Labor Economics: Introduction to Theory

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Outline

1. **Labor Supply**

2. **Labor Demand**

3. **Market Equilibrium**
   - Compensating Wage Differentials

Labor Supply

Consumer's Problem

- In most markets, people (consumers) provide the demand
- Labor is special: people provide the supply in the market
- An individual needs to choose how they will participate in the market:
  - Whether to work (**extensive margin**)
  - How much to work (**intensive margin**)
- Our framework: utility maximization (just like in Intermediate Micro!)

Labor-Leisure Problem

- Standard approach: consumer chooses between two goods (x_1, x_2) to maximize their utility $u(\cdot)$ given the prices (p_1, p_2) and their income (M)

$$\max_{x_1, x_2} \; u(x_1, x_2)$$
$$\text{s.t. } p_1 x_1 + p_2 x_2 = M$$

- Here: consumer chooses between consumption (c) and leisure (ℓ)
    - Consumer's income: earnings from labor (L = hours of work).
    - There are T hours in a time period (week), so $\ell + L = T$
    - Let hourly wage be w. Normalize price of consumption as \$1.

Labor-Leisure Problem

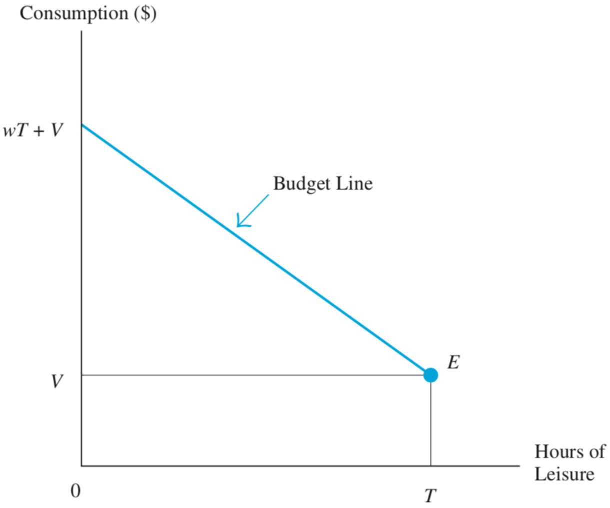
- Budget constraint: $1 \cdot c = wL = w(T - \ell)$
  - Re-write BC as $c + w\ell = wT$
  - Leisure has a price of w (opportunity cost of not working)
  - Can also let them have non-labor income (V), which they get no matter how much they work
- Consumer's problem becomes:

$$\max_{c,\ell} \; u(c, \ell)$$

$$\text{s.t. } c + w\ell = wT + V$$

Budget Line

Figure 1: Budget Line



Source: GB, Figure 2.5

Optimal Choice

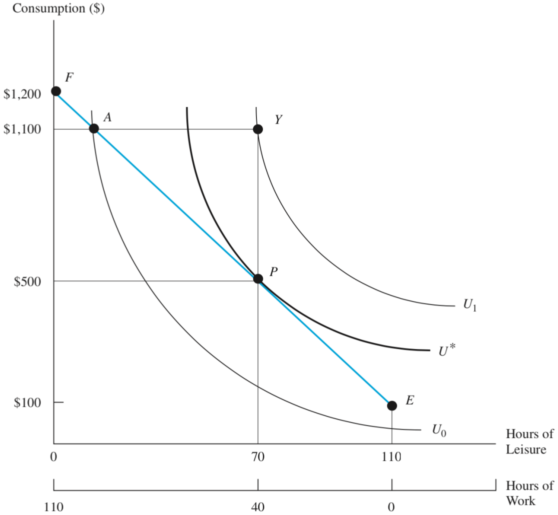
- An interior solution is found where:

$$MRS = \frac{MU_1}{MU_2} = \frac{p_1}{p_2}$$
$$\therefore \frac{MU_\ell}{MU_c} = w$$

- This is the **tangency condition**
  - *MRS* = rate at which you are willing to give up 1 hour of leisure for an extra unit of consumption
  - Price ratio = rate at which the market values 1 hour of leisure relative to consumption
  - Optimality: your internal valuation of leisure relative to consumption matches the market's valuation

