

Labor Supply

Objective of the following lectures on Labor Supply:

- a. Why is labor market attachment an important concern, and how do we measure it? How has it changed over the recent decades?
- b. General Theory of Labor supply that explains an individual's labor force participation decision.
- c. The factors that affect the labor force participation, and empirical evidence.

1. Measuring Labor Force

→ Does everyone who is eligible to be apart of the labor force in the labor force?

1. No! For what reasons do individuals choose not to participate in the labor force then;
 - a. Household activities
 - b. Education
 - c. Retirement

→ Why should we be concerned with labor force participation? Because changes affect;

1. Unemployment rates
2. Economic growth
3. Occupational and sex composition of labor force
4. Relative wages
5. Demand for unionization
6. Equal pay and equal employment legislation
7. Family Formation, such as types of marriage
8. Transmission of social mobility between parents and children
9. Pension programs

→ In Canada, the

1. **Potential Labor Force Participants (POP)** consists of individuals (noninstitutional population) 15 years or older, excluding Yukon, Northwest Territories, and those living on Indian reservations (In the U.S., only individuals 16 year or older are included). Of which
 - a. **Labor Force (LF)** are individuals working or actively seeking work, $LF=E+U$
 - i. **Employed (E)**
 - ii. **Unemployed (U)**
 - b. **Not in Labor Force (NLF)** are individuals such as
 - i. Students
 - ii. Retirees
 - iii. Household Workers
 - iv. Discouraged Workers and others not seeking work

→ So what is **Labor Force Participation Rate**: The Fraction of the Eligible Population that participates in the Labor Force= LF/POP (See how the **Canadian Labor Force Participation Rates has evolved over the last century on page 35 of your text, figure 2.2. What do you think caused this evolution?**

→ Other useful measures

1. **Employment Rate (Employment-Population Ratio), E/POP**

2. **Unemployment Rate, $UR=U/LF$**

*** Both of this statistic has individual flaws. One of the contentions is as follows: When do you classify an individual as really discouraged? If the individual has really been searching for a job and still is, but by some bureaucratic rule, he becomes classified under NLF, we would have understated LF, and U. What is the impact on UR?**

→ How has hours of work evolved? See page 37 of text, table 2.2

2. Neoclassical Model of Labor-Leisure Choice

- Let an individual obtain utility from consumption (C) and leisure (L)¹,
 - $U = f(C, L)$
- Her marginal utility of leisure is the change in utility resulting from an additional minute/hour devoted to leisure, and denote this as MU_L , and let her marginal utility of consumption be MU_C . Then the slope of his indifference curve by totally differentiating the utility function, and noting that along the indifference curve, she maintains the same level of utility is,

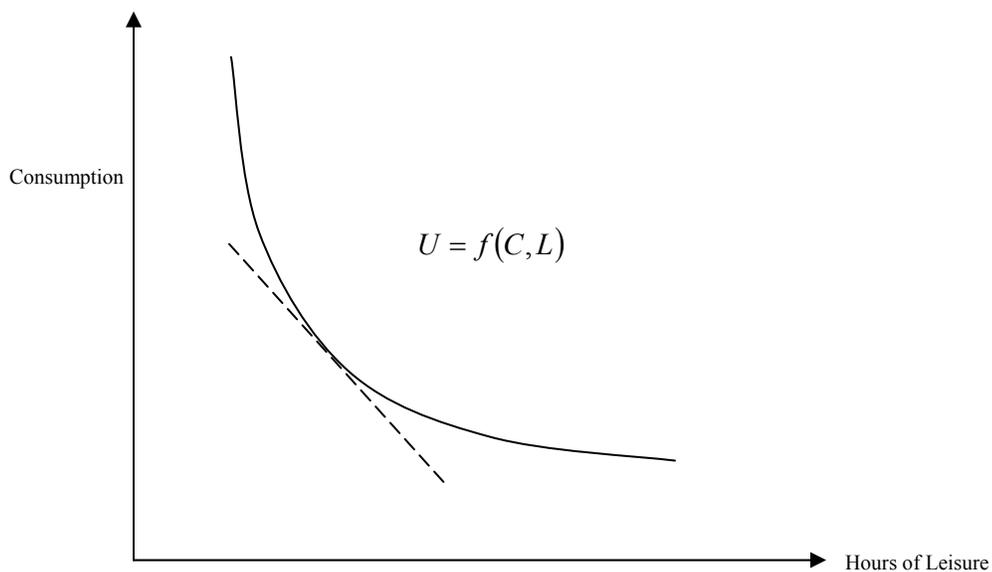


Figure 1: Indifference Curve

¹ Revision of what you learned in Microeconomics. What some characteristics of indifference curves:

