

Lec2: Labor Supply(I)

Labor Economics, Fall 2024

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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)

- 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?

Labor Force Participation Rates 2007, USA

TABLE 2-3 Labor Supply in the United States, 2007 (persons aged 25–64)

Source: U.S. Bureau of Labor Statistics, *Current Population Survey*, March 2007. The average number of hours worked is calculated in the subsample of workers. The percent of workers in part-time jobs refers to the proportion working fewer than 30 hours per week.

	Labor Force Participation Rate		Annual Hours of Work		Percent of Workers in Part-Time Jobs	
	Men	Women	Men	Women	Men	Women
All persons	87.1	72.7	2,153	1,810	3.6	14.8
Educational attainment:						
Less than 12 years	75.3	49.3	1,966	1,655	5.0	16.4
12 years	85.1	70.1	2,111	1,778	3.2	14.7
13–15 years	88.9	76.4	2,146	1,804	4.1	15.1
16 years or more	92.4	81.0	2,261	1,884	3.2	14.2
Age:						
25–34	92.2	75.6	2,090	1,768	3.9	13.6
35–44	91.9	77.5	2,203	1,814	2.4	15.6
45–54	88.3	76.6	2,209	1,879	2.6	12.5
55–64	68.9	55.0	2,058	1,747	7.8	19.7
Race:						
White	88.0	74.0	2,194	1,804	3.5	16.2
Black	79.6	74.3	2,015	1,864	4.7	8.6
Hispanic	88.1	65.3	2,040	1,766	3.2	12.6

International Female LFPR 1980-2003

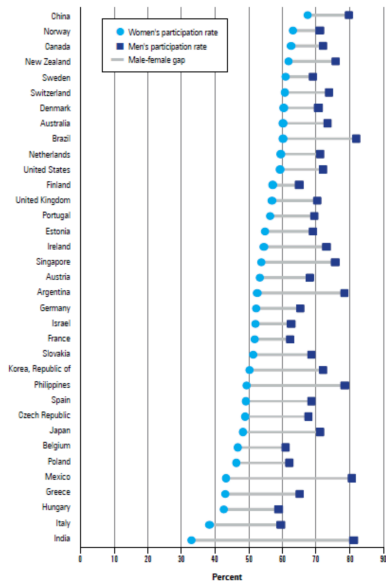
TABLE 2-4
International
Differences
in Female
Labor Force
Participation
Rate (women
aged 15–64)

Source: U.S. Bureau of the Census, *Statistical Abstract of the United States, 2006*, Washington, DC: Government Printing Office, Table 1343.

Country	1980	1990	2003
Australia	52.7	62.1	66.4
Canada	57.8	67.6	70.4
France	54.4	57.8	62.0
Germany	52.8	56.7	64.0
Greece	33.0	43.6	50.2
Ireland	36.3	43.8	56.2
Italy	39.6	45.9	46.8
Japan	54.8	60.3	64.2
Korea, South	—	51.2	54.3
Mexico	33.7	—	42.4
New Zealand	44.6	63.0	67.6
Portugal	54.3	62.9	67.2
Spain	32.2	41.2	50.7
Sweden	74.1	80.4	75.0
Turkey	—	36.7	26.9
United Kingdom	58.3	66.5	67.8
United States	59.7	68.5	71.7

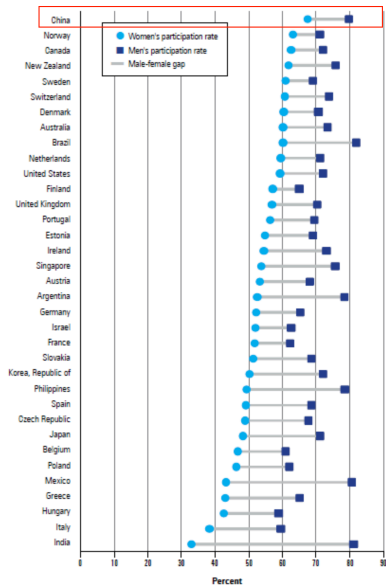
The gap of LFPR between men and women(ILO,2009)

Labor force participation rates by sex, selected countries, 2009



The gap of LFPR between men and women(ILO,2009)