Interior Solution

Figure 2: Interior Solution



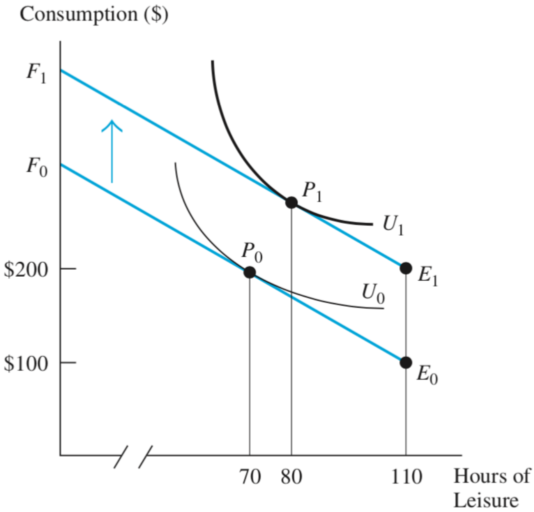
Source: GB, Figure 2.6

Changes to Non-Labor Income

- Suppose V increases to $V + \Delta$.
  - At every level of ℓ, I get Δ more dollars to use on consumption
  - Parallel shift of the budget line
- Assuming that leisure is a normal good, I should increase consumption and leisure

Changes to Non-Labor Income

Figure 3: Increase of Non-Labor Income (Leisure Normal)



Source: GB, Figure 2.7

Changes to Prices

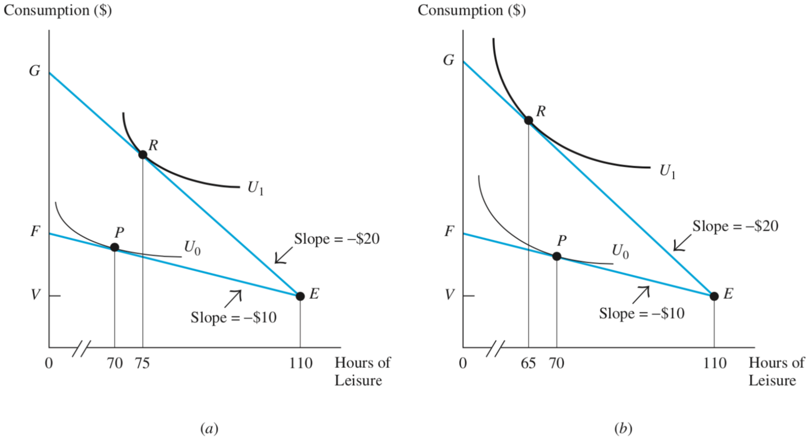
- In standard setting, changing the price of a good has two effects: (e.g. for a price increase)
  1. **Substitution Effect:** the good has become relatively more expensive $\implies$ switch away to substitute goods (and buy less complements)
  2. **Income Effect:** prices overall have risen, so I feel poorer overall $\implies$ reduce consumption of normal goods

- Price affects relative income, but it does not affect the (nominal) value of income itself. If $p_1 \uparrow$:
  - BL slope $\left(-\frac{p_1}{p_2}\right)$ falls, i.e. increases in absolute value (steeper)
  - BL x-intercept $\left(\frac{M}{p_1}\right)$ falls
  - BL y-intercept $\left(\frac{M}{p_2}\right)$ remains unchanged

Changes to Wage

- Consider the wage (i.e. price of leisure) changing. If $w \uparrow$:
  - BL slope $\left(-\frac{w}{1}\right)$ falls, i.e. increases in absolute value (steeper)
  - BL x-intercept (T) remains unchanged
  - BL y-intercept $(wT + V)$ increases
- It's a bit ambiguous!
  - Wage increase make leisure more costly $\implies$ SE says you should reduce leisure
  - But it also makes you richer $\implies$ IE says you should increase leisure

