boosting next period's demand by dropping the price in the current period, and monetizing on that with a higher price in the following period. Our results are related to a stream of literature in economics studying optimal cycles and chaos in growth models to explain business cycles, see [2].

Examining developers' pricing policies in our dataset, we find a large number of developers using price cycles as suggested by the model. In addition, our discussions with industry practitioners indicate that this strategy has been sought by some developers to take advantage of the indirect effect.

3. REFERENCES

[1] Rajiv Garg and Rahul Telang. Estimating app demand from publicly available data. mimeo, 2012.

[2] Kazuo Nishimura and Gerhard Sorger. Optimal cycles and chaos: A survey. *Studies in Nonlinear Dynamics & Econometrics*, 1(1):3, 1996.

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