Labor force participation rates by sex, selected countries, 2009



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

$$U = U(C, L)$$

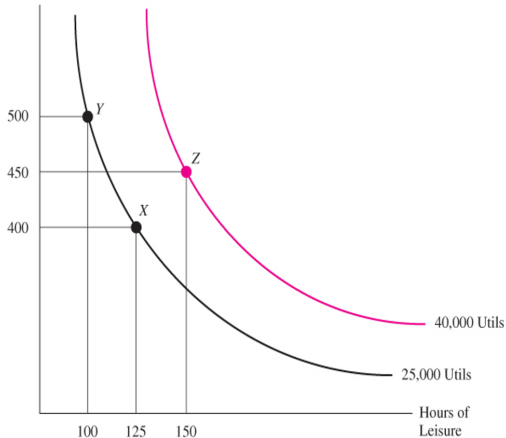
- C denotes *consumption* and L denotes *leisure*.

Indifference Curves in Labor Supply Model

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

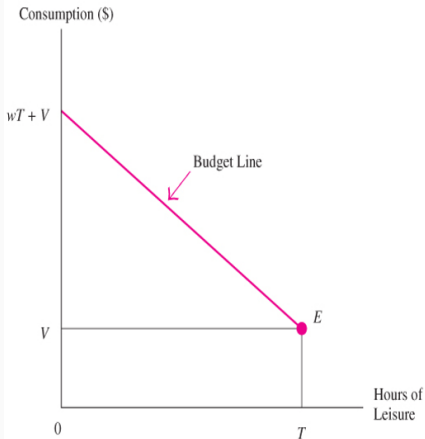
$$C + wL \leq wT + V \equiv M$$

- Where M is the **potential Income**, thus maximum income we can earn

The Budget Line

FIGURE 2-5 The Budget Line Is the Boundary of the Worker's Opportunity Set

Point E is the endowment point, telling the person how much she can consume if she does not enter the labor market. The worker moves up the budget line as she trades off an hour of leisure for additional consumption. The absolute value of the slope of the budget line is the wage rate.



Optimization Problem

$$\text{Max}_{\{C,L\}} U(C, L)$$

$$s.t. \quad C + wL \leq M$$

- 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 $C^* + wL^* = M$

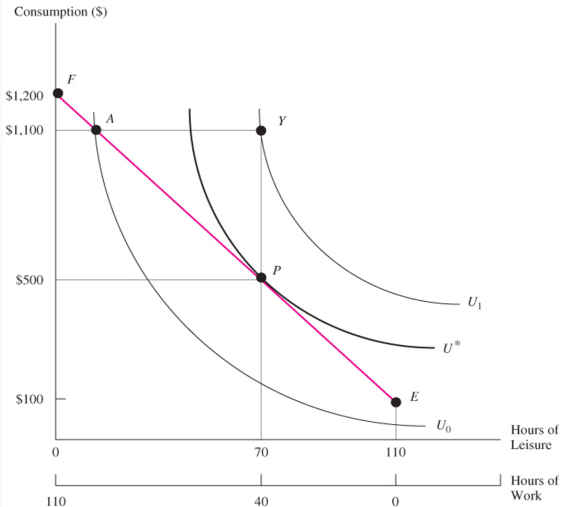
- The optimal labor supply is

$$T - L^* \equiv h^*$$

The Optimal Solution

FIGURE 2-6 An Interior Solution to the Labor-Leisure Decision

A utility-maximizing worker chooses the consumption-leisure bundle given by point P , where the indifference curve is tangent to the budget line.



The Corner Solution

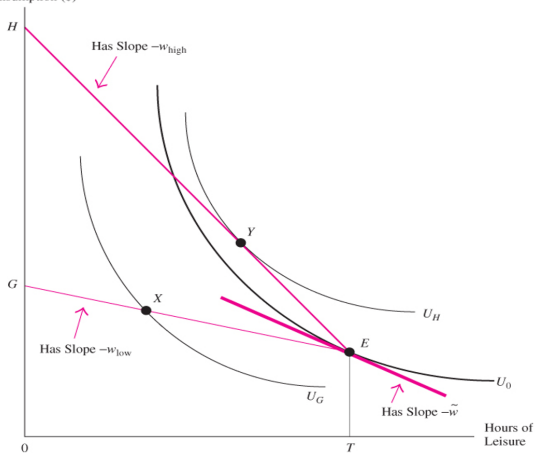
- Not working is a corner solution.
- Reservation wage
 - The wage that makes one indifferent between working and not working.
 - With no fixed cost of working, the wage is the slope of the budget line at the endowment point.
 - The same utility working 0 or 1 hour.

