Labor-Leisure Choice

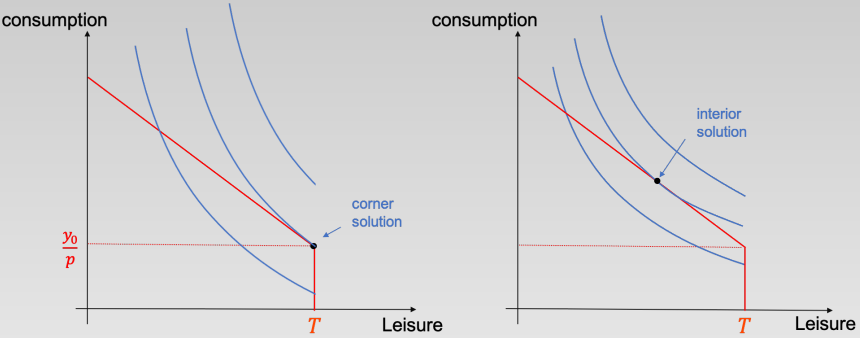
Utility Maximization

- Utility $= u(C, L)$, (C is the amount of goods and services consumed, and L is the amount of leisure)
- Budget constraint is $PC = WH + y_0$ (P is price of consumption goods; W is wage rate; H is hours worked; y_0 is unearned income)
- Time constraint is $H + L = T$ (T is time endowment)
- Eliminate H to get full budget constraint:

$$PC + WL = WT + y_0$$

  - left-hand-side is total cost of “commodities”
  - right-hand-side is “full income”
  - increase in W raises the price of leisure and raises full income

Budget Line and Indifference Curves



Analysis

- slope of budget line is $-W/P$ (the real wage rate)
- slope of indifference curves is $-MRS$, where the marginal rate of substitution between leisure and consumption (defined as a positive number) is

$$MRS(C,L) = \frac{u_L(C,L)}{u_C(C,L)}$$

- Optimal choice is a “corner solution” if at $(C^*, L^*) = (y_0/P, T)$,

$$MRS(y_0/P, T) \geq W/P$$

- Optimal choice (C^*, T^*) is an “interior solution” if the above inequality is false and

$$MRS(C^*, L^*) = W/P$$

Extensive Margin

- Begin with a low wage W such that the optimal choice is a corner solution: $MRS(y_0/P, T) > W/P$
- Gradually increase the wage. At some point W_0, the two sides become equal:

$$MRS(y_0/P, T) = W_0/P$$

- Such W_0 is called the reservation wage. The worker choose a corner solution $L^* = T$ (i.e., $H = 0$) if $W \leq W_0$, and chooses an interior solution ($H > 0$) if $W > W_0$.
- An increase in W always increases labor force participation

Reservation Wage with Hours Constraint

- Suppose an individual cannot freely choose her work hours: she either does not work ($H = 0$), or works a fixed number of hours $H = h_0$
- The reservation wage is defined as the W_0 such that

$$u\left(\frac{y_0}{P}, T\right) = u\left(\frac{y_0 + W_0 h_0}{P}, T - h_0\right)$$

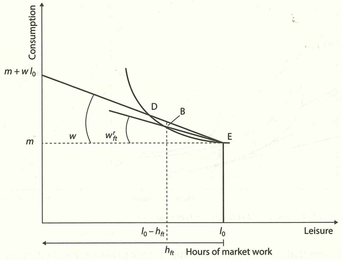
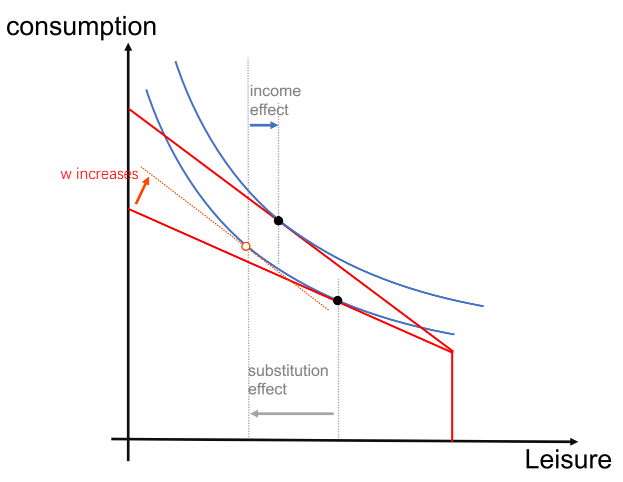


