Recitation Notes 9

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1 Market Power and "Classical" Labor Demand

The following is a slightly modified version of the classical labor demand model in the Hamermesh chapter in the HLE on long-run labor demand. I tried to fill in technical steps which are standard in production theory (and therefore omitted in the chapter) but which you may have been unfamiliar with. In terms of research, this is probably "cold matter" (the standard reference dates back to 1938), but it's useful stuff for you to have seen at least once if you go back to the older literature.

Suppose we have firms with identical production functions

$$Y = F(K, L)$$

with constant returns to scale which faces competitive factor markets for labor L and capital K with wages w and interest rate r. A firm sells its output on a product market with a demand function $D(p)$ which is not necessarily competitive. If there is only a monopolist, that firm maximizes profits

$$\Pi = pD(p) - wL - rK$$

over p, K and L under the restriction that $D(p) = F(K, L)$, under perfect competition, it produces at p equal to marginal costs.

Since revenue depends on K and L only through the production function, the problem satisfies a separability condition which allows us to solve it in two steps: (1) minimize production costs for given output, Y and get a cost function $C(r, w, Y)$ (this should remind you of the expenditure minimization problem), and (2) maximize overall profits equaling revenue minus the cost function in order to determine the optimal price/output.

The cost minimization problem

$$\min_{K,L} wL + rK, \text{ s.t. } F(K, L) \geq Y$$

gives us the cost function

$$C(w, r, Y) := wL^*(w, r, Y) + rK^*(w, r, Y)$$

which is linearly homogenous in (w, r) implying

$$C(w, r, Y) = C\left(\frac{w}{r}, 1, Y\right)$$

and constant returns to scale imply that we can rewrite

$$C(w, r, Y) = Yc(w, r)$$

This means that the firm will charge a price $p^* = \mu c(w,r)$ where $c(w,r)$ equals marginal and average costs because of constant returns to scale, and μ is a one plus some mark-up. Under perfect competition, $\mu = 1$, and if the firm is a monopolist, $\mu = \frac{\eta_p}{1+\eta_p}$, where $\eta_p := \frac{D'(p)p}{D(p)}$ is the the demand elasticity for the product.

Assuming that all firms have identical production functions, aggregate labor supply is the total amount of labor needed to produce $D(p^*)$, and by constant returns to scale, it doesn't matter whether production takes place in only one or many firms. Going back to the cost function, we know from Shepard's Lemma that

$$L^*(w,r,D(p^*)) = C_w(w,r,D(p^*)) = D(p^*)c_w(w,r)$$

so that the derivative of uncompensated labor demand with respect to wages is

$$\begin{aligned}\frac{d}{dw}L^*(w,r,D(p^*)) &= \frac{d^2}{dw^2}C\Big(w,r,D[\mu c(w,r)]\Big) \\ &= \frac{d^2}{dw^2}\left\{D[\mu c(w,r)]c_w(w,r)\right\} \\ &= D[\mu c(w,r)]c_{ww}(w,r) + D'[\mu c(w,r)]\mu(c_w(w,r))^2 \\ &= D(p^*)c_{ww}(w,r) + \mu D'(p^*)[c_w(w,r)]^2\end{aligned}$$

Now, let

$$\sigma := \frac{\partial \log\left(\frac{K^*}{L^*}\right)}{\partial \log\left(\frac{w}{r}\right)} = \frac{\partial\left(\frac{K^*}{L^*}\right)}{\partial\left(\frac{w}{r}\right)}$$

be the *elasticity of substitution* between labor and capital. It is the possible to show that[1]

$$c_{ww}(w,r) = -\sigma\frac{c_w(w,r)c_r(w,r)r}{wc(w,r)}$$

Now plug in all the other stuff we know: $D(p^*)c_r = K^*$ and $D(p^*)c_L = L^*$ by Shepard's Lemma, and $c(w,r) = \frac{p^*}{\mu}$ by monopoly pricing. Therefore, going back to the derivation