1. Indifference curves are downward sloping.
2. Higher indifference curves indicate higher levels of utility.
3. Indifference curves do not intersect.
4. Indifference curves are convex to the origin.

$$\Delta U = \frac{\partial f(C,L)}{\partial C} \Delta C + \frac{\partial f(C,L)}{\partial L} \Delta L = 0$$

$$\Rightarrow \frac{\Delta C}{\Delta L} = - \frac{\frac{\partial f(C,L)}{\partial L}}{\frac{\partial f(C,L)}{\partial C}} = - \frac{MU_L}{MU_C}$$

- Recall that this equation is just your **marginal rate of substitution (MRS) in consumption**. Individuals differ in taste for work, and consequently leisure. This would generate different indifference curves. The larger the MRS, or the steeper the indifference curve, the lower the individual's preference for work. Conversely, the lower the MRS, the higher the individual's preference for work. These differences generate labor supply differences.
- But are these variations observable? Consequently, economics focus on the observable variables that may affect individual's choice of labor supply, such as wages, and incomes.
- Since all individuals have insatiable demand for goods, but have limited means, to understand their choice for work, we need to understand how she would vary her choice given those means, i.e. her **Budget Constraint**:

$$C = wh + V$$

- where w is the hourly wage, and h is the hours worked, and V is the nonlabor income she may get from investment, lottery winnings, and such.
- At the same time, he is constrained by the amount of time he can spent working, that is excluding the amount of time he has to rest. Let that total time be T , then we can express this constraint as

$$T = L + h$$

- Substituting this into the usual budget constraint we get

$$C = w(T - L) + V$$

$$\Rightarrow C + wL = (wT + V)$$

- The last equation just says that all expenditures (debits) must equate with earnings (credits). Just simple accounting. All points below the budget constraint describes what the individual can obtain, since they are all within her means. Note that since she has insatiable wants any equilibrium point must be on the budget line

itself.

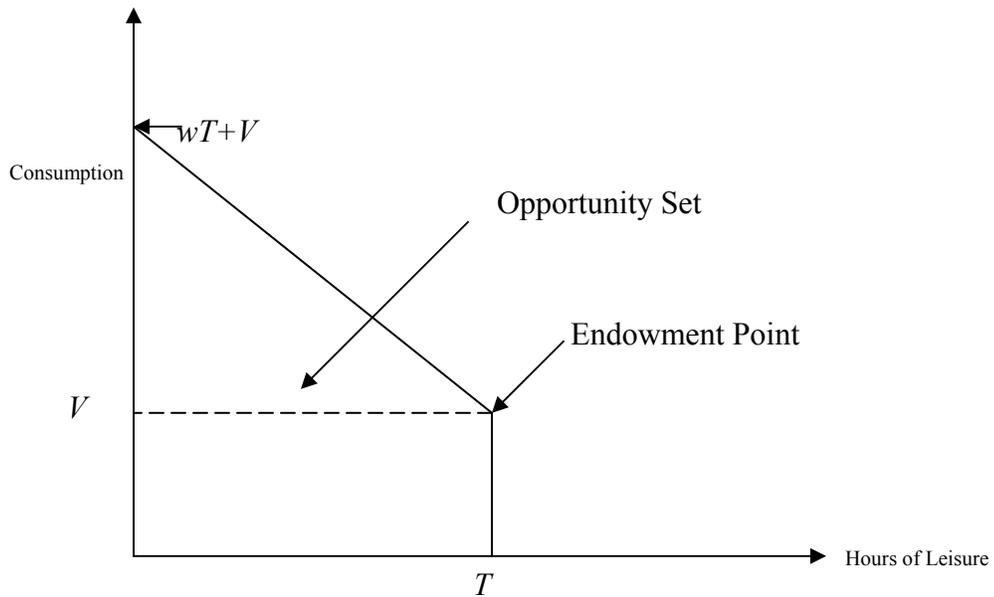


Figure 2: Budget Line

- Figure 3 describes how an individual attains equilibrium.