FIGURE 1.7. Reservation wage with a constraint on hours

Intensive Margin

- Higher W makes leisure more expensive: substitution effect is negative (choose less leisure)
- Higher W increases full income. Assume leisure is a normal good. Then income effect is positive (choose more leisure)
- Overall effect is ambiguous: labor supply can be upward sloping or backward bending

Graphical Illustration



Slutsky Equation

- If $H(W, y_0)$ is the "uncompensated labor supply" function and $H^c(W, u_0)$ is the "compensated labor supply" function,

$$\frac{\partial H}{\partial W} = \underset{(+)}{\frac{\partial H^c}{\partial W}} + \underset{(-)}{H\frac{\partial H}{\partial y_0}}$$

- Magnitude of income effect is larger if a person works more hours
  - on average, men work more hours than women
  - magnitude of income effect is larger for men
  - uncompensated labor supply for men is more inelastic

Labor Supply to an Industry or a Firm

- If a firm has no monopsony power, labor supply to this firm is infinitely elastic
- Labor supply to a specific industry is more elastic than labor supply to the economy as a whole (because a higher wage in one particular industry not only attracts people to work more intensively, but it attract people working in other industries to move to this particular industry)

Intertemporal Substitution

- Lifetime utility is

$$\sum_{t=0}^{\bar{t}} \frac{u(C_t, L_t)}{(1+r)^t}$$

- Lifetime budget constraint is

$$\sum_{t=0}^{\bar{t}} \frac{P_t C_t + W_t L_t}{(1+r)^t} = \sum_{t=0}^{\bar{t}} \frac{W_t T + y_t}{(1+r)^t} + A_0$$

- Suppose wage at time t_0 increases, while everything else remains unchanged
  - L_{t_0} becomes more expensive relative to C_{t_0}: standard substitution effect
  - increase in full income is a small fraction of lifetime full income: small income effect
  - L_{t_0} becomes more expensive relative to L_t for $t \neq t_0$: intertemporal substitution effect (change the timing of leisure consumption from time t_0 to other times, when leisure is cheaper)
- temporary increase in wage induces a stronger positive labor supply response than permanent increase in wage

Empirical Findings

- Over the long term, real wages have risen, but hours worked and labor participation have fallen for men, while hours and participation have risen for women.
  - One justification is that women used to work shorter (or even no) hours. Thus the strength of the income effect is smaller for women than for men.
  - The decline in labor participation of men is mainly concentrated among those with low market wages, so the decline in male labor participation reflects the substitution effect as well.
- Cross section studies of male labor supply often find that the income effect roughly cancels the substitution effect. Elasticity estimates center around -0.2 to $+0.1$. For women, the real wage rate is found to have a strong positive effect on labor force participation.

Is Leisure a Normal Good?

- Estimating income effect on leisure is difficult because people with large unearned income can be systematically different from those with small unearned income
- Hotz-Eakin, Joulifaian, and Rosen (1993) did a study that makes use of data on inherited wealth. They found that labor force participation among people who received larger amounts of inheritance (average USD 346,200) fell from 70% to 65%, while labor participation among people who received small amounts of inheritance (average USD 7,700) rose from 76% to 81% in the same period.
- People who received larger amounts of inheritance a more likely to experience a fall in earnings than are people who received less inheritance (perhaps because they work fewer hours or take a more desirable job at lower wages once thay received the inheritance).
- Other studies use lottery winnings

Intertemporal Labor Supply

- Camerer, Babcock and Loewenstein (1997) finds that New York City taxi drivers work fewer hours on days when the effective hourly wage is high. They propose a “target income hypothesis.”
- Gerald Oettinger (1999) studied labor supply of food vendors at a baseball stadium. These vendors are hired on a daily basis and they are free to choose whether to work at any given game. Earnings from sales fluctuate by the game, but these fluctuations are to some extent predictable. These fluctuations tend to cancel out so the income effect is probably not very strong (more precisely, one may think of the labor supply response as a response to intertemporal wage changes). Oettinger found that a US$10 rise in daily earnings (the average was about $43) lured an extra 6 vendors (the average number was about 45) to the stadium.