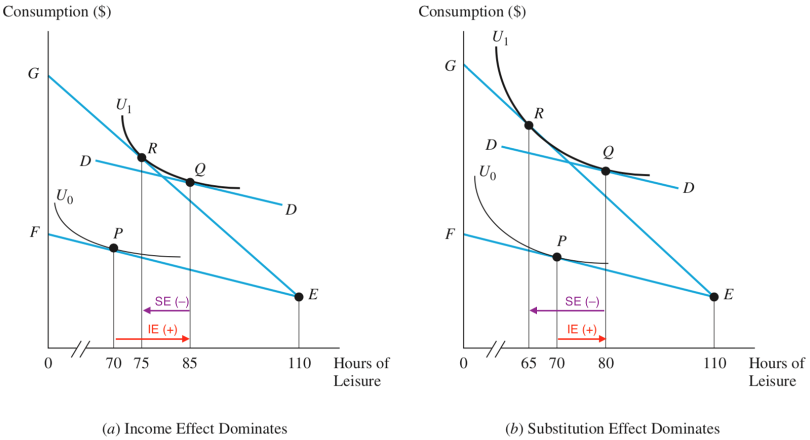
Figure 4: Increase of Wage



Source: GB, Figure 2.8

Changes to Wage Income

Figure 5: Increase of Wage



Source: GB, Figure 2.9

Reservation Wage

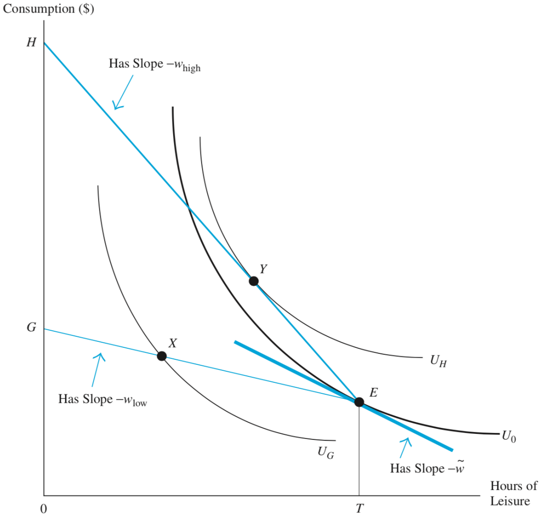
- In Intermediate Micro, you sometimes had "corner" solutions (i.e. consume only one good)
    - Only with Perfect Substitutes and Quasi-Linear utility functions
- Here, a "corner" involves using all time on leisure, i.e. not working
    - The budget line is cut-off. At $\ell = T$, you have zero earnings but can still use your non-labor income V for consumption
    - This is always an option for you (**outside option**)

Reservation Wage

- Thought experiment: suppose $V = \$100$. You leave your house looking for a job and go to the marketplace to see the current wage w.
  - You observe $w = 1¢ \rightarrow$ How insulting! Go home and enjoy your $\$100$
  - You observe $w = \$100 \rightarrow$Wow! Definitely going to be working
- Extending this reasoning, there must be some specific wage $\tilde{w}$ such that you are indifferent between working and not working
  - Call this the **reservation wage**
  - Your reservation wage depends on your preferences + outside option (how do you answers to the thought experiment change if $V = 0$?)

Reservation Wage

Figure 6: Reservation Wage Illustration



Source: GB, Figure 2.10

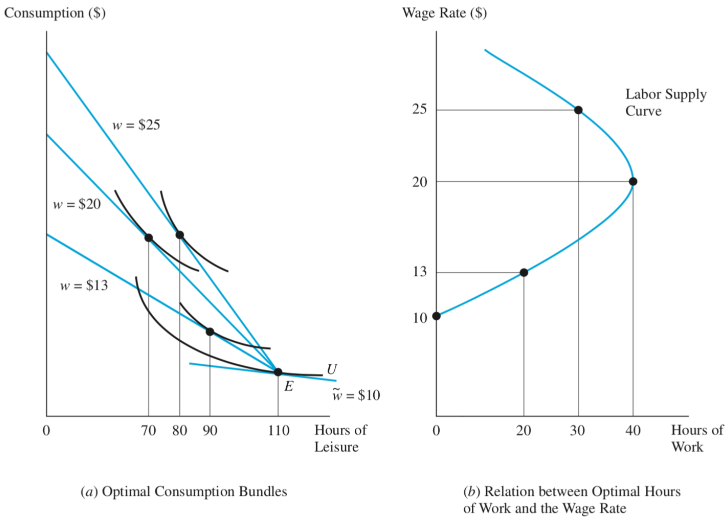
Labor Supply

- Usually, we use the consumer's utility maximization problem (UMP) to solve for demand
  - Intuitively solve UMP for every possible price and see what is the optimal quantity
- We can do this here. For every possible w, solve for the optimal leisure ℓ^*
  - This gives us leisure demand $\ell(w)$, the optimal hours of leisure as a function of the wage
  - Since $L = T - \ell$, then $L(w) = T - \ell(w)$ is the **labor supply curve**

