MIT 14.01: Principles of Microeconomics
Sp 2025, Lecture 16: Imperfect Competition (part III)

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Plan for Today

- A deeper dive into imperfectly competitive settings
- Focus now will be on imperfectly competitive *input* markets

Imperfect Competition in Input Markets

- We have studied settings in which firm f has market power in its output market
  - And seen how this is the same as saying that firm f faces a residual demand curve $RD_f(p)$ that is not perfectly elastic
- Today we'll study a similar phenomenon in which firm f has market power in one (or more) of its *input* markets (e.g. for the labor it hires)
- This will be the same as saying that firm f faces a residual *supply* curve $RS_f(w)$ for its input(s) that is not perfectly elastic (as function of the input price w), and where RS is given by:

$$(\text{residual input supply})_f = (\text{market input supply}) - (\text{other firms' input demand})$$

- One could easily imagine a firm that has market power in both its output and input markets (e.g. Walmart is a big seller and a big buyer) but for simplicity we'll keep these phenomena separate

Recap: Input Demand for a Competitive Input Market

- Suppose we are studying firm f, which produces its output using only labor
  - It uses the production function $q_f = \phi_f(L_f)$
  - And $\phi(\cdot)$ is DRTS
- Recall, in Lectures #8 and #10 we studied a firm's input demand decisions for the case of a perfectly competitive input market where the input prices (e.g. w here) are taken as given by the firm
- This firm's profit-maximization problem (assuming a competitive output market too, so p is fixed) is:

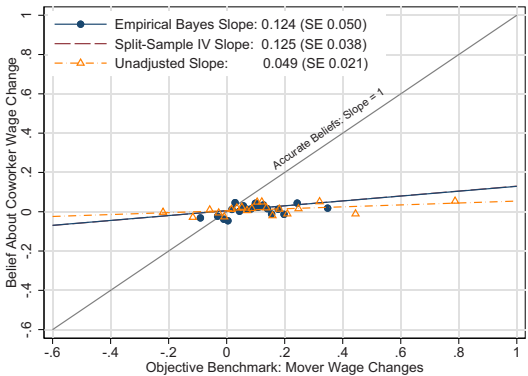
$$\max_{L_f} p\phi_f(L_f) - wL_f \quad \Rightarrow \quad w = p\frac{\partial \phi_f(L_f^*)}{\partial L_f} \equiv pMPL_f(L_f^*)$$

- Intuition:
  - Firm's optimum is where the price of the input w is equal to the value of the output produced by a marginal unit of that input (i.e. p times the physical marginal product, MPL_f)
  - Indeed, $pMPL_f(L_f^*)$ is sometimes called $VMPL_f$ for short (and sometimes the "marginal revenue product of labor", $MRPL_f$, too)

Why Might Some Firms Have Labor Market Power?

- Natural market power: a "company town" (e.g. Hershey, PA)
  - One big employer that has big MES and dominates the local labor market
- Labor market product differentiation: workers may value non-wage attributes of jobs (e.g. commuting time), and differentially so across employers
  - E.g. may be relatively few employers (for a type of worker) within the same commuting distance
- Collusive practices – a famous example (revealed in legal proceedings):
  - Steve Jobs to Eric Schmidt (Google CEO, Apple board member!) in 2007 email: "I would be very pleased if your recruiting department would stop doing this" (i.e. poaching software engineers)
  - Schmidt to HR department: "I believe we have a policy of no recruiting from Apple and this is a direct inbound request. Can you get this stopped and tell me why it is happening?"
- Unnatural barriers to entry:
  - E.g. non-compete agreements that workers must sign
- Workers may have incorrect information about their outside options (or how successful bargaining may be)

