Labor Supply

• Labor supply is the relationship between desired hours worked and wages

• Each of us in modern economic society have to make the following decisions

1. whether or not to work (extensive margin)
2. How many hours to work if employed (intensive margin)
Content

• Develop a formal framework to study labor supply decisions.

1. Individual labor supply model
2. Family labor supply model
3. Life-cycle and dynamic labor supply

Motivation

• Helps us understand trends in labor force participation and working hours.
• Allows us to address a number of questions with important policy and social consequences:
  ① What is the optimal level of income and payroll taxes?
  ② How should we design welfare and social assistance programs to help the poor?
  ③ What explains changes in labor force participation over time and how does these changes affect the wage structure?
### TABLE 2-3  Labor Supply in the United States, 2007 (persons aged 25–64)


<table>
<thead>
<tr>
<th>Educational attainment:</th>
<th>Labor Force Participation Rate</th>
<th>Annual Hours of Work</th>
<th>Percent of Workers in Part-Time Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
</tr>
<tr>
<td>All persons</td>
<td>87.1</td>
<td>72.7</td>
<td>2,153</td>
</tr>
<tr>
<td>Less than 12 years</td>
<td>75.3</td>
<td>49.3</td>
<td>1,966</td>
</tr>
<tr>
<td>12 years</td>
<td>85.1</td>
<td>70.1</td>
<td>2,111</td>
</tr>
<tr>
<td>13–15 years</td>
<td>88.9</td>
<td>76.4</td>
<td>2,146</td>
</tr>
<tr>
<td>16 years or more</td>
<td>92.4</td>
<td>81.0</td>
<td>2,261</td>
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</table>

<table>
<thead>
<tr>
<th>Age:</th>
<th>Labor Force Participation Rate</th>
<th>Annual Hours of Work</th>
<th>Percent of Workers in Part-Time Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
</tr>
<tr>
<td>25–34</td>
<td>92.2</td>
<td>75.6</td>
<td>2,090</td>
</tr>
<tr>
<td>35–44</td>
<td>91.9</td>
<td>77.5</td>
<td>2,203</td>
</tr>
<tr>
<td>45–54</td>
<td>88.3</td>
<td>76.6</td>
<td>2,209</td>
</tr>
<tr>
<td>55–64</td>
<td>68.9</td>
<td>55.0</td>
<td>2,058</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Race:</th>
<th>Labor Force Participation Rate</th>
<th>Annual Hours of Work</th>
<th>Percent of Workers in Part-Time Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
</tr>
<tr>
<td>White</td>
<td>88.0</td>
<td>74.0</td>
<td>2,194</td>
</tr>
<tr>
<td>Black</td>
<td>79.6</td>
<td>74.3</td>
<td>2,015</td>
</tr>
<tr>
<td>Hispanic</td>
<td>88.1</td>
<td>65.3</td>
<td>2,040</td>
</tr>
</tbody>
</table>

### TABLE 2-4  International Differences in Female Labor Force Participation Rate (women aged 15–64)


<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>52.7</td>
<td>62.1</td>
<td>66.4</td>
</tr>
<tr>
<td>Canada</td>
<td>57.8</td>
<td>67.6</td>
<td>70.4</td>
</tr>
<tr>
<td>France</td>
<td>54.4</td>
<td>57.8</td>
<td>62.0</td>
</tr>
<tr>
<td>Germany</td>
<td>52.8</td>
<td>56.7</td>
<td>64.0</td>
</tr>
<tr>
<td>Greece</td>
<td>33.0</td>
<td>43.6</td>
<td>50.2</td>
</tr>
<tr>
<td>Ireland</td>
<td>36.3</td>
<td>43.8</td>
<td>56.2</td>
</tr>
<tr>
<td>Italy</td>
<td>39.6</td>
<td>45.9</td>
<td>46.8</td>
</tr>
<tr>
<td>Japan</td>
<td>54.8</td>
<td>60.3</td>
<td>64.2</td>
</tr>
<tr>
<td>Korea, South</td>
<td>—</td>
<td>51.2</td>
<td>54.3</td>
</tr>
<tr>
<td>Mexico</td>
<td>33.7</td>
<td>—</td>
<td>42.4</td>
</tr>
<tr>
<td>New Zealand</td>
<td>44.6</td>
<td>63.0</td>
<td>67.6</td>
</tr>
<tr>
<td>Portugal</td>
<td>54.3</td>
<td>62.9</td>
<td>67.2</td>
</tr>
<tr>
<td>Spain</td>
<td>32.2</td>
<td>41.2</td>
<td>50.7</td>
</tr>
<tr>
<td>Sweden</td>
<td>74.1</td>
<td>80.4</td>
<td>75.0</td>
</tr>
<tr>
<td>Turkey</td>
<td>—</td>
<td>36.7</td>
<td>26.9</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>58.3</td>
<td>66.5</td>
<td>67.8</td>
</tr>
<tr>
<td>United States</td>
<td>59.7</td>
<td>68.5</td>
<td>71.7</td>
</tr>
</tbody>
</table>
Labor Supply Model
Individual Labor Supply