$$\frac{d}{dw}L^*(w,r,D(p^*)) = -\frac{\mu r K^* L^*}{wp^*D(p^*)}\sigma + \mu D'(p^*)\left(\frac{L^*}{D(p^*)}\right)^2 = -\mu\sigma\left(\frac{rK^*}{p^*D(p^*)}\right)\frac{L^*}{w} + \mu\frac{D'(p^*)p^*}{D(p^*)}\left(\frac{wL^*}{p^*D(p^*)}\right)\frac{L^*}{w}$$

If we denote labor's share of the firm's revenue with $s = \frac{wL}{pY}$, the labor demand elasticity (with respect to wages, of course) becomes

[1] For the first equality, use Shepard's Lemma

$$\frac{K^*}{L^*} = \frac{c\left(\frac{w}{r},1\right) - \frac{w}{r}c_w\left(\frac{w}{r},1\right)}{c_r\left(\frac{w}{r},1\right)} = \frac{c\left(\frac{w}{r},1\right)}{c_w\left(\frac{w}{r},1\right)} - \frac{w}{r}$$

Differentiating with respect to $\frac{w}{r}$, get

$$\frac{\partial\left(\frac{K^*}{L^*}\right)}{\partial\left(\frac{w}{r}\right)} = \frac{c_w\left(\frac{w}{r},1\right)^2 - c\left(\frac{w}{r},1\right)c_{ww}\left(\frac{w}{r},1\right)}{c_w\left(\frac{w}{r},1\right)} - 1 = -\frac{c\left(\frac{w}{r},1\right)c_{ww}\left(\frac{w}{r},1\right)}{c_w\left(\frac{w}{r},1\right)}$$

Therefore, by the first expression we had for $\frac{K^*}{L^*}$

$$\sigma = -\frac{cc_{ww}}{c_w c_r}\frac{w}{r} \Rightarrow c_{ww}(w,r) = -\sigma\frac{rc_w c_r}{wc}$$

$$\eta_L := \frac{\partial L^*}{\partial w}\frac{w}{L^*} = \underbrace{\mu s \eta_p}_{\text{scale effect}} \quad \underbrace{-\mu\sigma(1-s)}_{\text{own-wage elasticity}}$$

Therefore, if the substitution elasticity is high, labor demand will also be more elastic, and this will also be true if the demand for the product is more elastic (i.e.η_p very negative). The comparative statics with respect to the share of labor depend on whether η_p is greater or less than σ.
Under perfect competition, $\mu = 1$, and

$$\eta_L = -\sigma(1-s) - s|\eta_p|$$

It may at first sight seem puzzling that a firm in a perfectly competitive environment would adjust output in a nontrivial way as its marginal costs go up - under Bertrand competition this firm would, other things equal, simply go out of business. However, here the change in marginal costs comes from an increase in the (market) wage, so that it hits all competing firms at the same time, and the whole market equilibrium moves along the demand curve.

2 Estimating Market Power

In the lecture we looked at papers that were inferring monopsony rent from the labor supply elasticity the - putative - monopsonist was facing on its respective labor market. I will now give a short account how exactly the elasticity is linked to the question of market power in a give market, and why in the related (and more advanced) literature in empirical industrial organization is far more pessimistic about our ability to make any inferences except in very special cases.