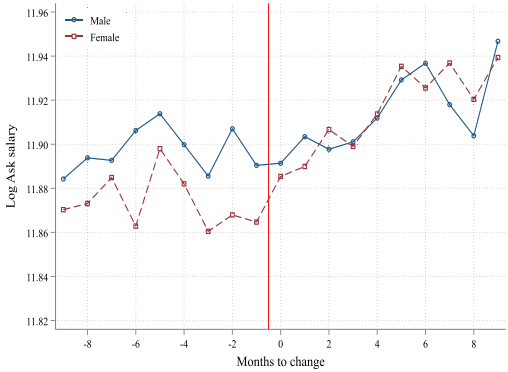
German Workers' Ignorance About Outside Options



Jaeger et al (*Q. J. Econ.*, 2024)

- Survey of workers in Germany
- y-axis: what a survey respondent thinks a typical coworker's wage change would be if they were to leave the firm
- x-axis: actual wage changes for workers (of same type of respondent) who left that actual respondent's firm from 2015-19
- Suggestive evidence that workers don't know much about prevailing wages at other potential employers

The "Ask Gap"



Rousille (*Q. J. Econ.*, 2024)

- Study of all applicants for software engineering jobs on Hired.com
- Platform allows applicants to propose an "ask" bid for their salary when applying
- In mid-2018 this cell on the application web form shifted from being pre-filled empty to being pre-filled with the median bid salary on the platform over the past 12 months
- Suggestive evidence of the baseline "ask" (prior to the change in the web form) being lower for female applicants than for male ones

Profit-Maximization Subject to a Residual Input Supply Curve

- How will firm f's profit-maximizing choices change if it faces the residual supply curve $RS_f(w)$ for the labor it wants to hire?
- Similarly to Lecture #14 we treat this as profit-maximization subject to the constraint of $L_f = RS_f(w)$:

$$\max_{L_f} p\phi_f(L_f) - wL_f \quad \text{s.t.} \quad L_f = RS_f(w)$$

- Or (just like we did in Lecture #14) if we denote the firm's inverse residual supply function by $w = RS_f^{-1}(L_f) \equiv W_f(L_f)$ then can write this as an unconstrained problem:

$$\max_{L_f} p\phi_f(L_f) - W_f(L_f)L_f$$

Profit-Maximization Subject to a Residual Input Supply Curve

- What will the solution look like? A pair (L_f^*, w^*) that satisfy the FOC:

$$VMPL_f(L_f^*) = MCL_f(q_f^*, w^*) \text{ with } MCL_f(L_f^*, w^*) \equiv \frac{d(wL_f)}{dL_f} = w^* + L_f^* \frac{dW_f(L_f^*)}{dL_f}$$

  - NB: MCL_f = "marginal cost of hiring labor" – this is related to, but not quite the same as, the firm's marginal cost MC_f that we've used in earlier lectures

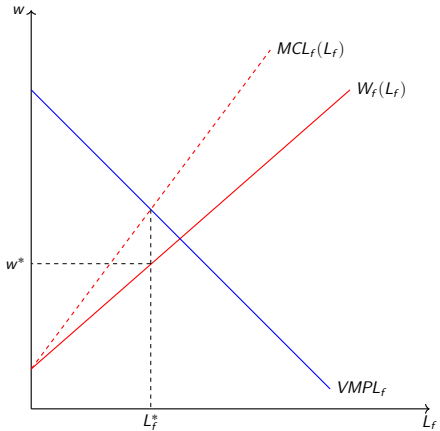
- So the case of perfect competition above is a special case of this in which L_f has no effect on w (i.e. w^* is just the w that the firm takes as given), so we had $\frac{dW_f}{dL_f} = 0$ and hence:

$$MCL_f(L_f^*, w^*) = w \quad \text{and hence} \quad w = VMPL_f(L_f^*)$$

- But now in the imperfectly competitive case we have:

$$MCL_f(L_f^*) = \underbrace{w^*}_{\substack{\text{extra marginal cost of} \\ \text{hiring one more unit of } L_f}} + \underbrace{L_f^* \frac{dW_f(L_f^*)}{dL_f}}_{\substack{\text{extra labor costs on all infra-marginal} \\ \text{units of } L_f \text{ due to sliding up RS curve}}}$$