• A trade-off between Consumption and Leisure. （不仅要赚钱，也要会花钱）

• An Individual’s preferences is determined by

\[ U = U(C, L) \]

• C denotes consumption and L denotes leisure.

FIGURE 2.2 Indifference Curves
Points X and Y lie on the same indifference curve and yield the same level of utility (25,000 utils); point Z lies on a higher indifference curve and yields more utility.

Consumption ($)
Budget Constraint

\[ C \leq wh + V \]

- Where \( C \) is still consumption
- \( h \) denotes working hours
- \( w \) is the wage rate
- \( V \) denotes non-labor income such as investment income, transfer income etc.

Budget Constraint

- We denote \( T \) is the total time of an individual in a week (thus \( 16 \times 7 = 110 \) hours) or a day (24 or 16 hours)
- So \( T = h + L \), thus working hours plus leisure equal to total time.
- Then we can obtain
  \[ C + wL \leq wT + V \equiv M \]
- Where \( M \) is the potential Income, thus maximum income we can earn
Optimization Problem

\[ \text{Max } U(C, L) \]
\[ \{C, L\} \]
\[ s.t. \quad C + wL \leq M \]

- The Lagrangian function

\[ \ell(C, L, \mu) = U(C, L) + \mu(M - C - wL) \]
Optimization Solution

• First Order Condition
\[ U_C(C, L) - \mu = 0 \]
\[ U_L(C, L) - \mu w = 0 \]

• So the solution
\[ w = \frac{U_L(C^*, L^*)}{U_C(C^*, L^*)} \]

• Here \( C^* + wL^* = M \)

• The optimal labor supply is
\[ T - L^* = h^* \]
The Corner Solution

• Not working is a corner solution.
• Reservation wage
  – The wage that makes one indifferent between working and not working
  – With no fixed cost of working, the wage is the slope of the budget line at the endowment point
  – The same utility working 0 or 1 hour.

FIGURE 2-10 The Reservation Wage
If the person chooses not to work, she can remain at the endowment point E and get $U_E$ units of utility. At a low wage ($w_{low}$), the person is better off not working. At a high wage ($w_{high}$), she is better off working. The reservation wage is given by the slope of the indifference curve at the endowment point.

Consumption ($)
Optimal Labor Supply Function

• Based on the solution, the demand function of leisure is

\[ L^* = L(w, M) \]

• And because

\[ h^* = T - L^* \\
M = wT + V \]

• So the optimal labor supply function is

\[ h^* = T - L^*(w, wT + V) = h(w, V) \]
Microeconomics Review:

• 在消费者行为决策时，收入以及某种商品价格的变动将对消费者产生两方面的影响。
• Income and Substitution effects（收入和替代效应）
• Which one dominates the net effect by whether the good is Normal and Inferior goods（正常品与劣等品）

What Happens to Working Hours

• Suppose nonwage income increase, then how does the budget constrain line change?
• And what happens to working hours?
What Happens to Working Hours: Nonlabor income

- When non-labor income increase, then individual tends to spend more time on leisure, in turn, reduce their working hours if leisure is normal goods.
- If leisure is inferior goods, then non labor income increase will let individual spend more time on working.
What Happens to Working Hours

• Suppose wage increase, then how does the budget constrain line change?

• How about the wage decrease?

