INCOMPLETE DRAFT:

Notes on Antitrust Policy and Optimal Innovation in a Model of Productive Variety

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The Issues:

It is a commonplace today to say that it is time for economists to think about whether the proper guide to the twenty-first century might be not Adam Smith but Joseph Schumpeter: that we should stop thinking of the good firm as a competitive price taker and instead think of the good firm as a dynamic and innovative monopolist—see, for example, DeLong and Summers (2002). Traditional antitrust policy tries to push today's prices down to today's marginal cost. Today's commonplace welcomes monopoly power, and large wedges between price and marginal cost, for it is the expectation of future monopoly profits from protected intellectual property that is the spur to research and development that induces technological progress and economic growth.

Robert Barro (2007a) argues that not just the *profits* but the *revenues* of a company like Microsoft serve as a likely rough lower bound to the social value of its innovations and contributions to economic growth. If firm revenues are a rough match to contributions to economic growth, than the profits of technologically-dynamic monopolists are not too large but too small: they are insufficient to provide the efficient spur to research and development, and governments should be thinking not of antitrust policies to reduce the profits of dynamic innovative monopolies but of protrust policies to subsidize them.

Let's try to think about the simple analytics here. Let's try to model these related ideas of intellectual property, antitrust policy, and economic growth. Let us do so by following Barro (2007b), who follows a line of authors back to at least Romer (1994), in building our model.

The Framework:

Start with the standard assumption that final goods Y are produced by labor (and other factor inputs) L and by ideas I according to the production function:[1]

$$Y = L^{1-\alpha} I^{\alpha}$$

Where I is a Dixit-Stiglitz aggregation of N varieties of monopoly-produced intermediate goods:

$$I = \left[\sum_{j=1}^{N} \left(x_j \right)^{\sigma} \right]^{(1/\sigma)}$$

x(j) is the amount of final goods purchased to produce the jth variety of the intermediate good, sigma is a parameter between 0 and 1, and where each of the N intermediate goods is produced by a different monopolist, each of which has intellectual property rights over and so owns the "idea" of producing its particular variety. Technological progress in this model takes the form of investment to increase the number N of ideas.

The more ideas—the greater the number N of varieties of intermediate goods that the economy can produce—the better. And the more distinct are the varieties--the less they are substitutes—the smaller is the parameter sigma—the better. If X are the total inputs devoted to producing intermediate goods, then the aggregate quantity of intermediate goods supplied to the competitive final-goods producers is:

$$N^{((1-\sigma)/\sigma)}X$$

When sigma is near zero, the number of varieties matters a lot. When sigma is one, the number of varieties doesn't matter for society's productive potential at all.

Set the price of the final good Y to be equal to one, to be numeraire. The monopolist intermediate goods producers purchase the final good and sell it, transformed using their intellectual property, at a price P(j) so that the operating profits of the jth monopolist are:

$$\pi_j = x_j(P_j - 1)$$

Demand x(j) for the jth intermediate good by the competitive industry of final goods producers will be:

$$x_j = \left(\frac{\alpha YI}{P_j}\right)^{\sigma-1}$$

Which implies that the profit-maximizing price for the jth monopolist would be:

$$P_j = \frac{1}{\sigma}$$

But (following Barro (2007b)) antitrust policy regulates the intermediate goods producers. They charge only a fraction lambda of the profit-maximizing price, with lambda greater than sigma, so that in fact:

$$P_j = \frac{\lambda}{\sigma}$$

In order to induce efficient production at any one point in time, we want to set lambda to maximize C right now: lambda = sigma, so that final goods producers can purchase intermediate inputs at their short-run social marginal cost. But that would eliminate profits—and in this institutional setup it is the expectation of future

monopoly profits that induces the research and development that expands the number of varieties N.

The Cobb-Douglas form of the final-goods production function means that the amount final goods producers spend on purchasing intermediate goods is equal to alpha times final output Y, which means that the quantity of intermediate goods is:

$$X = \frac{\alpha\sigma Y}{\lambda}$$

Which means that Y is:

$$Y = L\left(\frac{\alpha\sigma}{\lambda}\right)^{(\alpha/(1-\alpha)} N^{((\sigma(1-\alpha))/(\alpha(1-\sigma))}$$

And so net consumable output C is:

$$C = Y - X = (1 - \alpha\sigma/\lambda)L\left(\frac{\alpha\sigma}{\lambda}\right)^{(\alpha/(1-\alpha)} N^{((\sigma(1-\alpha))/(\alpha(1-\sigma))}$$