Profit-Maximization Subject to a Residual Input Supply Curve



- Firm's FOC requires L_f^* to satisfy: $VMPL_f(L_f^*) = MCL_f(L_f^*)$
- Then w^* is where $w^* = W_f(L_f^*)$
- Second-order condition (SOC) always satisfied here since $VMPL_f$ is downward-sloping and MCL_f is upward-sloping

Markdowns, Elasticities, and Market Power

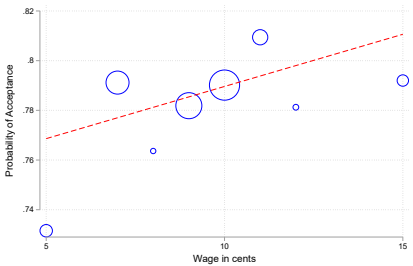
- Two definitions:
  1. *markdown* ("wage is marked down below its value marginal product"): $\mu_f \equiv VMPL_f^* - w^*$
  2. *wage-marginal product margin* (like the *Lerner index*): $M_f \equiv \frac{VMPL_f^* - w^)}{VMPL_f^*}$

- Can write the firm's FOC in elasticity form (using fact that $\varepsilon_{RS_f^{-1},L} = \frac{1}{\varepsilon_{RS_f,w}}$) as:

$$\frac{\mu_f}{VMPL_f^*} \equiv M_f = \frac{1}{\varepsilon_{RS_f,w}}$$

- Intuition:
  - Higher elasticity of RS $\Rightarrow$ lower markdown relative to VMPL
  - We say that high M implies that the firm has a lot of *market power* in its labor market – its actions have a relatively large effect on the wage
  - Under perfect input market competition, firm has no market power (i.e. $\mu_f = M_f = 0$ since $\varepsilon_{RS_f,w} \to \infty$)

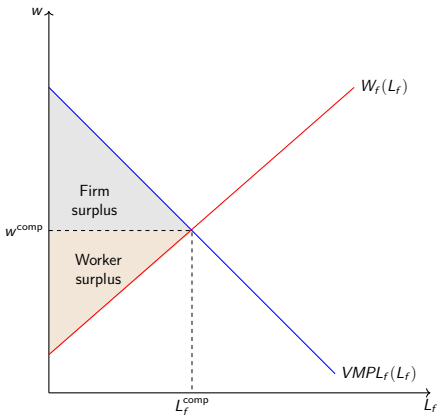
A Randomized Wage Experiment



Dube, Manning and Naidu (2020)

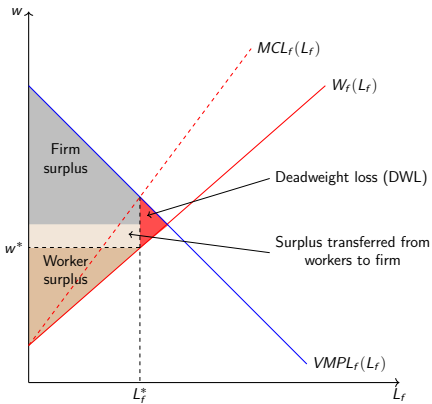
- Amazon MTurk is an online platform where workers can accept various tasks (e.g. data entry) for a given offered wage (a price paid per task completed)
- Authors went on platform, created identical tasks (advertised to workers in identical manner), but randomized the wage offered
- Figure implies an estimated elasticity of residual labor supply facing this "firm" (i.e. the one the authors set up) of around 0.1
  - Can be as high as 0.15 if condition on workers being relatively experienced with MTurk
  - But still very low and certainly very far from the perfectly competitive benchmark of $\varepsilon_{RS_f,w} \to \infty$!