The Conduct Parameter

To recap, the monopsonist maximizes

$$\Pi = R(L) - w(L)L$$

where $w(L)$ is inverse labor supply, and $R(L)$ is the firm's revenue as a function of employment. The first-order condition for this problem is

$$R_L - w_L L - w = 0 \Leftrightarrow \text{MPL} = w\left(1 + \frac{1}{\eta_L}\right)$$

where $\eta_w := \frac{dL}{dw}\frac{w}{L}$ is the (market) labor supply elasticity. The most common measure of market power is the Lerner index which in our example becomes

$$\frac{\text{MPL} - w}{w} = \frac{1}{\eta_L}$$

Note that a firm facing a labor supply elasticity η_L, this is only an upper bound on the margin on labor costs the firm can achieve only if it actually *behaves like* an profit-maximizing monopsonist (which is probably not true e.g. for hospitals run by the Veterans' Administration ...).
Therefore the mere fact that a firm faces an upward sloping (rather than flat) labor supply curve does by itself not mean that it actually *acts as* a monopsonist, but it is only a necessary condition for a monopsonist being able to extract any rents from workers. E.g. you could imagine a firm being the only

employer in a small closed economy, but all workers in the economy have exactly the same reservation wage, so that the labor supply curve is totally flat. Then even a firm with maximal market power can't extract rents from workers since labor supply is infinitely elastic, not because of competition, but for purely "technological" reasons.
This distinction is crucial because if we e.g. want to predict employment effects of a rise in the minimum wage or make a statement on whether the market works efficiently, it is more important to know whether the firm *does* - rather than just *could* - extract monopsony rents from its workers. This is an old problem in the industrial organization and antitrust, which has already figured out many things which seem to not yet have found their way into the literature on monopsony on labor markets (in particular because there's a lot more money involved in testimonies before court in antitrust cases than academic research on the minimum wage...).
An extensive literature in IO (which has fallen out of grace among other things for a reason we'll come back below) looks at a normalized measure of "how competitively" firms in a certain product market behave (i.e. whether they play Cournot equilibria, collude, or fail to optimize altogether). To fix thoughts, assume that there are N firms in a given product market, and we observe market price P_t and total quantity supplied (by all firms together) Q_t. The primary object of interest is then an elasticity adjusted Lerner index (note that now we are looking at a monopolist or oligopoly in a product market)

$$\hat{\theta}_i = \frac{P - \mathrm{MC}_i}{P}\eta_P$$

where η_P is the aggregate demand elasticity. $\hat{\theta}$ is commonly referred to as the *conduct parameter* of firm i, and if firms collude on the monopoly price, the corresponding $\hat{\theta}_i$ equals 1, whereas under perfect competition, $\hat{\theta}_i = 0$, and in a Cournot equilibrium, $\hat{\theta}_i = \frac{1}{N}$. Therefore, rejecting that firms in the market collude (or whether the only firm in the market behaves like a profit-maximizing monopsonist) reduces to a test against the null that $\hat{\theta}_i = 1$. Conversely, we can detect deviations from perfect competition by testing against $\hat{\theta}_i = 0$.

The Corts Critique[2]

The main practical difficulty with this is that it is almost always impossible to get a good measure of true marginal costs (or the marginal product of labor in the monopsony case), because the accounting exercise is very involved, and firms have every incentive to keep information about their marginal costs private. Therefore, the standard approach is to estimate the parameter in a standard linear IV framework.
Typically researchers would specify market inverse demand as

$$P_t = \alpha_0 + X_t\gamma + Q_t\theta + \varepsilon_t$$

where X_t are exogenous demand shifters, and solve the endogeneity problem in Q_t by instrumenting with cost shifters W_t. However, the paper by Corts points out that this strategy still only identifies *changes* in the adjusted Lerner index as a response to demand shifts, but still fails to identify its *level*. This means that, as Proposition 1 in his paper states, we identify the conduct parameter only if the actual change in the adjusted Lerner index is actually linear in exogenous demand shifts (and there's no reason to assume that this is true). Therefore, except under very heroic assumptions, we will fail to to make correct inferences about how competitive the market is. The underlying reason for this is quite easy to see: the cost shifters can only be informative about changes, but not levels of marginal costs, so that unless we have additional information on the cost structure, we can't identify that component of the conduct parameter.

[2] Corts, K. (1999): Conduct Parameters and the Measurement of Market Power, Journal of Econometrics **88**, 227-50