The Value of Innovation:

In this framework, the value of inventing a marginal additional variety dN is:

$$dC = \frac{\left((\sigma(1-\alpha))/(\alpha(1-\sigma)\right)C}{N} dN$$

Barro (2007a) argued that the social value dC of inventing the marginal Nth variety is likely to be bounded below by the total spending dS on that marginal Nth variety. With the monopolist charging a price P = lamba/sigma for that marginal variety, total spending on that newly-invented marginal intermediate good is:

$$dS = \frac{\alpha C}{N(1-\alpha\sigma/\lambda)}\,dN$$

(Note: dS is *not* the increase in intermediate goods spending. dS is spending on the additional possible intermediate good.) And the ratio of social benefit to total sales of the intermediate good is:

$$\frac{dC}{dS} = \frac{(1-\sigma)(1-\alpha\sigma/\lambda)}{\sigma(1-\alpha)}$$

When competition policy sets prices equal to marginal cost (lamba = sigma), then:

$$\frac{dC}{dS} = \frac{(1-\sigma)}{\sigma}$$

When prices are above marginal cost the ratio of social benefit to revenue is lower, as it should be. When there is no antitrust policy and lambda = 1, then:

$$\frac{dC}{dS} = \frac{(1-\sigma)(1-\alpha\sigma)}{\sigma(1-\alpha)}$$

If alpha is near one, then the ratio of the social benefit from to the sales of the marginal intermediate good variety becomes very large; for small alpha not necessarily so. As sigma approaches zero the ratio of the social benefit from to the sales of the marginal intermediate good variety becomes arbitrarily large: for sigma near zero, Microsoft's sales vastly understate its social value. As sigma approaches one, the ratio of the social benefit from to the sales of the marginal intermediate goods variety approaches zero: Microsoft's sales vastly overstate its social value. This is how it should be: an invention that does something completely new (sigma near zero) should have a much bigger impact than an invention that is a close substitute for already existing technologies (sigma near one).

In the limit in which sigma=1, there is--in conventional models--no benefit at all to learning how to produce a new variety. When sigma=1:

$$C = Y - X = (1-\alpha)L(\alpha)^{(\alpha/(1-\alpha)}$$

And net final output does not depend on N, so dC/dS = 0.

The Utility of Antitrust Policy:

Of particular interest from the standpoint of antitrust policy is the ratio of social value to new firm profits:

$$\frac{dC}{\pi_j dN} = \frac{(1-\sigma)(1-\alpha\sigma/\lambda)}{\sigma(1-\alpha)}\left(\frac{\lambda}{(\lambda-\sigma)}\right)$$

If there is no antitrust policy, lambda is equal to one, and:

$$\frac{dC}{\pi_j dN} = \frac{(1-\alpha\sigma)}{\sigma(1-\alpha)}$$

Since dC/(π(j)dN > 1, incentives for innovation are too small even when there is no antitrust policy in the picture.

The desire to induce efficiency in static production—to get final-goods producers using the right amount of intermediate inputs—would lead us to wish to push lambda down below one, toward the value lambda = sigma at which intermediate goods' prices are equal to short-run marginal social cost. But the value of an innovative variety is already greater than the monopolist's profits when lambda = 1—and pushing lambda down will only worsen the incentives for innovation. Whether antitrust policy is desirable (and how much is desirable) then turns on three things:

- The rate of discount
- How much each marginal diminution of monopoly profits reduces the pace of innovation.
- The size of the static Harberger triangle produced by the elevation of price over marginal cost made possible by the absence of antirust policy.

TO BE CONTINUED…

Notes:

[1]Barro (2007b) deviates from standard versions of this "ideas" setup by asserting that dC/dS is independent of sigma. The reason he calculates that dC/dS does not depend on sigma is the particular specification of the total factor productivity term A in his production function. Barro makes total factor productivity in final goods production a function of N:

$$A = A_0 N^{((\sigma-\alpha)/\sigma)}$$

Thus, as sigma approaches one in Barro's setup, all firms in the economy become more productive and more efficient as a result of the invention of a new intermediate goods variety—no matter how much of or whether they actually use that new intermediate goods variety. Simply the fact that it is possible to produce it provides a big boost to the economy. That's why the ratio dC/dS does not depend on whether the new variety is a close substitute for existing varieties or something radically new.

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