Firm and Worker Surplus in a Competitive Labor Market



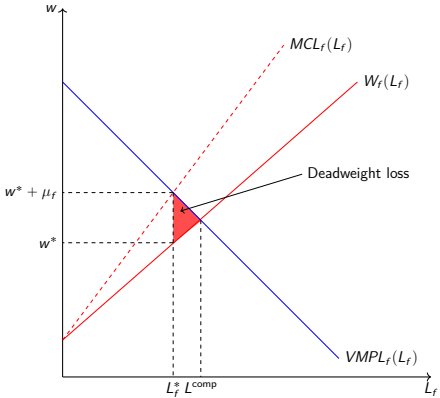
- Suppose the firm were to (for some reason) charge the competitive wage $w^{comp} = VMPL_f(L_f^{comp})$
  - Then workers and firm would split surplus
- Firm surplus is same as the PS we have seen before
  - But now the firm is doing the buying. So illustrating the PS as the area below the firm's input demand curve, instead of the area above its market supply curve
- Workers' surplus is the analog of the CS we have seen before
  - But now the "consumers" are workers who are selling something (their labor) to the firms
  - So the area above their supply curve is their surplus
- NB: also (not shown here) this firm is presumably creating genuine CS for the buyers of its good

Inefficiency Due to Labor Market Power



- As you'd expect, imperfect competition in the input market leads to a Pareto inefficient allocation (i.e. $DWL > 0$)
  - Just as in Lecture #14 for the case of the output market, imperfect competition in the input market is a violation of one of the conditions for the First Welfare Theorem (Lectures #4 and #12)
- Why does imperfect competition do worse?
  - Here, firm f uses its market power to capture some of the worker surplus, but in the process creates some deadweight loss (DWL)
  - Exactly analogous to the output market power case of Lecture #14
  - As there, the real inefficienty is not market power per se but "blunt" power (no price discrimination)

How Large is the Deadweight Loss Due to Input Market Power?



- Everything is analogous to output market power in Lecture #14:
  - The markdown μ_f is a wedge between the wage and the firm's VMPL
  - The markdown causes DWL because at L_f^* there are workers who would have high VMPL but the firm doesn't want to hire them because the firm finds it better not to (because, due to its market power, hiring more workers would require raising wages of all inframarginal workers)

- Like in Lectures #5 and #14, can show that DWL "Harberger triangle" approximation is:

$$DWL = \frac{1}{2}\mu_f(L^{comp} - L_f^*)$$

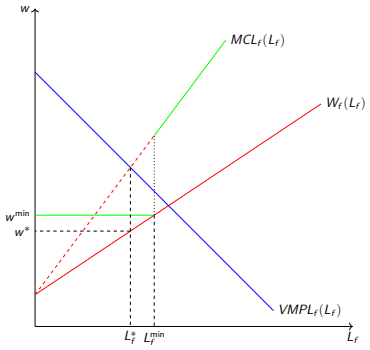
A Linear Supply Example

- Suppose that firm f only uses one input (labor), has $VMPL_f(L_f) = a - L_f$, and faces a linear residual supply curve for labor given by $RS_f(w) = b + w$
- What will be the firm's optimal wage and labor demand pair (w^*, L_f^*)?
  - If $L_f = RS_f(w) = b + w$ then $w = W_f(L_f) = L_f - b$
  - So $MCL_f \equiv \frac{d(wL_f)}{dL_f} = w + L_f \frac{dW_f}{dL_f} = w + L_f$
  - So $VMPL_f(L_f^*) = MCL_f(L^*) \iff a - L_f^* = w^* + L_f^*$
  - Solve for L_f^* using $w^* = W_f(L_f^*)$: $a - L_f^* = (L_f^* - b) + L_f^* \iff L_f^* = \frac{a+b}{3}$
  - So $w^* = W_f(L_f^*) = L_f^* - b = \frac{a-2b}{3}$
- And what is the firm's markdown?
  - $\mu_f \equiv VMPL_f(L_f^*) - w^* = (a - L_f^*) - w^* = a - \frac{a+b}{3} - \frac{a-2b}{3} = \frac{a+b}{3}$
- And what will be the DWL due to this firm's input market power?
  - $DWL = \frac{1}{2}\mu_f(L^{\text{comp}} - L_f^*)$, so we just need L^{comp}
  - But L^{comp} satisfies $W_f(L_f^{\text{comp}}) = VMPL_f(L_f^{\text{comp}})$, or $a - L_f^{\text{comp}} = L_f^{\text{comp}} - b$
  - So $L^{\text{comp}} = \frac{a+b}{2}$
  - So $DWL = \frac{1}{2}\left(\frac{a+b}{3}\right)\left(\frac{a+b}{2} - \frac{a+b}{3}\right) = \frac{(a+b)^2}{36}$