To work or not to work

FIGURE 2-10 The Reservation Wage

If the person chooses not to work, she can remain at the endowment point E and get U_0 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

$$h^* = T - L^*(w, wT + V) = h(w, V)$$

Optimal Labor Supply Function

- Because

$$h^* = h(w, V)$$

- So **wage**(w) and **non-labor income**(V) will affect the labor supply decision for individuals.
- We have to make the comparative static (比较静态) analysis by changing V and w respectively.

Microeconomics Review:

- When consumers make decisions, changes in income and the price of a certain product will have two effects on them.
- **Income** and **Substitution** effects (收入和替代效应)
- Which one dominates the net effect depends on whether the good is **Normal** and **Inferior** goods (正常品与劣等品)

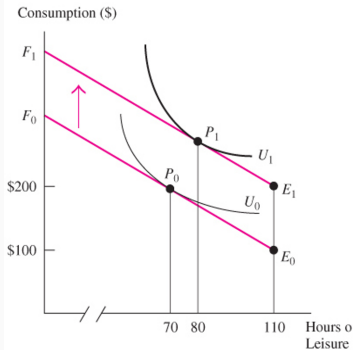
What Happens to Working Hours

- Suppose **nonwage income** increase, then how does the budget constrain line change?
- And what happens to working hours?

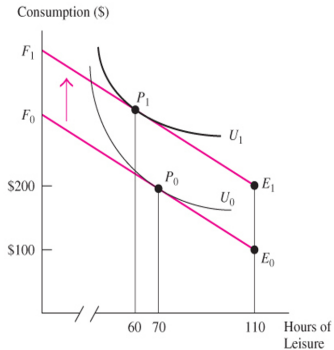
To work or not to work

FIGURE 2-7 The Effect of a Change in Nonlabor Income on Hours of Work

An increase in nonlabor income leads to a parallel, upward shift in the budget line, moving the worker from point P_0 to point P_1 . (a) If leisure is a normal good, hours of work fall. (b) If leisure is an inferior good, hours of work increase.



(a) Leisure Is a Normal Good



(b) Leisure Is an Inferior Good

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

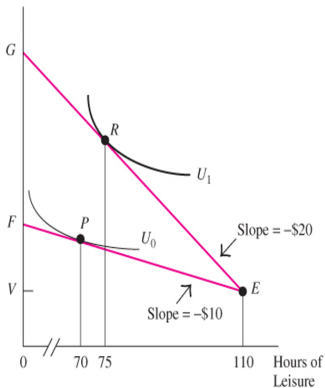
- Suppose wage increase, then how does the budget constrain line change?
- How about the wage decrease?

Wage Change on Working hours

FIGURE 2-8 The Effect of a Change in the Wage Rate on Hours of Work

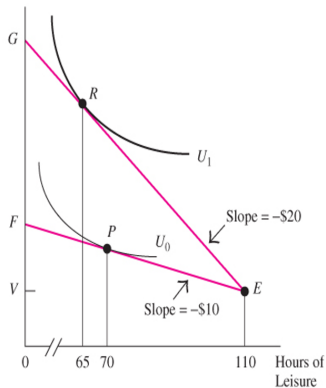
A change in the wage rate rotates the budget line around the endowment point E . A wage increase moves the worker from point P to point R , and can either decrease or increase hours of work.

Consumption (\$)



(a)

Consumption (\$)



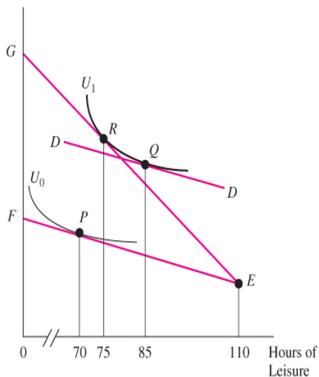
(b)

Wage Change on Working hours

FIGURE 2-9 Decomposing the Impact of a Wage Change into Income and Substitution Effects

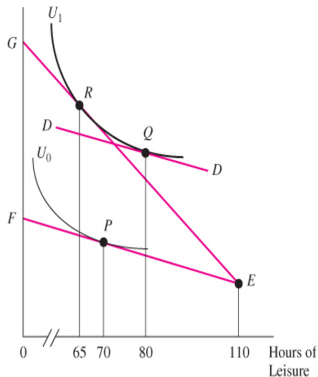
An increase in the wage rate generates both income and substitution effects. The income effect (the move from point P to point Q) reduces hours of work; the substitution effect (the move from Q to R) increases hours of work.