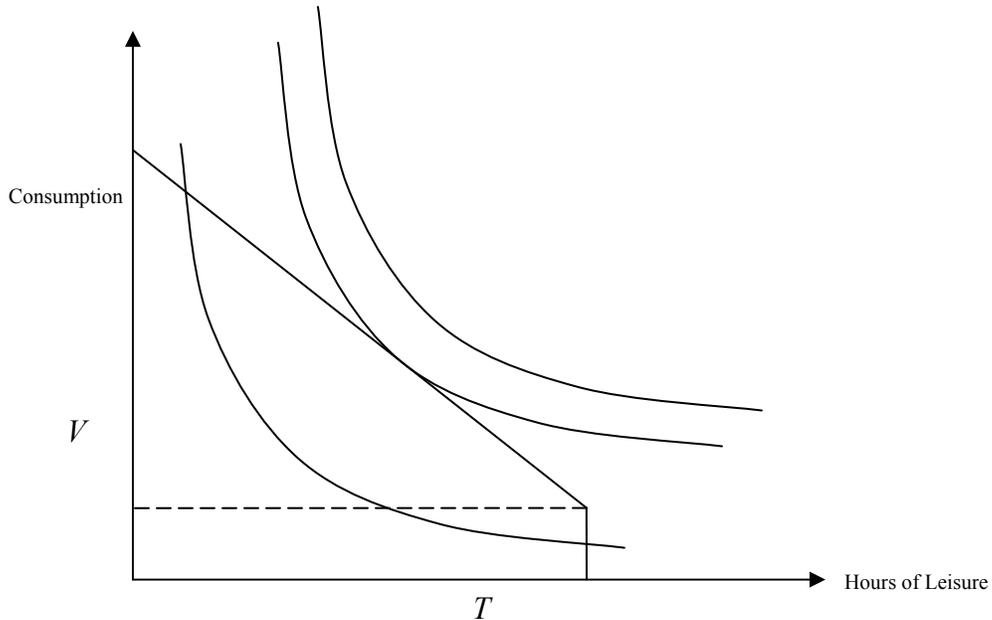


Figure 3: Attaining Equilibrium

- In terms of the equations we had before, we can find the equilibrium by solving the unconstrained problem

$$L = f(C, L) + \lambda(wT + V - C - wL)$$

the first order conditions are

$$\begin{aligned}
 f_c(C,L) &= \lambda \\
 f_L(C,L) &= \lambda w \\
 wT + V &= C + wL \\
 \Rightarrow \frac{f_L(C,L)}{f_c(C,L)} &= \frac{MU_L}{MU_C} = w
 \end{aligned}$$

- That is the marginal rate of substitution in leisure is equal to the wage rate, the point of tangency between the indifference curve and the budget constraint.
- What happens when nonlabor income increases?

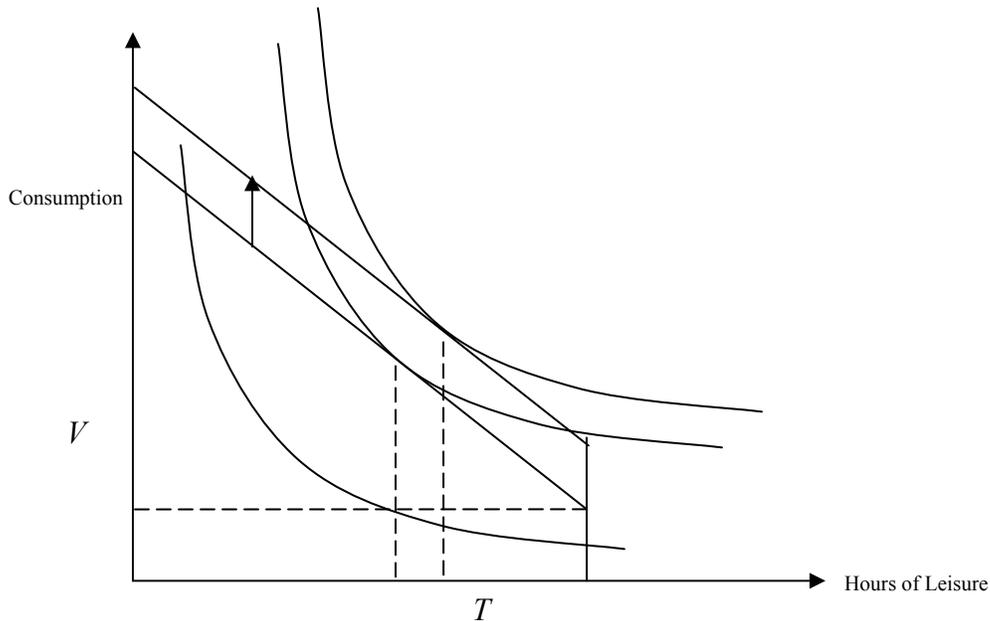


Figure 4: Change in Nonlabor Income

Figure 4 show a possible outcome when nonlabor income rises under the assumption that leisure is a normal good. Which means that given an increase in income, demand for a normal good, leisure here, must rise, and hours of work must fall. What is leisure is an inferior good? What if nonlabor income decreases?