Labor Supply

- Demand for a product follows the law of demand: downward sloping
- Labor supply (and likewise leisure demand) are more tricky:
  - From $w = 0$ to $w = \tilde{w}$, the reservation wage: zero labor (not worth it to work)
  - For low $w > \tilde{w}$: SE $>$ IE, so labor increases with w (most people)
  - At some point, $w \gg \tilde{w}$: IE $>$ SE, so labor decreases with w (too rich to work)
- This gives us a backward bending supply curve

Figure 7: Backward Bending Labor Supply Curve



Source: GB, Figure 2.11

Market Labor Supply

- As usual, we aggregate individual supply curves "horizontally" to get the market supply curve

$$\underbrace{L(w)}_{\substack{\text{Total hours people are} \\ \text{willing to work at wage } w}} = L_1(w) + \ldots \underbrace{L_i(w)}_{\substack{\text{Number of hours person } i \\ \text{is willing to work at wage } w}} \cdots + L_N(w)$$

- We are often interested in what happens to labor supply if w changes
  - This is the **labor supply elasticity**: if w increases by 1%, how much does labor supply change by (as % change)

$$\sigma = \frac{\%\Delta \text{ in Labor Supply}}{\%\Delta \text{ in Wage}} = \frac{dL}{dw} \cdot \frac{w}{L}$$

  - If $|\sigma| > 1$, we say labor supply is elastic (very response to wage). If $|\sigma| < 1$, it is inelastic

Labor Demand

The Firm's Problem

- The firm wants to choose its inputs, labor (L) and capital (K), to maximize profits
  - Subject to prices of its inputs (w, r), the price of its output (p), and its production function, $f(K, L)$
  - Key: assuming price taker of *all* prices

$$\max_{K,L} \; pf(K, L) - wL - rK$$

- In the short run, often assume that capital is fixed $\implies$ to get more output, firms need to hire more workers
- In the long run, all inputs are variables $\implies$ firm can substitute capital for labor

The Firm's Problem

- SR optimization. Take FOC (derivative) with respect to L:

$$p\frac{\partial f}{\partial L} - w = 0$$
$$p \cdot MP_L = w$$

- MP_L is the **marginal product of labor**: how much extra output do you get from hiring an additional unit of labor
- Intuition for optimal L: hire workers until the extra revenue ($p \cdot MP_L$) that you get from the last unit is equal to the cost of hiring them (w)
  - Common shorthand: "workers are paid their marginal product"

Short Run Demand Curve

- In the optimality condition, $p \cdot MP_L = w$, firms cannot choose prices (p) or wages (w)
- The only thing they can choose is L, which in turn determines MP_L. They choose L so that the condition holds
- But as w changes, then the L needs to be re-chosen to keep the equality true
- Doing this for every w gives us the short-run labor demand curve $L(w)$

Market Demand Long Run Demand

Labor Demand Elasticity

- Analogous to labor supply, we can define the labor demand elasticity
$$\delta = \frac{\%\Delta \text{ in Labor Demand}}{\%\Delta \text{ in Wage}}$$
- Since the firm's problems differ, we define δ for both the short-run and long-run demands
    - Firms have more flexibility in LR $\implies \delta_{LR} > \delta_{SR}$ (LR more elastic)