Consumption (\$)



(a) Income Effect Dominates

Consumption (\$)



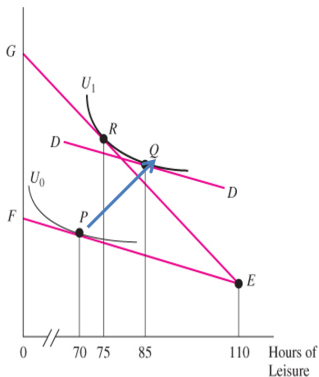
(b) Substitution Effect Dominates

Wage Change on Working hours

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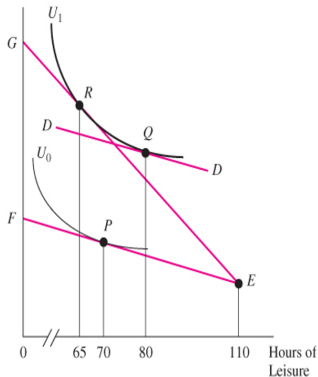
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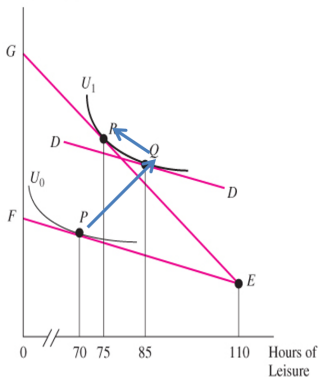
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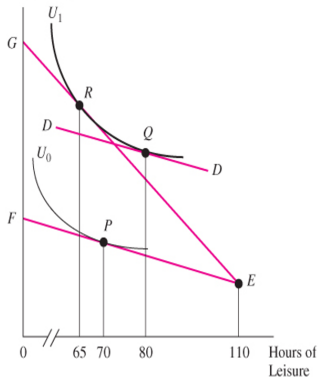
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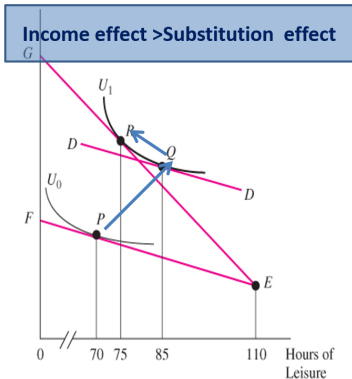
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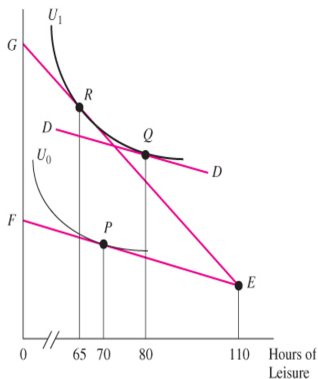
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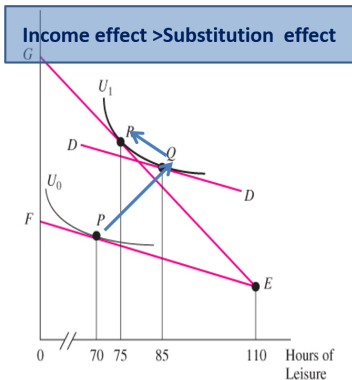
(b) Substitution Effect Dominates

Wage Change on Working hours

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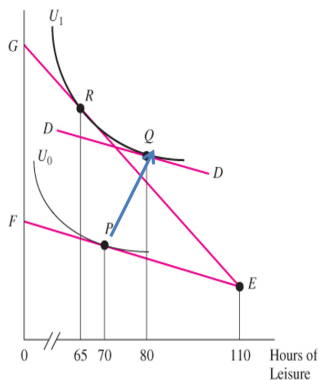
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Consumption (\$)



(a) Income Effect Dominates

Consumption (\$)



(b) Substitution Effect Dominates

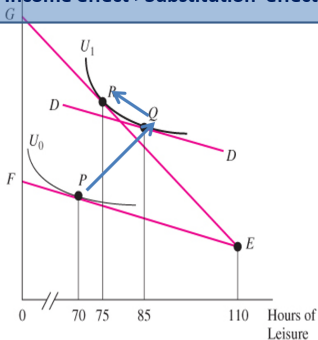
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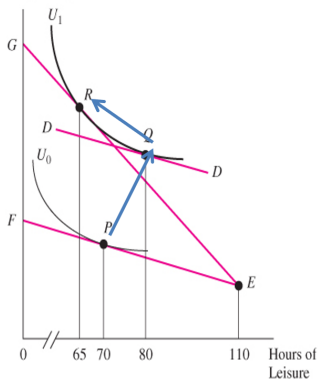
Consumption (\$)