Uber Drivers

Table 1: Boston Uber Drivers

	All Boston Drivers (1)	Eligible Drivers (2)	Experimental Drivers (3)	Strata-Adjusted Difference (4)
Female	0.14	0.14	0.14	0.00
	(0.35)	(0.34)	(0.35)	(0.01)
Age	40.90	41.58	41.80	0.15
	(12.13)	(12.20)	(12.29)	(0.36)
Hours Last Week of July	14.99	13.86	15.72	0.42
	(16.27)	(10.49)	(11.26)	(0.28)
Average Hours/Week in July	14.42	13.13	14.51	0.06
	(14.39)	(5.69)	(5.81)	(0.08)
Average Hourly Earnings in July	15.39	17.59	17.40	-0.10
	(8.64)	(6.19)	(6.05)	(0.17)
Average Weekly Farebox in July	372.06	310.91	342.82	-0.80
	(447.51)	(192.04)	(198.12)	(3.93)
Months Since Sign-up	13.89	14.26	11.14	-0.08
	(9.43)	(9.25)	(8.67)	(0.15)
Vehicle Solutions	0.08	0.08	0.08	0.01
	(0.26)	(0.27)	(0.28)	(0.01)
Car Model Year 2003 or Older	0.03	0.03	0.12	0.00
	(0.17)	(0.17)	(0.33)	(0.00)
Car Model Year 2011 or Newer	0.64	0.64	0.56	-0.01
	(0.48)	(0.48)	(0.50)	(0.01)
Commission	22.34	22.24	23.21	0.00
	(2.50)	(2.49)	(2.40)	(0.01)
Number of Observations	19316	8685	1600	8685

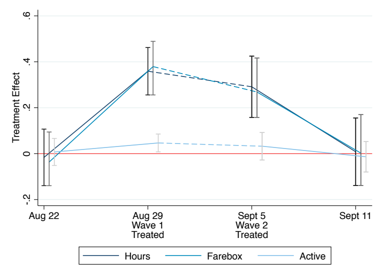
Field Experiment

- Angrist, Caldwell and Hall (2019) did an experiment to create wage variations for Uber drivers and measure their labor supply response.
- 1600 drivers were randomly drawn and given the opportunity to drive fee-free in the “opt-in week.” If the Uber fee is 20%, drivers would be receiving 1 dollar instead of 80 cents per dollar revenue. This represents a 25% increase in their hourly wage.
- Only 1,031 drivers accepted this opportunity. For those who accepted, they were offered a further opportunity to participate in two “taxi-weeks.” They could continue to drive fee-free if they buy a “lease” for $110 per week. (They can break even if they get $550 revenue that week.)

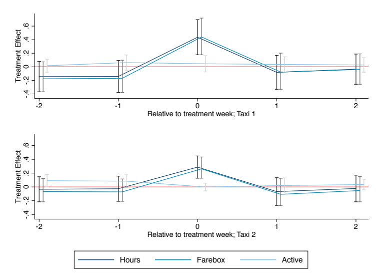
Effects on Labor Supply

Figure 7: Participation Effects on Labor Supply

A. Opt-in Week



B. Taxi



Instrumental Variables Estimation

- They can use this experiment to back out the labor supply elasticity.
- First, estimate the following (first stage) equation:

$$\log(\text{wage}) = \gamma \times (\text{offerred opportunity}) + \text{controls}$$

  - the variable "(offerred opportunity)" is generated by experimental randomization and is uncorrelated with anything else. It satisfies the exclusion condition
  - wages tend to be higher for people who are "offerred opportunity." It satisfies the relevance condition

Second Stage

- Once they estimate a $\hat{\gamma}$ from the first stage regression, they can compute a predicted wage $\hat{\log w}$ using the estimated $\hat{\gamma}$
- Then estimate the second stage regression:

$$\log(\text{hours}) = \alpha(\hat{\log w}) + \text{controls}$$

- The estimated $\hat{\alpha}$ is the IV estimate (also called the two-stage least squares estimate) of the elasticity of hours with respect to wage
- The estimated elasticities range from about 1.2 for opt-in week to 1.8 for taxi week.
- There is some evidence that drivers under-subscribe to the taxi-week opportunity in the sense that they fail to take up the offer even though it is financially attractive. The authors attribute this to “loss aversion.”

Children and Female Labor Supply

- Comparing the labor supply of women with more children against those with fewer children is not enough for causal inference. Why?