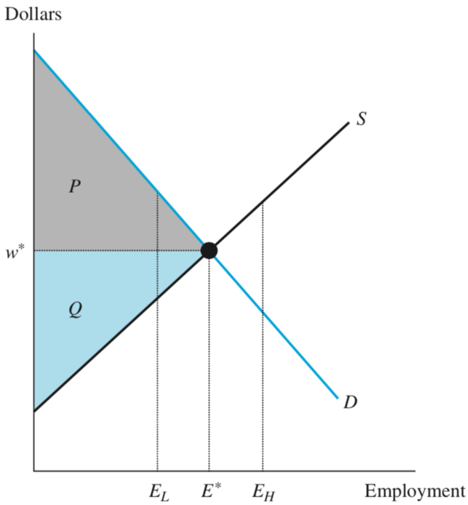
Market Equilibrium

Single Market Equilibrium

- We bring together the market demand and market supply to calculate the equilibrium
- Wages will adjust until quantity of labor demanded equals the quantity supplied
- Properties of the competitive market:
  - Single wage (w^*). All workers receive the same wage
  - No unemployment. Everyone willing to work at w^* or lower gets a job
  - Efficient: it maximizes **gains from trade** (consumer + producer surplus)

Market Equilibrium

Figure 8: Labor Market

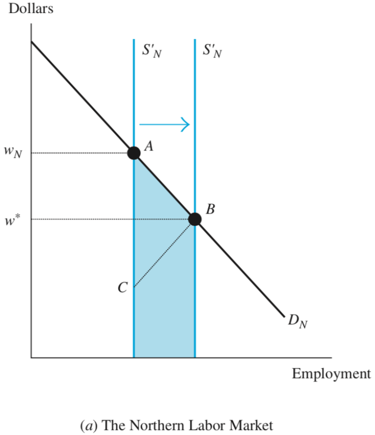


Source: GB, Figure 4.1

Multiple Market Equilibrium

- Realistically, we have more than one market
  - Same industry, different locations
  - Same location, different industries
- Suppose two markets (North and South)
  - Workers in both regions have <u>same</u> skills (i.e. they are perfect substitutes)
  - Exists a wage differential ($w_{North} > w_{South}$)
  - Is this an equilibrium? Does it depend on the cost of migration?

Figure 9: Two Labor Markets with Migration



Source: GB, Figure 4.2

Market Equilibrium

Compensating Wage Differentials

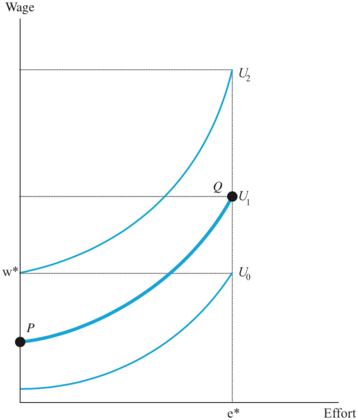
Multiple Market Equilibrium

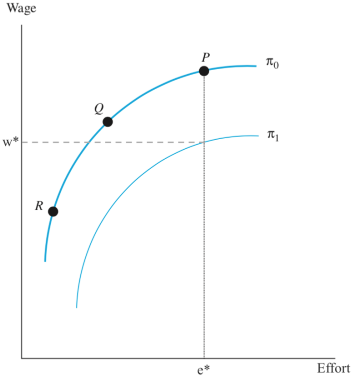
- Even with multiple markets, still get a single wage w^* in the market
  - Key assumption: all jobs are alike and all workers are alike
- Reality: jobs and workers are different, we observe variation in wages
- Rationalization: **compensating wage differentials**

Job Difficulty

- Suppose that each job can be characterized by how much effort (e) it takes to perform
    - "Effort" captures how difficult a job is due to risk, long hours, benefits etc
    - Workers dislike effort (it is a bad)
    - Firms' profit increases with effort
- We can plot indifference and iso-profit curves on a effort-wage axis
    - If $e \uparrow$, then $u \downarrow$ and $\pi \uparrow$ (for fixed w)
    - If $w \uparrow$, then $u \uparrow$ and $\pi \downarrow$ (for fixed e)
    - To ensure indifference, upward sloping ICs and IPs
    - ICs increasing in u towards NW, IPs increasing in πtowards SE

