Labor Demand

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Why should you demand to understand labor demand?

- It takes two sides to do the equilibrium market tango
- I think of labor-market policy as either "supply-side" or "demand-side" based on whose behavioral *response* we should watch most closely as policies change. Taxes and transfer effects are mediated by the consumers' budget set (hough the GE consequences involve labor demand too, a point argued by Rothstein 2010). In competitive markets, the minimum wage moves us back along a demand curve. Immigration is a supply shift that traces demand (whence, Borjas (2003))

A Labor as a single variable factor (aka short-run labor demand)

- The *production function* tells us what the firm can make or services the firm can provide as function of inputs. In reality, there are many of these, but we can extract the important economic ideas with just two . . . sometimes even one is enough!
- The one-factor setup is derived from two:

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

  Now, fix one:

$$f(L) \equiv F(\bar{K}, L); f'(L) > 0; f''(L) < 0$$

  Think of this as a short-run production function (in the long run, all factors are variable)

- Initially, we assume firms are price takers in goods and factor markets and that they choose inputs so as to maximize profits: the discipline of the marketplace and free entry make it so. Given these key assumptions, firms can max profits:

$$\pi(L) = pf(L) - wL,$$

  where p is the product price, w is the price of labor (the wage), r is the price of capital (usually thought of as an interest rate), all given.

- $\pi-$max f.o.c.'s:

$$\begin{aligned} pf'(L) &= w \\ MR &= MC \end{aligned}$$

- We say: *in competitive markets, the firms demand curve for labor is given by the value of marginal product of labor*
- Aggregating individual firm demands yields market-level labor demand; with aggregate supply, this produces (competitive) equilibrium wages

Two variable factors introduce substitution possibilities

- $\pi-$max becomes:

$$\pi = pF(K,L) - wL - rK$$

with f.o.c.s

$$\begin{aligned} pF_L &= w \\ pF_K &= r \end{aligned}$$

so the optimal input combo satisfies

$$MRS = \frac{F_L}{F_K} = \frac{w}{r}. \qquad (1)$$

At the optimum, the slope of an isoquant (a feature of technology) equals the slope of a budget (isocost) line (DRAW THIS)

B Substitution and Scale Effects

- Although familiar, this tangency masks something important: there's action at both the firm and market level. Firm's face the question of how best to make something, a technological choice. At the market level, there's the question of how much product the industry can expect to sell and at what price (the same for all firms in competitive industry eq).

  1. We first ask: what's the cheapest way to make q? This generates *conditional factor demands*

  $$\{K^c(w,r,q), L^c(w,r,q)\} = \arg\min_{K,L} rK + wL \quad s.t. \quad F(K,L) = q$$

  2. Conditional factor demands determine the *cost function* (What piece of consumer theory does this remind you of?):

  $$C(w,r,q) \equiv rK^c(w,r,q), +wL(w,r,q)$$

  Now choose q to max:

  $$\pi(q) = pq - C(w,r,q) = pq - C^*(q)$$

  Output solves $p = MC$, i.e., generating the firm's supply curve: the product price determines *scale*

- This leads to a Slutsky-like equation for labor demand

B.1 Key Theoretical Concepts

Technical Substitution Elasticities

- The *elasticity of (technical) substitution* describes movement along an isoquant:
$$\sigma = \frac{dln(K^c/L^c)}{dln(w/r)} = \frac{dln(K^c/L^c)}{dln(F_L/F_K)} > 0$$
- Special production functions: Cobb-Douglas ($\sigma = 1$); Linear ($\sigma = \infty$); Leontief ($\sigma = 0$); CES ($\sigma = \frac{1}{1-\rho}$, where $q = A[\alpha K^\rho + (1-\alpha)L^\rho]^{\frac{1}{\rho}}$)

Constant Returns to Scale

- *Constant returns to scale* (CRTS) is a commonly-invoked mathematical metaphor for "the long run" because we imagine, given sufficient time, we can clone a production process by scaling all inputs (capital, energy, labor, and land). Under CRTS:
  - The cost function of firm j is proportional to unit cost:
  $$C_j(w, r, q_j) = q_j C(w, r, 1) = q_j c(w)$$
  where $c(w)$ is unit cost written as a function of wages and we're assuming all firms are identical except possibly for the level of output (why?). Hence, marginal cost is constant
  - Any one firm's output is indeterminate (the firm's long run supply curve is horizontal at p=constant MC. Price is driven to MC by entry, while *industry* scale is determined by market demand at this lowest-possible long-run price. And it's industry scale that matters for labor demand!