- What if wage rate falls?

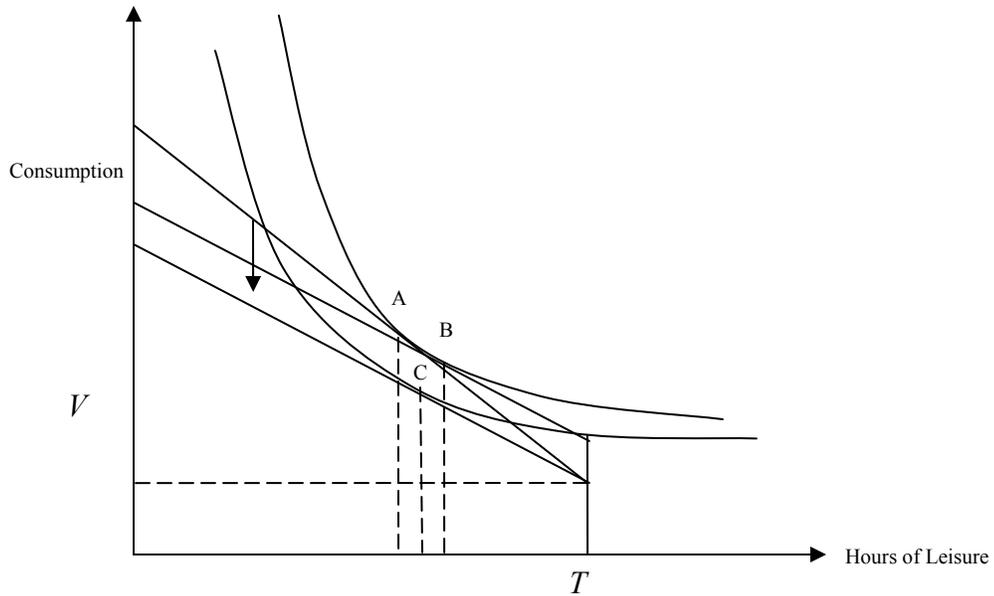


Figure 4: Change in Wage Rate, where the Substitution Effect (AB) dominates the Income (BC) Effect

- Additional questions:
 1. What is Income Effect Dominates Substitution Effect?
 2. What is wage rate rises?
 3. Show yourself what it means?
 4. How about in terms of the equation we have used thus far?

3. Reservation Wages

- How do we model labor participation, rather than labor supply?

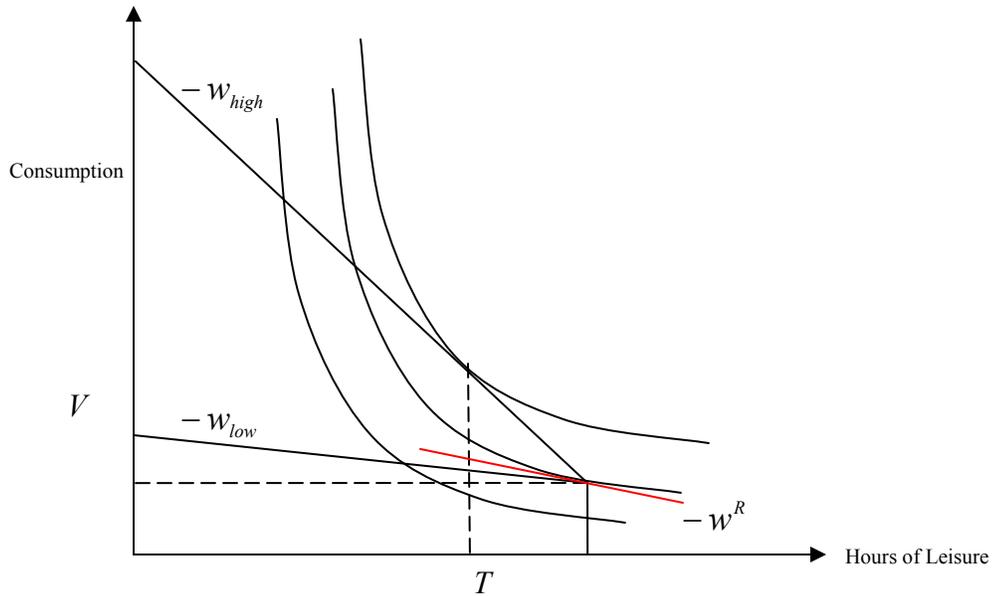


Figure 5: Change in Nonlabor Income

When the wage rate offered is too low, w_{low} , the individual would rather not work. In fact, for any wage rate below w^R , he would rather spend all his time at leisure. Only at wage rate at or above w^R would he choose a nonzero level of labor supply. This level of wage rate is known as the reservation wage level.