Income effect > Substitution effect



(a) Income Effect Dominates

Consumption (\$)



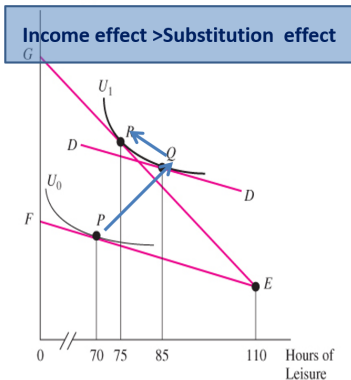
(b) Substitution Effect Dominates

Wage Change on Working hours

FIGURE 2-9 Decomposing the Impact of a Wage Change into Income and Substitution Effects

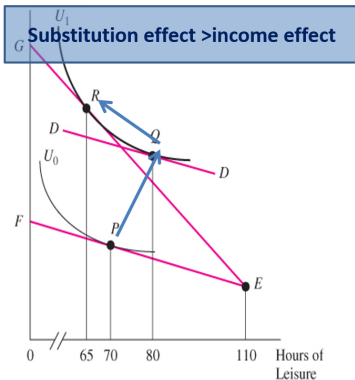
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Consumption (\$)



(a) Income Effect Dominates

Consumption (\$)



(b) Substitution Effect Dominates

What Happens to Working Hours

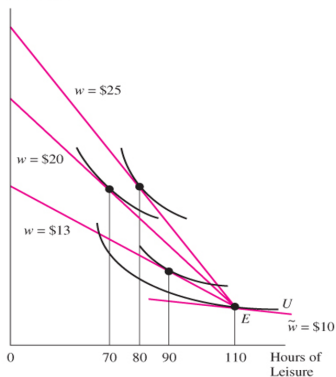
- Negative if substitution effect dominates
- Positive if income effect dominates
- Dominating income effect is more likely to occur when hours of work (T-L) is already at a high level.
- Thus, backward bending labor supply curve.

Backward Bending Labor Supply Curve

FIGURE 2-11 Deriving a Labor Supply Curve for a Worker

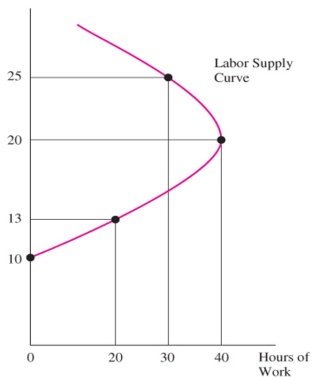
The labor supply curve traces out the relationship between the wage rate and hours of work. At wages below the reservation wage (\$10), the person does not work. At wages higher than \$10, the person enters the labor market. The upward-sloping segment of the labor supply curve implies that substitution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

Consumption (\$)



(a) Optimal Consumption Bundles

Wage Rate (\$)



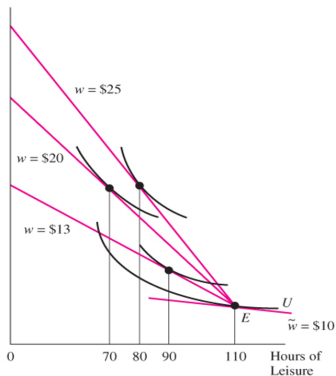
(b) Relation between Optimal Hours of Work and the Wage Rate