FIGURE 2.8 The Effect of a Change in the Wage Rate on Hours of Work
A change in the wage rate rotates the budget line around the endowment point $E$. A wage increase moves the worker from point $P$ to point $R$, and can either decrease or increase hours of work.

Consumption ($)  

Hours of Leisure

(a)  

(b)
What Happens to Working Hours

- Negative if substitution effect dominates
- Positive if income effect dominates
- Dominating income effect is more likely to occur when hours of work (T-L) is already at a high level.
- Thus, backward bending labor supply curve.
Market Labor Supply

FIGURE 2.11 Deriving a Labor Supply Curve for a Worker
The labor supply curve traces out the relationship between the wage rate and hours of work. At wages below the reservation wage ($10), the person does not work. At wages higher than $10, the person enters the labor market. The upward-sloping segment of the labor supply curve implies that substitution effects are stronger initially; the backward-bending segment implies that income effects may dominate eventually.

FIGURE 2.12 Derivation of the Market Labor Supply Curve from the Supply Curves of Individual Workers
The market labor supply curve "adds up" the supply curves of individual workers. When the wage is below $w_a$, no one works. As the wage rises, Alice enters the labor market. If the wage rises above $w_b$, Brenda enters the market.
Labor Supply Elasticity

\[ \sigma = \frac{\text{Percent change in hours of work}}{\text{Percent change in wage rate}} = \frac{\Delta h / h}{\Delta w / w} = \frac{\Delta h}{\Delta w} \cdot \frac{w}{h} \quad (2-11) \]

- The labor supply elasticity gives the percentage change in hours of work associated with a 1 percent change in the wage rate.
- Hours of work are more responsive to changes in the wage the greater the absolute value of the labor supply elasticity.

Empirical Estimates

- Labor supply function: if we can observe data on labor supply \( h_i \), wages \( w_i \) and non-labor income \( V_i \), we may estimate the following equation

\[ h_i = \beta_0 + \beta_1 w_i + \beta_2 V_i + \varepsilon_i \]

- So \( \beta_1 \) is the most important parameter, which describes the how labor supply changes when wage changes, generally via taxing by government.
Empirical Estimates

- But there are two major complications which make the work are not easy...
  1. wages are likely to be endogenous...
  2. there are individuals who don’t work and for those individuals hourly wages remain unobserved.
- So using simple OLS may yield an inconsistent or biased estimate.

Summary

- In theory, we can not predict a positive labor supply responses to a higher wage because income and substitution effects co-exist.
- In reality, there are also some unobserved variables and sample selection which may affect labor supply and other important factors simultaneously.
- We can’t run simple OLS to estimate labor supply equation across people.
Policy Application: Welfare Programs and Work Incentives in USA

- A “War on Poverty” in the mid-1960s.
- A lot of welfare programs were implemented in 1970s.
  1. Aid to Families with Dependent Children (AFDC)
  2. Disability Insurance (DI)
  3. Supplemental Security Income (SSI)
  4. Food and Nutrition (FN)
  5. Housing
  6. Medicaid
  7. Earned Income Taxed Credit (EITC)

Problems with the Welfare System

- The “War on Poverty” has been lost.
- Hypotheses:
  - Encourage recipients to “live off the dole”
  - Foster dependency on public assistance
- Reform has wide support from all major political parties.
- “End welfare as we know it.” – Bill Clinton, 1992.
Welfare Reform in 1996

- Personal Responsibility and Work Opportunity Reconstruction Act
- Imposes lifetime limits on the receipt of various types of welfare programs
- Tightens eligibility requirements for many families.
  - AFDC was replaced with the Temporary Assistance for Needy Families (TANF) program.
- Incentive built in for labor supply (EITC)

Classical Types of Welfare

- Cash grants (现金补贴)
- AFTC (现金补贴+工资控制)
- EITC (工资所得税减免)
Cash grants and labor supply

• Each eligible persons are given cash grants, say $500 per month as long as they remain outside the labor force.

• If the person enter the labor market, the government officials immediately assume that the he or she no longer need public assistance.