Monopsony and Oligopsony

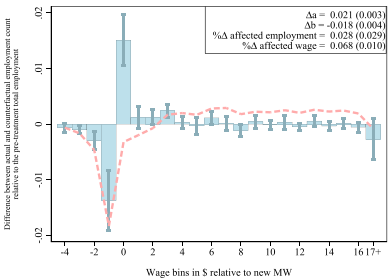
- Everything so far has taken $RS_f(w)$ as given, but where does $RS_f(w)$ come from?
- As with the analogous case of imperfectly competitive output markets (in Lectures #14 and #15) the answer is:
  - $RS_f(w) = S(w) - D_o(w)$, where $S(w)$ is total market input supply and $D_o(w)$ is the demand for this input by other firms
  - So the real question is: where does $D_o(w)$ come from, i.e. what is the *market structure* of the input market?
- One simple case is that of *monopsony* where firm f is alone in this input market and hence $D_o(w) = 0$
  - Analogous to the *monopoly* case of Lecture #14
- The more complicated case is one of *oligopsony* where firm f is one of a "few" buyers of the input and there are strategic interactions among the buyers
  - Analogous to the examples like Stackelberg, Cournot, collusion, and Bertrand competition that we saw in Lecture #15 for *oligopoly*

Minimum Wages Revisited



- Recall from Lecture #5: in competitive market, binding price controls lead to:
  - In labor market context, binding price control = minimum wage policy (at $w^{min} > w^{comp}$)
  - Causes unemployment: $L_f^{min} < L_f^{comp}$ (i.e. DWL)
  - And those who are do find a job might not necessarily be those most willing to work (i.e. inefficient rationing)
- But in the imperfectly competitive labor market illustrated here, things could be different:
  - The firm's MCL_f curve is now the green line
  - So policy results in a higher wage, but also *higher* employment (i.e. $L_f^{min} > L_f^*$). This is also more efficient (lower markdown, lower DWL, probably less rationing).
  - Another example of "two wrongs (here: price controls and market power) make a right" (i.e. inefficiency-correcting policy)
  - Also reduces inequality (assuming firm owners are rich)

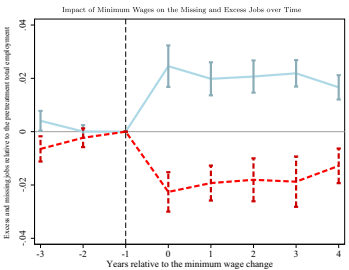
Effects of Minimum Wages in the US



Cengiz et al (*Q. J. Econ*, 2019)

- Authors examine all 138 raises in US state-level min. wages from 1979-2016
- Compute diff-in-diff estimates of effects on share of state workers at each "wage bin" (in $ relative to the new level of the min. wage, after each change)
  - T: states that got a MW change in any given year
  - C: states that did not get a MW change in that same year
  - ...then "stack" the set of all such diff-in-diff estimates over all years
- Estimates (one per wage bin) shown here in blue
  - Clear evidence for workers whose wages were below the new MW simply having their wages raised to the new MW value

Effects of Minimum Wages in US



Cengiz et al (*Q. J. Econ*, 2019)