Backward Bending Labor Supply Curve

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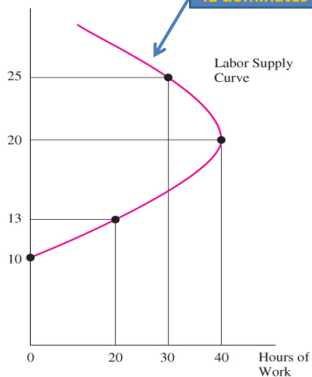
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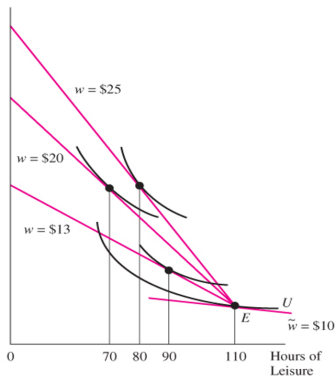
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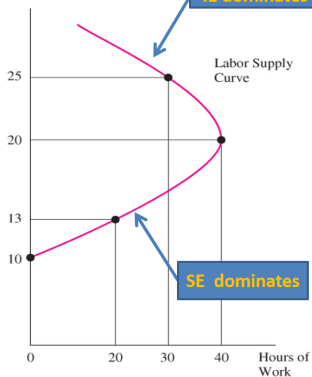
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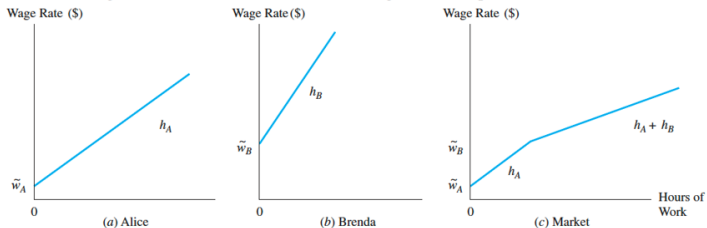


(b) Relation between Optimal Hours of Work and the Wage Rate

Market Labor Supply

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 \tilde{w}_A , no one works. As the wage rises, Alice enters the labor market. If the wage rises above \tilde{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 β_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.
- Therefore, the OLS regression estimate may suffer from **inconsistent** or **biased** estimates.
- Using RCTs or natural experiments to solve the endogenous problem.
 1. taxi drivers in NYC(New York City)
 2. messengers by bikes in Zurich

Empirical Estimates

- 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 by Lyndon Johnson.
- A lot of welfare programs were implemented in 1970s.
 - a) Aid to Families with Dependent Children (AFDC)
 - b) Disability Insurance(DI)
 - c) Supplemental Security Income(SSC)
 - d) Food and Nutrition (FN)
 - e) Housing
 - f) Medicaid
 - g) 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."** by Bill Clinton, 1992.

Welfare Reform in 1996

- Personal Responsibility and Work Opportunity Reconstruction Act (PRWORA)
- Objectives:
 - "Provide assistance to needy families...
 - "End the dependence of needy parents on government benefits by promoting job preparation, work, and marriage.
- Carrying on:
 - Imposes lifetime limits on the receipt of various types of welfare programs
 - Tightens eligibility requirements for many families.

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

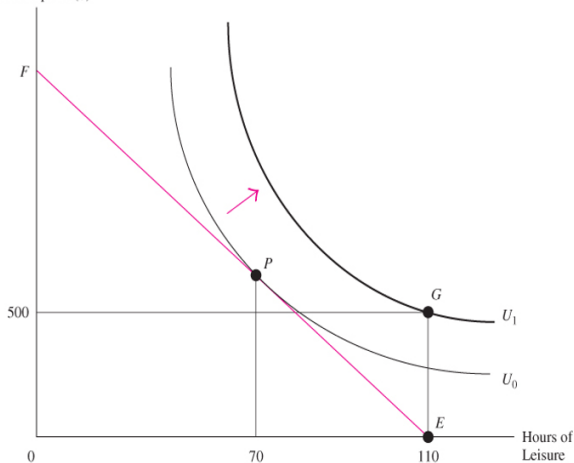
- Each eligible persons are given cash grants, say \$500 per month as long as they remain outside the labor force.
- If the person enter the labor market, the government officials immediately assume that the he or she no longer need public assistance.

Cash grants and labor supply

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.

Consumption (\$)



AFTC and Labor Supply

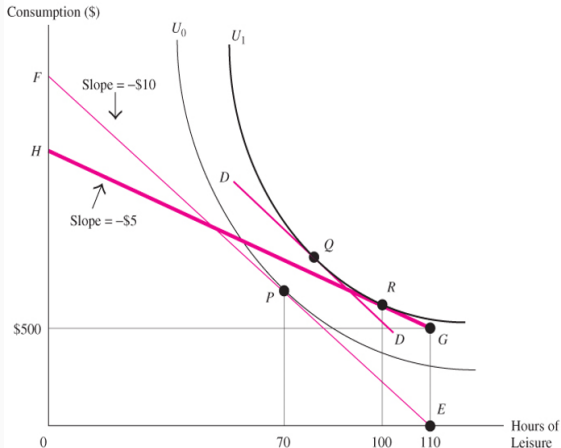
- If a woman does not work at all, her monthly income is \$500.
- If she enters the labor market, government will take away 50 cents from the cash grant for every dollar earned in the labor market.
- Assume wage is \$10/hour, then
 - a) 1 hour work, total income = $500 + 5 = 505$
 - b) 2 hour work, total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