Challenge

- The challenge is to find an instrumental variable that
  - affects the number of children (relevance condition)
  - but is otherwise unrelated to women's labor supply decision (exclusion condition)
- Angrist and Evans (1998) finds an ingenious IV: the sex parity of children

Relevance

TABLE 3—FRACTION OF FAMILIES THAT HAD ANOTHER CHILD BY PARITY AND SEX OF CHILDREN

	All women				Married women			
	1980 PUMS (649,887 observations)		1990 PUMS (627,362 observations)		1980 PUMS (410,333 observations)		1990 PUMS (477,798 observations)	
Sex of first child in families with one or more children	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child
(1) one girl	0.488	0.694 (0.001)	0.489	0.665 (0.001)	0.485	0.720 (0.001)	0.487	0.698 (0.001)
(2) one boy	0.512	0.694 (0.001)	0.511	0.667 (0.001)	0.515	0.720 (0.001)	0.513	0.699 (0.001)
difference (2) − (1)	—	0.000 (0.001)	—	0.002 (0.001)	—	0.000 (0.001)	—	0.001 (0.001)

	All women				Married women			
	1980 PUMS (394,835 observations)		1990 PUMS (380,007 observations)		1980 PUMS (254,654 observations)		1990 PUMS (301,588 observations)	
Sex of first two children in families with two or more children	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child
one boy, one girl	0.494	0.372 (0.001)	0.495	0.344 (0.001)	0.494	0.346 (0.001)	0.497	0.331 (0.001)
two girls	0.242	0.441 (0.002)	0.241	0.412 (0.002)	0.239	0.425 (0.002)	0.239	0.408 (0.002)
two boys	0.264	0.423 (0.002)	0.264	0.401 (0.002)	0.266	0.404 (0.002)	0.264	0.396 (0.002)
(1) one boy, one girl	0.494	0.372 (0.001)	0.495	0.344 (0.001)	0.494	0.346 (0.001)	0.497	0.331 (0.001)
(2) both same sex	0.506	0.432 (0.001)	0.505	0.407 (0.001)	0.506	0.414 (0.001)	0.503	0.401 (0.001)
difference (2) − (1)	—	0.060 (0.002)	—	0.063 (0.002)	—	0.068 (0.002)	—	0.070 (0.002)

Notes: The samples are the same as in Table 2. Standard errors are reported in parentheses.

Wald Estimate

- Wald estimate is $\frac{y_1 - y_0}{x_1 - x_0}$
  - y is labor supply, x is number of children
  - subscript 1 refers to families with one girl and one boy; subscript 0 refers to families with two girls or two boys
  - similar to IV estimate

TABLE 5—WALD ESTIMATES OF LABOR-SUPPLY MODELS

	1980 PUMS			1990 PUMS			1980 PUMS		
		Wald estimate using as covariate:			Wald estimate using as covariate:			Wald estimate using as covariate:	
Variable	Mean difference by *Same sex*	*More than 2 children*	*Number of children*	Mean difference by *Same sex*	*More than 2 children*	*Number of children*	Mean difference by *Twins-2*	*More than 2 children*	*Number of children*
More than 2 children	0.0600 (0.0016)	—	—	0.0628 (0.0016)	—	—	0.6031 (0.0084)	—	—
Number of children	0.0765 (0.0026)	—	—	0.0836 (0.0025)	—	—	0.8094 (0.0139)	—	—
Worked for pay	−0.0080 (0.0016)	−0.133 (0.026)	−0.104 (0.021)	−0.0053 (0.0015)	−0.084 (0.024)	−0.063 (0.018)	−0.0459 (0.0086)	−0.076 (0.014)	−0.057 (0.011)
Weeks worked	−0.3826 (0.0709)	−6.38 (1.17)	−5.00 (0.92)	−0.3233 (0.0743)	−5.15 (1.17)	−3.87 (0.88)	−1.982 (0.386)	−3.28 (0.63)	−2.45 (0.47)
Hours/week	−0.3110 (0.0602)	−5.18 (1.00)	−4.07 (0.78)	−0.2363 (0.0620)	−3.76 (0.98)	−2.83 (0.73)	−1.979 (0.327)	−3.28 (0.54)	−2.44 (0.40)
Labor income	−132.5 (34.4)	−2208.8 (569.2)	−1732.4 (446.3)	−119.4 (42.4)	−1901.4 (670.3)	−1428.0 (502.6)	−570.8 (186.9)	−946.4 (308.6)	−705.2 (229.8)
ln(*Family income*)	−0.0018 (0.0041)	−0.029 (0.068)	−0.023 (0.054)	−0.0085 (0.0047)	−0.136 (0.074)	−0.102 (0.056)	−0.0341 (0.0223)	−0.057 (0.037)	−0.042 (0.027)

Notes: The samples are the same as in Table 2. Standard errors are reported in parentheses.

Lessons for Causal Inference

- Conduct field experiments to manipulate variations in independent variable
- Find instrumental variables that satisfy relevance condition and exclusion condition to get at causal inference