Figure 10: Indifference and Iso-Profit Curves





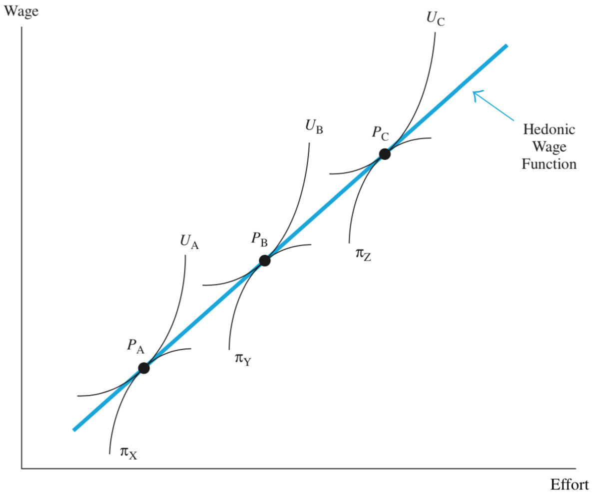
Source: GB, Figure 5.1, 5.5

Hedonic Wage Function

- In standard model, everyone is alike. Here, people and firms differ and there is matching
  - Firms choose their optimal wage-effort combination based on their production function
  - Workers choose the firm that offers them the best contract based on their preferences
- In equilibrium: firms are on their zero-profit iso-profit line
  - If $\pi > 0$, another firm can offer a better wage to employee and they will leave
  - If $\pi < 0$, firm will decrease wage to lower costs
- We can look at how *w* varies with *e* in equilibrium - this gives the **hedonic wage function**

Hedonic Wage Function

Figure 11: Hedonic Wage Function



Source: GB, Figure 5.6

Compensating Wage Differentials

- Hedonic wage function is upward sloping: receive higher wages for tougher jobs
- **Compensating wage differentials** arise to compensate workers for non-wage characteristics of a job
    - Interpretation: how much do I have to pay the marginal worker (last hired) to join my firm, in equilibrium?
    - Key assumptions: perfect information and mobility

Towards Empirics

- Our simple model has given us a **testable implication**
  - A relationship or outcome that we can check if it holds in real life
  - This is the sign of a good model
- In this case: tougher jobs should be paid more, *all else equal*
  - The "all else equal" makes things difficult. Rarely holds in real life
  - Comparing college prof to coal miner - not great
  - Comparing college prof in NYC to college prof in Boise, ID - much better (but not perfect)

Gender Gap

- Let's look at two papers that study the **gender pay gap**
- We observe that women earn less than men, on average
- One possible explanation: women have stronger preferences for positive job attributes (e.g. able to work from home, flexible hours) and so accept lower wages
- Fits into the compensating differentials story
- Get around "all else equal" by doing experiments (we'll talk a lot about this later in the class)

Preference for the Workplace, Investment in Human Capital, and Gender

Matthew
Wiswall

Basit
Zafar

QJE, 2017

Paper Overview

- Surveyed NYU students in May 2012
    - Sample: 247 people; 65% female; average age was 21.5
- Offered choices between hypothetical jobs with different qualities
    - From this, they estimate the average **willingness-to-pay** for each job attribute
    - Interpretation: if you increase the job attribute by one unit, how much more do you have to pay me to keep me indifferent? (slope of the indifference curve!)

WTP Estimates

Table 1: Average WTP Estimates

	WTP (% of earnings)		
	Overall	**Men**	**Women**
Percent chance of being fired	2.8	0.6	4.0
Bonus as % of earnings	−1.4	−0.9	−1.7
Percent of men at jobs	0.1	0.1	0.0
Annual % raise in earnings	−1.6	−3.4	−0.6
Hours per week of work	1.1	0.8	1.3
Part-time option available	−5.1	−1.1	−7.3

Source: Wiswall and Zafar (2017), Table 6

Main Results

- WTP estimates show that women do indeed value non-monetary job characteristics more than men
- Do a follow-up survey (71 respondents) to see what jobs they actually end up taking four years later
    - WTP results do predict actual workplace choices!
    - e.g. people who valued flexible work options in the college survey were more likely to have jobs with greater flexibility
- Estimate that at least one quarter of the gender gap in early career earnings is explained by these average gender differences in preferences

Valuing Alternative Work Arrangements

Alexandre
Mas

Amanda
Pallais

AER, 2017

Paper Overview

- Posted advertisements for a telephone interviewer positions at a call center in 68 metro areas
  - Sample: 3,245 people; 75% female; average age was 33
- Asked applicants for preference between two positions: a standard 9-5 job vs. one of five alternatives
  - Alternatives:
    - flexible schedule, flexible hours (choose number of hours)
    - work from home, combined flexible (choose schedule + hours)
    - employer discretion (employer decides with short notice)
  - Wages also varied