- So the real wage is \$5 per hour.
- Then AFTC change the budget line in two ways
 - a) The endowment point
 - b) The slope of the budget line

AFTC and Labor Supply

FIGURE 2-15 Effect of a Welfare Program on Hours of Work

A welfare program that gives the worker a cash grant of \$500 and imposes a 50 percent tax on labor earnings reduces work incentives. In the absence of welfare, the worker is at point *P*. The income effect resulting from the program moves the worker to point *Q*; the substitution effect moves the worker to point *R*. Both income and substitution effects reduce hours of work.

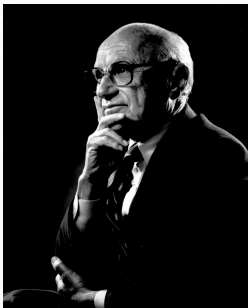


- A welfare program that includes a cash grant a tax on labor earnings **must reduce** hours of work.
- Move from P to Q is an *income effect* and represent the impact of the cash grant on hours of work.
- Move from Q to R represents the *substitute effect* induced by tax on labor earnings.

EITC and Labor Supply

- It is a refundable tax credit for low- to moderate-income working individuals and couples, particularly those with children.
- By 2007, it was the largest cash benefit entitlement program in U.S., nearly \$40 billion to low-income households.
- The amount of EITC benefit depends on a recipient's income and number of children. Low-income adults with no children are eligible.
- A tax credit is first determined based on needs but then on workers qualify.

Negative Income Tax



Milton
Friedman(1912-
2006)

- Income above a certain level is subject to taxation at *progressive tax rate*.
- If the income is below a certain level, subsidies are provided.
- As the income level increases, the subsidies decrease gradually. Until it reaches a certain level, the government starts imposing taxes again.
- Conclusion: From a societal standpoint, social welfare and taxation are inherently connected.
- However, the impact of welfare programs differs significantly depending on income distribution.

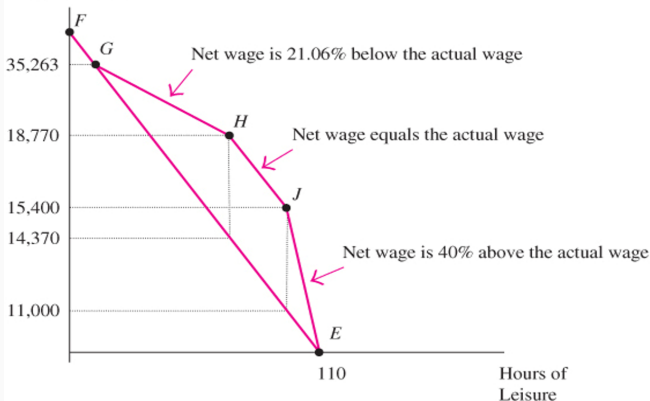
EITC and Labor Supply:

- The credit is paid in the form of reduced income tax. For a working mom with 2 children in 2005.
- If $\text{earning} \leq \$11000$, credit is phased in at 40% rate. Up to maximum credit of \$4400.
- If $\$11000 < \text{earning} < \14370 credit remains at \$4400.
- If $\text{earning} > \$14370$, 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)

EITC and Labor Supply

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 amount as long as she earns between \$11,000 and \$14,370. The tax credit is then phased out as her earnings rise above \$14,370. Her net wage is 21.06 cents below her actual wage whenever she earns between \$14,370 and \$15,400.

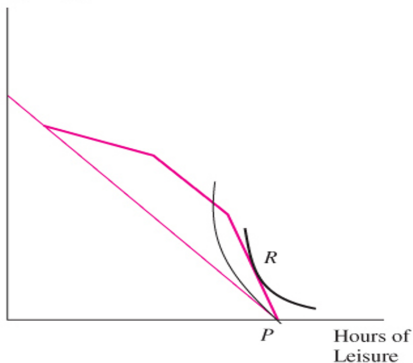


EITC and Labor Supply

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.