B.2 Factor Demand Elasticities Under CRTS (Hamermesh 1993 notation)

- *Conditional factor demand elasticities*, also known as substitution elasticities (not the same as technical σ, above - watch out!), describe the effects of factor prices on conditional factor demands. Under CRTS, these are:
$$\begin{aligned}\eta_{LL} &\equiv \frac{\partial L^c}{\partial w}\frac{w}{L} = -(1-s_L)\sigma < 0 \\ \eta_{LK} &\equiv \frac{\partial L^c}{\partial r}\frac{r}{L} = (1-s_L)\sigma > 0\end{aligned}$$
where $s_L = \frac{wL}{pq}$ is the labor share

- *Total factor demand elasticities* include substitution and scale effects. Under CRTS, these can be shown to be:

$$\eta'_{LL} = -(1 - s_L)\sigma - s_L\eta \tag{2}$$
$$\eta'_{LK} = (1 - s_L)(\sigma - \eta) \tag{3}$$

where $\eta = \frac{D'(p)p}{q}$ is the absolute value of the product demand elasticity. =

- Slutsky-like equation (2) is known to applied-micro mavens as the *fundamental law of factor demand* (we'll sketch a derivation shortly)

Hicks-Marshall Laws of Derived Demand

There are four of these; the first two come directly from the fundamental law of factor demand. The third sounds plausible, though few now living can prove it. The fourth also comes from (2).

1. Factor demand elasticities increase with ease of substitutability:

$$\sigma \uparrow \Rightarrow \eta'_{LL} \uparrow$$

2. Factor demand elasticities increases as product demand gets more elastic:

$$\eta \uparrow \Rightarrow \eta'_{LL} \uparrow$$

3. Factor demand elasticities increases as other factors are supplied more elastically (e.g., a highly elastic supply of capital makes it cheaper to substitute towards capital when wages go up).

4. Increasing the labor share makes labor demand more or less elastic as η is greater than or less than σ. In other words, because

$$\eta'_{LL} = -(1 - s_L)\sigma - s_L\eta = -\sigma - s_L(\eta - \sigma),$$

η'_{LL} increases with s_L when $\eta > \sigma$. It makes sense that a big factor share increases the scale effect, but there's also the substitution term to contend with!]

- Who cares about the Hicks-Marshall rules anyway?

Deriving the Fundamental Law of Factor Demand

We start this in class ...

- Using Shephard's lemma and CRTS,

$$L_j^c(w,r,q) = \frac{\partial C_j(w,r,q_j)}{\partial w} = q_j c'(w)$$

- Now sum to get the market demand for labor:

$$L = \sum_j L_j^c(w,r,q) = Qc'(w) = D(p)c'(w)$$

  where $Q = \sum q_j$

- But $p = MC$, so market demand is

$$D[c(w)]c'(w)$$

- Next, use the chain rule to write

$$\frac{\partial L}{\partial w} = \underbrace{Qc''(w)}_{Q-conditional\ response} + \underbrace{D'(p)[c'(w)]^2}_{product\ mkt\ response}$$

  - To be finished ... in recitation

- Key points:
  - By Shephard's lemma, the first term is the derivative of (the sum of all firms') *conditional* factor demands; that's the substitution effect
  - The second term reflects the elasticity of product demand (an industry-level response); that's the scale effect
  - *These effects are both negative, yo*

- In Angrist (1996), I estimate Israeli demand for Palestinian labor, using Intifada-induced supply shocks to trace out market demand (at the time, Israeli agriculture and construction employed many Palestinian day laborers). My results suggest Israeli demand in the 1980s-90s was surprisingly inelastic, giving Palestinians potential market power (alas, this did not last).

C Market Structure

Who's got the power?

- Perfect competition means firms are everywhere *price-takers*, that is, prices are parametric in product and factor markets
- We explore the power of market power in a 1-factor model

Power in the product market

- This means individual employers face downward sloping demand instead of perfectly elastic demand, so $p(q) = D^{-1}(q)$ where q is total output, produced by Monopoly Me
- The monopolist's $\pi - max$ problem:

$$\pi(L) = D^{-1}[f(L)]f(L) - wL$$

- The monopolist's f.o.c.

$$pf'(L) + p'(q)f'(L)f(L) - w = 0$$

The derivative of $D^{-1}(q)$ is $1/D'(p)$, so we have

$$pf'(L) + \frac{q}{D'(p)}f'(L) = w$$

- Simplify

$$pf'(L)\left[1 + \frac{1}{\eta}\right] = w, \tag{4}$$

where $\eta = \frac{D'(p)p}{q}$. This is an MR=MC type relation: the monopolist sets MR equal to the wage, but MR is no longer simply $pf'(L)$ (DRAW THIS)