WTP Estimates

Table 2: Average WTP Estimates

	WTP (% of earnings)		
	Overall	**Men**	**Women**
Flexible schedule	−2.8	−0.9	−3.4
Flexible number of hours	1.3	2.0	1.1
Work from home	−7.8	−4.0	−9.4
Combined flexible	−6.9	−0.2	−9.2
Employer discretion	20.1	12.4	25.1

Source: Mas and Pallais (2017), Table 5 and 10

[level WTPs divided by $17 following footnote 29]

Main Results

- Results suggest that that women have stronger preference for flexibility than men, but...
- Find that there is little gender gap in *actual* work arrangements (using survey data)
  - Conclude that this cannot explain the gender wage gap
  - "The differences in observed work arrangements are not large enough to lead to significant gender gaps even with substantial compensating wage differentials."

Next Steps

- Two papers, published in the same year (2017), both at top journals... with quite different results
  - Everything comes out cleanly in theoretical models
  - Real world is much more complicated!
- Next step: dive more into empirical work

Appendix

Market Demand Curve

- Usually, we just sum individual curves horizontally. More complicated here!
- Suppose $w \downarrow$. Then every firm will want to hire more workers: $L \uparrow (*)$
- But if firms hire more workers, then their output increases: $q \uparrow$
  - Higher supply in the market drives down the price of the output: $p \downarrow$
- Lower prices mean that firms will want to hire less workers: $L \downarrow$
- In the end, labor increases but by less than you would initially think $(*)$

Aggregating Demand

Figure A1: Industry Short-Run Demand Curve

(*a*) Individual Firms

(*b*) Industry

Source: GB, Figure 3.4 Back

Long Run Demand Curve

- In the LR, firm can choose any mix of K and L.
  - More options to respond to price changes!
- If $w \downarrow$, then current mix of K, L will be cheaper - but it won't be optimal
  - Substitute K with L to get the same output for cheaper - still not optimal!
  - Since costs are lower, firm will want to expand. Hire more L for sure
  - Will they also hire more K?

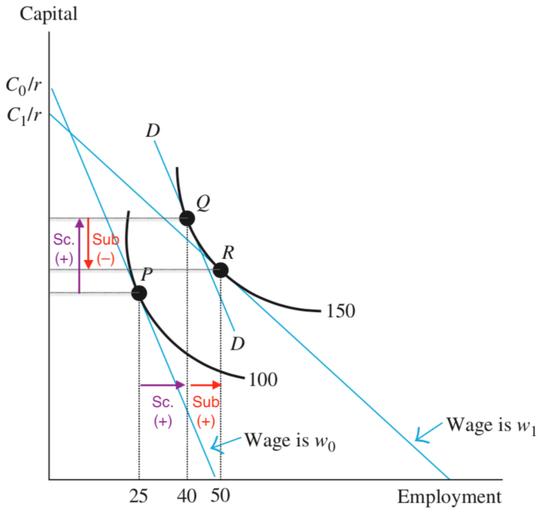
Substitution and Scale Effects

- Just like for consumers, a change in input prices has two effects:
  1. **Substitution Effect:** If w falls, then labor is relatively cheaper and, holding output constant, the firm will switch from capital to labor (i.e. have a more labor intensive production)
  2. **Scale Effect:** If w falls, costs overall are lower, so the firm wants to expand its production by increasing the levels of both inputs

- Therefore, for a decrease in wage:
  - $K \uparrow$ if scale effect dominates the substitution effect
  - $K \downarrow$ if substitution effect dominates the scale effect

Decomposition of Wage Decrease

Figure A2: Effect Decomposition



Source: GB, Figure 3.12 Back

References

References

Mas, A. and A. Pallais (2017). "Valuing alternative work arrangements". In: *American Economic Review* 107.12, pp. 3722–3759.

Wiswall, M. and B. Zafar (2017). "Preference for the Workplace, Investment in Human Capital, and Gender". In: *The Quarterly Journal of Economics* 133.1, pp. 457–507.