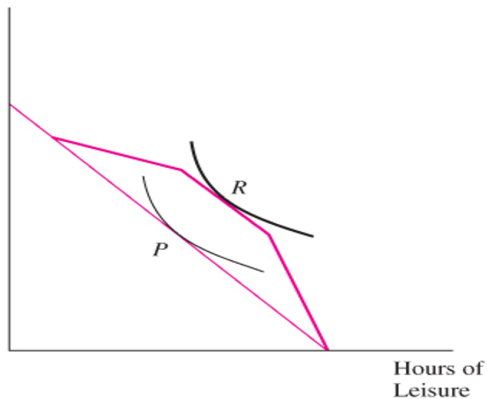
Consumption (\$)



(a) EITC Draws Worker into Labor Market

EITC and Labor Supply

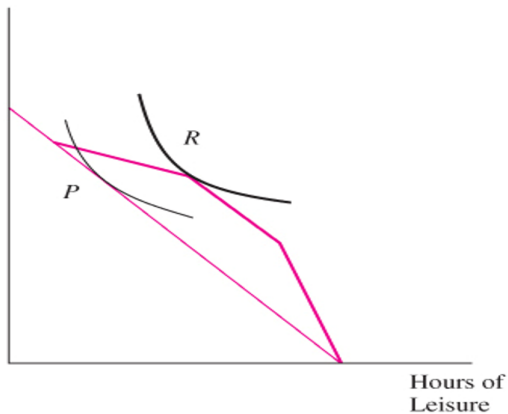
Consumption (\$)



(b) EITC Reduces Hours of Work

EITC and Labor Supply

Consumption (\$)



(c) EITC Reduces Hours of Work

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.

EITC and Labor Supply

	<i>Before</i>	<i>After</i>	<i>Difference</i>	Difference-in-differences
<i>Treatment</i> Group (unmarried women with children - <i>eligible</i> for EITC)	0.729 [0.004]	0.753 [0.004]	0.024 [0.006]**	0.024 [0.006]**
<i>Control</i> Group (unmarried women <i>without</i> children - ineligible for EITC)	0.952 [0.001]	0.952 [0.001]	0.000 [0.002]	

(Eissa & Liebman (1996, p. 617). Standard errors in brackets.)

- ▶ 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

Variables	Dependent variable: Annual hours	Annual hours
	All single women with hours > 0 (1)	Less than high school with hours > 0 (2)
Coefficient estimates		
Other income (1000s)	-21.83 (.61)	-26.81 (2.93)
Number of preschool children	-66.28 (10.42)	-72.21 (25.57)
Nonwhite	-140.94 (11.77)	-142.84 (41.29)
Age	786.82 (22.38)	475.01 (64.29)
Age squared	-21.45 (.75)	-12.62 (2.21)
Education	56.69 (6.41)	14.22 (17.07)
Education squared	-1.58 (.25)	-0.21 (1.22)
Unemployment rate	-9.98 (3.85)	-31.37 (14.58)
Unemployment rate × kids	5.27 (4.17)	33.60 (13.44)
Maximum monthly AFDC benefit	-0.22 (.06)	-0.10 (.18)
Kids (γ_0)	-83.03 (47.82)	-249.44 (132.61)
Post86 (γ_1)	-29.95 (23.61)	63.27 (78.03)
<i>Kids</i> × <i>Post86</i> (γ_2)	25.22 (15.18)	2.98 (46.04)
Observations	55,474	5700

What about China

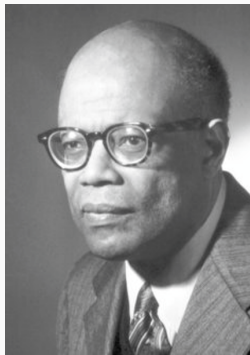
What about China: Welfare Programs

- 《最低生活保障制度》
 - 城市居民：1999 年全国建立
 - 农村居民：2007 年全国逐渐建立
- 补助标准：各省市制定，差异较大。
 - 2018 年，城市平均 575 元/月/人；2022 年北京市 (1245 元/月/人)，海南 (576.8 元/月/人)，平均 722 元/月/人。
 - 2018 年，农村平均 4754 元/年/人；2022 年北京市 (14940 元/年/人)，贵州 (4824 元/年/人)，平均 6506.8 元/年/人。
 - 2018 年，覆盖了全国 4620 万人。2022 年救助：城市 716.8 万人 + 农村 3411.1 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.
- by 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 incomplete 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.
- *Qu and Zhao(2017)"Glass ceiling effect in urban China: Wage inequality of rural-urban migrants during 2002–2007" ,China Economic Review 42 118–144.*

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".