- Implications:
  1. Note that (4) requires $|\eta| > 1$, i.e., equilibrium demand must be *at least* unit elastic (elasticities aren't really constant though we write them in Greek). Highly elastic demand means I don't have to reduce product price much to sell more; this keeps MR from additional L positive. Therefore,

  $$0 < 1 + \frac{1}{\eta} < 1$$

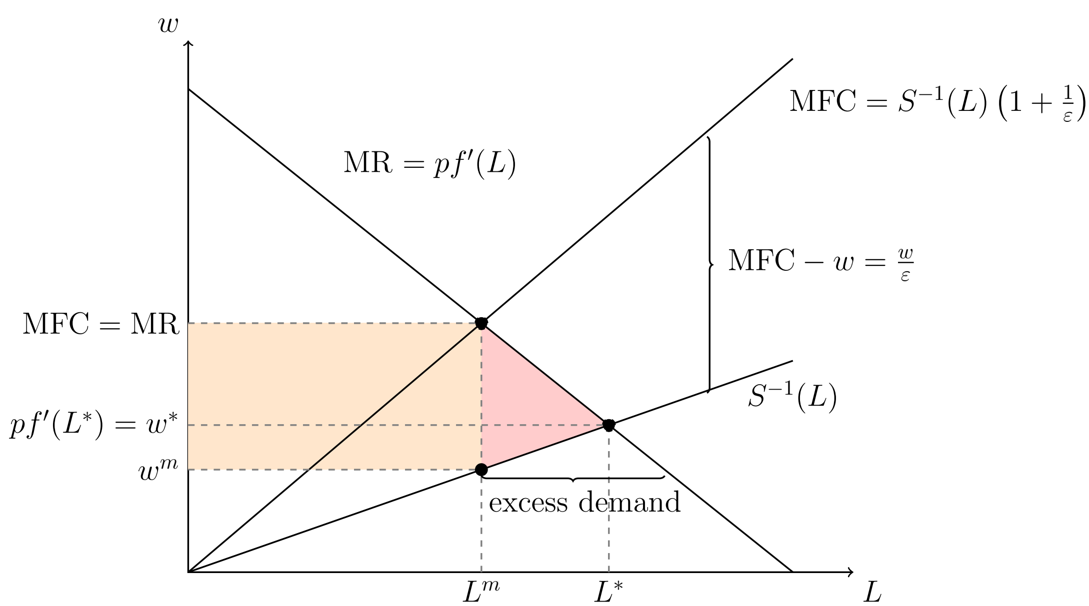
  so MR is attenuated by the need to lower prices to sell the extra output produced by additional workers. The good news is that MR is enhanced by restricting output, since price then rises!
  2. We get p-comp as a special case when

  $$\eta = -\infty$$

  Output and employment consequently rise.
- And yet, this model seems to miss something fundamental about power in the the product market. . .
  - Do Verizon, Comcast, and MIT really employ *fewer* workers than they would do if the market for cable, phone services, and higher ed were more competitive?
  - Where does monopoly power come from anyway?

Power in the factor market

- This means *individual employers* face upward sloping instead of perfectly elastic supply, so $w(L) = S^{-1}(L)$. Define supply elasticity $\varepsilon = \frac{S'(w)w}{L}$.
  - Market power drives a wedge between the wage and *marginal factor cost* [NUMERICAL EXAMPLE]
- The monopsonist's $\pi - max$ problem:
$$\pi(L) = pf(L) - S^{-1}(L)L$$
- with FOC:
$$pf'(L) - \left[S^{-1}(L) + Lw'(L)\right] = 0$$
- Re-arrange:
$$pf'(L) - \left[w + \frac{L}{S'(w)}\right] = 0$$
$$pf'(L) = w\left[1 + \frac{1}{\varepsilon}\right] > w$$
again, an MR=MC type relation. Here, the marginal factor cost (MFC) exceeds the wage because of the need to raise wages to hire more workers (we pay inframarginals this higher wage too). We say: *the monopsonist sets MR equal to MFC* (DRAW THIS)



orange: "exploitation". red: deadweight loss.

- Implications:
  1. A monopsonist exploits the opportunity to decrease wages as employment falls (in fact, he *exploits* his workers - how?)
  2. We get p-comp as a special case when
  $$\varepsilon = \infty$$
  3. Is it good to be king of the factor market? The exploitative monopsonist collects rents ... yet never sleeps easy - he'd always like to hire more workers at current wages. Monopolists are often heard on CNBC bellyaching about "labor shortages." (DRAW THIS)
- Classical monopsony is rare. But monopsony-related policy implications to go through when employers have *some* market power (see, e.g. CK's *Myth and Measurement* or Manning, 2003). *Speak truth to monopsony power: it's merely a matter of upward-sloping supply!*

D Monopsony and the Min

- A binding minimum wage imposed on an employer with power in the factor market ... raises employment (perhaps)
  - If the labor market is competitive, the min moves us back along downward sloping demand; if not, all bets are off (DRAW THIS)
  - Taking rents from capitalists and giving them to workers - what's not to love?
- Minimum wage effects are often taken as a litmus test for whether the labor market is competitive
- Some say "most employers are small, and so must pay the going wage." Others note the pervasive presence of recruiting bonuses and the like. Such marginal non-wage inducements are the Red Badge of Market Power
- Modern evidence on the min comes from diffs-in-diffs style analyses; we'll look briefly at a classic and at a modern study
  - The min debate continues at maximum intensity: see recent contributions by Neumark and Wascher (2014), Cengiz, et al (2020), and Derenoncourt, et al (2022), among others. Much debate revolves around the relevant control group and the robustness of diffs-in-diffs estimates to local trends

Jersey Boys