FIGURE 2-14  Effect of a Cash Grant on Work Incentives
A take-it-or-leave-it cash grant of $500 per month moves the worker from point $P$ to point $G$, and encourages the worker to leave the labor force.
AFTC and Labor Supply

• If a women does not work at all, her monthly income is $500.
• If she enter the labor market, government will take away 50 cents from the cash grant for every dollar earned in the labor market.
• Assume wage is $10/hour, then
  ① 1 hour work, total income=500+5=505
  ② 2 hour work, total income=500+10=510

So the real wage is $5 per hour.

Then AFTC change the budget line in two ways

① The endowment point

② The slope of the budget line
AFTC and Labor Supply

- A welfare program that includes a cash grant and a tax on labor earnings must reduce hours of work.

- Move from P to Q is an income effect and represent the impact of the cash grant on hours of work.

- Move from Q to R represents the substitute effect induced by tax on labor earnings.
EITC and Labor Supply

• By 2007, it was the largest cash benefit entitlement program in U.S., nearly $40 billion to low-income households.

• A tax credit is first determined based on needs but only workers qualify.

• A working mom with two qualifying children in 2005.

Earned Income Tax Credit

• Friedman(1962) negative income tax

• Positive Income tax: 收入超过一定水平缴税，累进税率。

• negative income tax: 收入低于一定水平，补助。随着收入水平的提高，补助越老越少。直到超过某一水平，政府又开始课税。

• 结论：社会福利跟税其实是一体两面。
EITC and Labor Supply

- The credit is paid in the form of reduced income tax.
- If earning<= $11000, credit is phased in at 40% rate. Up to maximum credit of $4400.
- If $11000 <= earning < $14370 credit remains at $4400.
- If earning > $14370, the credit will be phased out in a way that each additional dollar earned reduced credit by 21.06 cents.
- When the credit completely disappears once the woman earns $35263. (Question: how to get the number)

**FIGURE 2-16** The EITC and the Budget Line (not drawn to scale)

In the absence of the tax credit, the budget line is given by $FE$. The EITC grants the labor earnings as long she earns less than $11,000. The credit is capped at $4,400. The tax credit is then phased out in a way that each additional dollar earning reduces the credit by 21.06 cents. Net wage is 21.06 cents below her actual wage whenever she earns between $11,000 and $14,370. The tax credit is then phased out in a way that each additional dollar earned reduces the credit by 21.06 cents. Net wage is 21.06% below her actual wage.
EITC and Labor Supply

- So the budget line
- No EITC, FE is the line
- Annual Income<$11100, 40% credit, JE part.
  - Net wage is 40% above the actual wage.
- Annual Income<$14370, $4400 credit, HJ part.
  - Net wage equals the actual wage.
- Annual Income>=$14370, 21.06% tax, HG part.
  - Net wage is 21.06% below the actual wage.
- Annual Income>=$35263, no credit, GF part.

FIGURE 2.17 The Impact of the EITC on Labor Supply
The EITC shifts the budget line, and will draw new workers into the labor market. In (a), the person enters the labor market by moving from point P to point R. The impact of the EITC on the labor supply of persons already in the labor market is less clear. In the shifts illustrated in (b) and (c), the worker reduced hours of work.
EITC and Labor Supply

(b) EITC Reduces Hours of Work

(c) EITC Reduces Hours of Work
EITC and Labor Supply

- In the theory, EITC has two distinct effects on labor supply.
  ① Increases the number of labor force participations.
  ② Change the working hours for persons who would have been in the labor force without the program. The net effect will depend on the relative importance of the income and substitution effect.

Eissa and Liebman (1996) study the effect of EITC on labor supply.

- Background: In 1987, EITC experienced a large expansion, which increased the maximum credit from $550 to $851.
- Goal: compare labor supply of eligible family before and after reform.
- Problem: other things may have changed over time as well, affecting labor supply (e.g., economic climate)
EITC and Labor Supply

- Solution: single women with kids in order to avoid complications joint labor supply decisions of the whole family.
- Empirical Strategy: Difference-in-differences
- Control group: Single women without kids
- Treatment group: Single women with kids


- the control group allows to account for trends: Difference-in-differences strategy
- Conclusion: The EITC significantly increased labor supply.
The Impact of the EITC on Working Hours

