A Simple Model of Enshittification

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July 2025

In this note I present a simple mathematical model of the behavior of a firm whose product generates network effects, so that it becomes more attractive to consumers as more people use it. I'll show that enshittification, aka penetration pricing, aka "earnings inflection," is the optimal strategy — that is, a profit-maximizing firm will charge low prices and offer high quality until its customer base reaches critical mass, then switch to extracting rent by charging as much as it can for a worse product while stabilizing that customer base.

I *think* I have this right, although admittedly I'm a bit rusty at this sort of thing.

When I began working on this model, it seemed likely that someone had already done something like it. And it's quite possible that I'm repeating existing work. But I haven't been able to find it. Possibly that's because I'm using a simplified, ad hoc representation of consumer behavior, while the papers I've been able to find assume rational expectations. But if there is something like this out there, I'll be happy to acknowledge and cite it.

Anyway, here we go.

Imagine a firm that owns a platform which at any given point in time has a subscriber base B(t). Assume for the sake of simplicity that the marginal cost of providing service to subscribers is zero. The firm can also charge subscribers a price P(t) for the use of the service. I'll assume that this price can't be negative, that it can't actually pay people to sign up.

Given these assumptions, the firm's present value is

$$V = \int_{t=0}^{\infty} P(t)B(t)e^{-rt}$$

where r is the discount rate.

Assume that there are positive network effects, so that if the price isn't too high, the subscriber base will grow over time because the platform becomes more useful the more people are on it. I'm just going to assume an ad hoc linear growth equation (the linearity is why I need a lower bound on the price):

$$\dot{B} = -\alpha(P - \overline{P})$$

where $\bar{P}$ is the price just high enough to choke off further subscriber growth.

OK, this is a dynamic programming problem. At any point in time, the firm will want to maximize

$$V(t) = P(t)B(t) + S(t)\dot{B}(t) = P(t)B(t) - S(t)\alpha(P(t) - \bar{P})$$

where S(t) is the shadow value of an additional subscriber, which we have to calculate by induction, working backwards through time. The derivative of V with respect to the price is

$$\frac{\partial V}{\partial P} = B - \alpha S$$

The profit-maximizing strategy will look like this: Eventually the firm raises the subscription price to $\bar{P}$, extracting as much as it can from a stable subscriber base. At that point the value of a subscriber will be S = $\bar{P}$/r. Also, at that point the firm must have no incentive either to increase or to reduce its price, which tells us the size of its subscriber base:

$$\frac{\partial V}{\partial P} = 0 => B = \bar{B} = \alpha\bar{P}/r$$

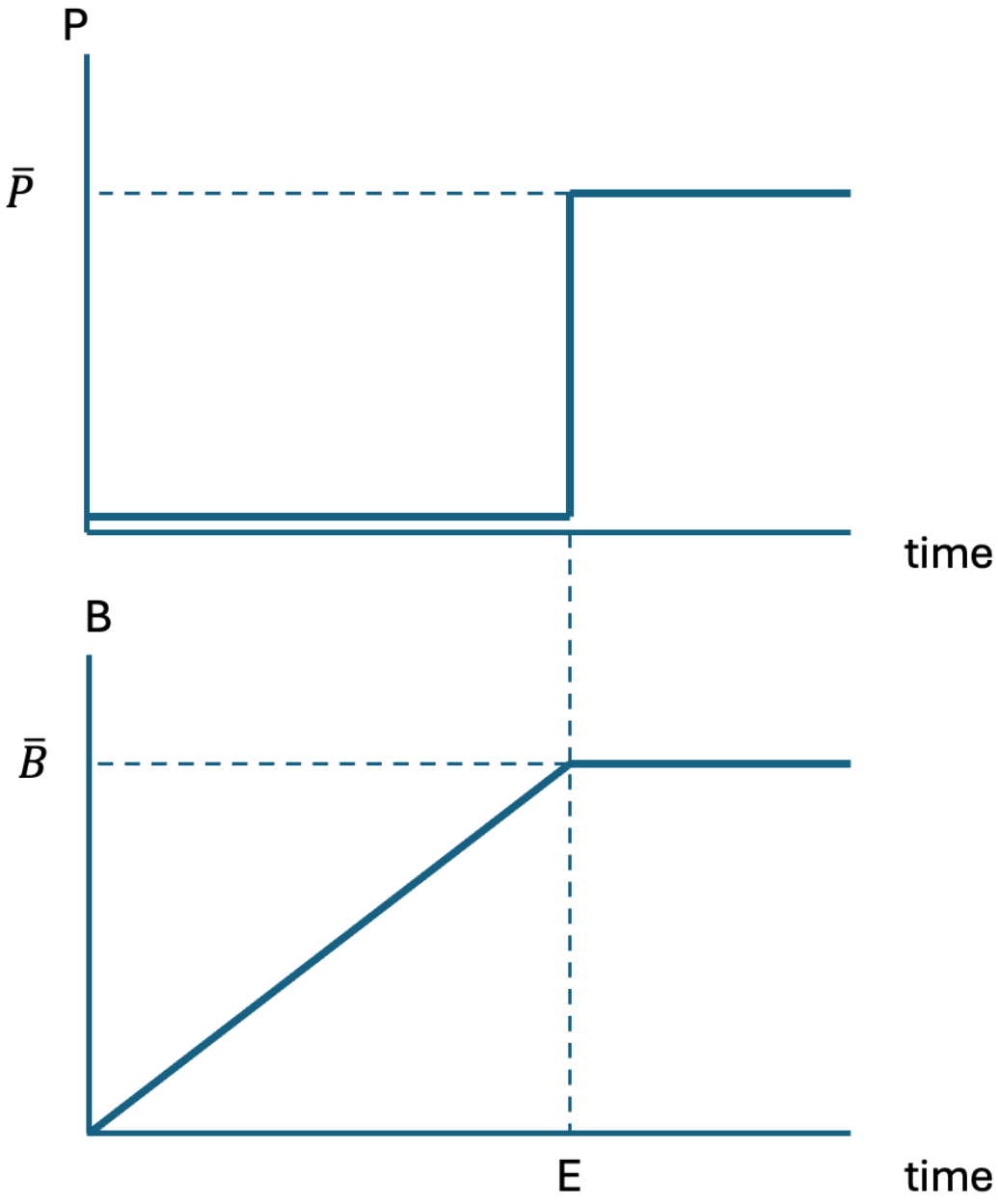
Prior to that point, with a smaller subscriber base,

$$\frac{\partial V}{\partial P} < 0$$

so the firm wants to set the price as low as it can — in this case zero — to maximize the rate at which its subscriber base grows.

So the paths over time of the price and the subscriber base look like the figure below, with E the point of enshittification.

As I say in the post, you can imagine complicating factors that make the transition to enshittification less sharp, and also make it involve lower quality as well as a higher price. But I think this model gets at the essential logic.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