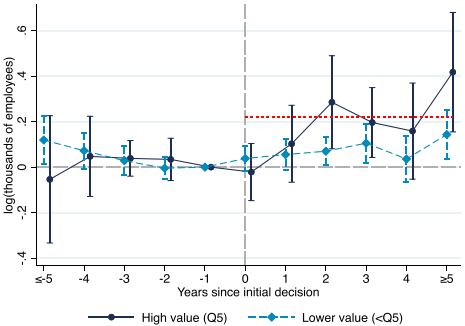
- Did this increase in wages cause a reduction in employment?
  - (As a perfectly competitive labor market model would predict would happen)
- This figure shows the path of diff-in-diff estimates over time before and after a typical MW raise
  - Blue: effects on number of workers being paid at (or $<$ \$1 above) the new MW
  - Red: effects on number of workers being paid (0 to \$2 below) the new MW
- These two effects add up to essentially zero (regardless of the horizon), suggesting that the typical MW raise did raise wages (i.e. was binding) but did not reduce employment for affected workers
  - Consistent with the oligopsonistic labor markets model we've seen

Do Workers Benefit from Firm Profitability Shocks?

- If firm f gets a shock to its $VMPL_f(\cdot)$ then the firm hires more L_f, and its profits go up. But what happens to the wage w?
  - Competitive L market: no effect on w (assuming this firm is so small in the labor market that its increased hiring has no effect)
  - Imperfectly competitive L market: w will increase, since (by definition) the firm faces an upward-sloping RS_f curve (so if it wants to hire more, it has to raise the wage)

- One nice thought experiment:
  - Consider a firm that gets awarded a patent for its main potential product
  - This makes the firm effectively more productive/profitable (i.e. raises $VMPL_f$)
  - But what happens to hiring, profits, and wages paid?

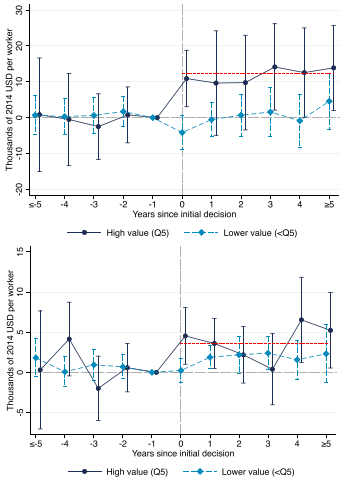
Do Workers Benefit from Firm Profitability Shocks?



Kline et al (*Q. J. Econ*, 2019)

- This study examines all US firms who filed for their first patent from 2000-2010
  - Merge data on all patent filings to IRS data on all (from 1995-2017) firm-level corporate tax filings and their workers' income tax filings
- This figure: diff-in-diff analysis comparing:
  - T: firms whose first patent application is granted at date "0"
  - C: firms whose first patent application is denied at date "0"
  - Dark blue: T and C are both firms with (pre-determined) characteristics that tend to predict the patent being relatively high market value (and light blue: lower market value)
- So being granted a high-value patent causes a $> 20\%$ increase in L_f

Do Workers Benefit from Firm Profitability Shocks?



Kline et al (*Q. J. Econ*, 2019)

- Top figure: effects on firm's "total surplus" (defined as profits plus total wage costs, wL_f) per worker
- Bottom figure: effects on firm's total wage costs (wL_f) per worker (i.e. an "average annual salary" measure)
- So (e.g.) for high-market value patents:
  - Wages went up (by about \$4K per worker p.a.)
  - Profits went up (by about \$8K=\$12K-\$4K per worker p.a.)
  - Hence the firms shared about one third of the increase in surplus with their employees
- Consistent with labor markets being imperfectly competitive

Concluding Remarks

- **Key concepts from today's lecture:**
  - Perfect competition in input markets: firm faces perfectly elastic input (e.g. labor) supply curve(s)
  - Imperfect competition in input markets: firm faces somewhat inelastic elastic supply curve(s), and uses this market power to charge an input price (e.g. wage) that is marked down relative to the input's value marginal product (VMPL)
  - Wage-marginal product margin: ratio of markdown to VMPL
  - Markdowns lead to DWL (and usual Harberger triangle formula applies)
  - Monopsony: when only one buyer of the input in the input market
  - Oligopsony: when only a "few" buyers of the input in the input market
  - Minimum wages: with imperfectly competitive labor market, can raise wage without reducing employment