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Annual hours</th>
<th>Annual hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All single women with hours &gt; 0</td>
<td>Less than high school with hours &gt; 0</td>
</tr>
<tr>
<td>Variables</td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Coefficient estimates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other income (1000s)</td>
<td>$-21.83 (.61)$</td>
<td>$-26.81 (2.93)$</td>
</tr>
<tr>
<td>Number of preschool children</td>
<td>$-66.28 (10.42)$</td>
<td>$-72.21 (25.57)$</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>$-140.94 (11.77)$</td>
<td>$-142.84 (41.29)$</td>
</tr>
<tr>
<td>Age</td>
<td>786.82 (22.58)</td>
<td>475.01 (64.29)</td>
</tr>
<tr>
<td>Age squared</td>
<td>$-21.45 (.75)$</td>
<td>$-12.62 (2.21)$</td>
</tr>
<tr>
<td>Education</td>
<td>56.69 (6.41)</td>
<td>14.22 (17.07)</td>
</tr>
<tr>
<td>Education squared</td>
<td>$-1.58 (.25)$</td>
<td>$-0.21 (1.22)$</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>$-9.98 (3.85)$</td>
<td>$-31.37 (14.58)$</td>
</tr>
<tr>
<td>Unemployment rate × kids</td>
<td>5.27 (4.17)</td>
<td>33.60 (13.44)</td>
</tr>
<tr>
<td>Maximum monthly AFDC benefit</td>
<td>$-0.22 (.06)$</td>
<td>$-0.10 (.18)$</td>
</tr>
<tr>
<td>Kids ($γ_1$)</td>
<td>$-83.03 (47.82)$</td>
<td>$-249.44 (132.61)$</td>
</tr>
<tr>
<td>Post86 ($γ_2$)</td>
<td>$-20.05 (23.63)$</td>
<td>$-23.97 (29.03)$</td>
</tr>
<tr>
<td>Kids × Post86 ($γ_{12}$)</td>
<td><strong>25.22 (15.18)</strong></td>
<td><strong>2.98 (46.04)</strong></td>
</tr>
<tr>
<td>Observations</td>
<td>53,474</td>
<td>5106</td>
</tr>
</tbody>
</table>

What about China: Welfare Programs

- 《最低生活保障制度》
  - 城市居民：1999年建立
  - 农村居民：2007年建立
- 现在补助标准
  - 城市：575元/月/人（2018年）
  - 农村：4754元/年/人（2018年）
  - 覆盖了全国4620万人。
- 性质上，属于现金补贴制度。
What about China?

- Labor supply had been not a important issue for China during a long time.
- In a planning economy, there is no a formal labor market.
- Even after reform, we would rather worry about labor demand than labor supply, because we had an “unlimited labor supply” for a long time.
- Until recently, economists have a hot debate about whether China has reached the “Lewisian turning point” (刘易斯转折点)

“Lewisian turning point”

- A term to describe a phase in economic development for a dual economy by an Noble Prize winner
- Sir Arthur Lewis (1915-1991)
“Lewisian turning point”

• Developing countries have a virtually unlimited supply of labor for the industrial sector because of the massive labor surplus in rural areas.

• Before achieving the point, along with the productivity improvement in the industrial sector, the economy expands employment (in the industrial sector as well as in the whole economy) by absorbing surplus labor in the agricultural workforce and without causing any wage increase.

• After achieving the point, the industrial sector needs to raise wages in order to secure workers by reducing those in the agricultural sector.

Has China Reached the Lewis Turning Point?

• A hot debate topic among economists and policy makers focusing on Chinese economy.
• Pros:
  – rural to urban migrant wages rose significantly since 2003
• Con
  – there is still large-scale surplus labor in the rural area.
• My view: both correct but uncomplete answers.
Has China Reached the Lewis Turning Point?

• My view: both correct and uncomplete answers.
• There are still some institutional constraints impeding rural to urban migrants’ access to the urban welfare which create difficulties for them settle down in urban areas.

Summary

• There is a huge difference in labor supply between the perspective of China and those of most developed countries.
  – In most developed countries, people tends to concern “too much welfare, less labor supply”.
  – In China, we had been worrying “too much labor supply, less welfare” until recently.
• Now, I think the situation can be described as
  – “still relative less welfare, but less labor supply in future”.