- How do we find this reservation wage?

$$\frac{f_L(V, L)}{f_C(V, L)} = \frac{MU_{L|L=T}}{MU_{C|L=T}} = w^R$$

Therefore the individual's decision to work is dependent on a comparison between the market wage rate, and the individual's reservation level. Therefore, someone who has a high reservation wage is less likely to work. The reservation wage is dependent on an individual's taste for work, i.e. the slope of his indifference curve. This theory predicts that an increase in wage rate raises an individual's probability of working. (Why is it a probability?)

- An increase in nonlabor income V raises the reservation wage.

Proof: Differentiating the reservation wage equation with respect to V

$$\frac{\partial w^R}{\partial V} = \frac{-f_L(V, L)f_{CC}(V, L)}{f_C(V, L)} \geq 0$$

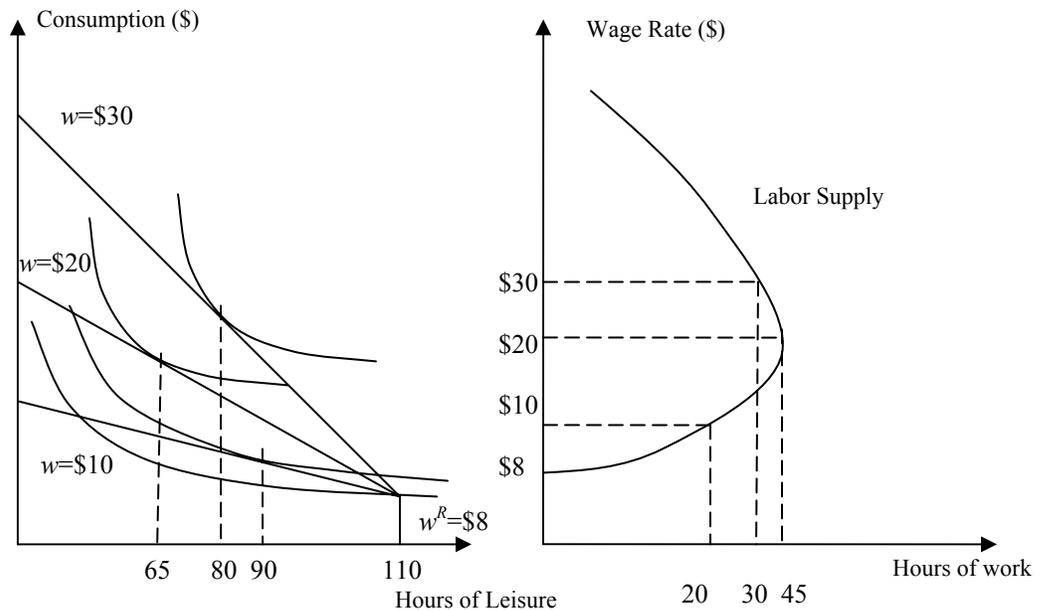
Can you draw a diagram to show why this may be so? The intuition of this finding is as follows: As nonlabor income rises, bribe must increase to induce work.

- Holding the reservation wage constant, an increase in wage for a high wage individual raises hours of work. Then a rise in wage rate may raise the labor participation rate for some segment of the labor market. This has been used to explain the rise in labor participation rate among women.

- Why is there a difference here compared to the neoclassical consumption-leisure theory in terms of an increase in wage rate? The principal difference is in the type of individual we are considering. In the former, because the individuals are already working, there is an income effect giving it the ambiguity in outcome (Intensive Margin). However, in the current case, the individuals are not in the labor market, and hence there is no income effect to speak of (Extensive Margin).

4. Labor Supply Curve

- The predicted relation between hours of work and wage rate is called the labor supply curve. The neoclassical theory can help us derive the labor supply curve by varying the offered wage.



- Derivation of the Market Labor Supply: The horizontal sum of individual labor supply curves.
- To measure the responsiveness of hours of work to changes in the wage rate, economists use the **labor supply elasticity**. It gives the percentage change in hours of work associated with a 1 percent change in the wage rate.

$$\sigma = \frac{\text{Percentage change in hours of work}}{\text{Percentage change in wage rate}} = \frac{\frac{\Delta h}{h}}{\frac{\Delta w}{w}} = \frac{\Delta h}{\Delta w} \frac{w}{h}$$

- The sign of σ is dependent on whether the labor supply is upward $\frac{\Delta h}{\Delta w} > 0$ or downward $\frac{\Delta h}{\Delta w} < 0$ sloping.

- It is then positive when substitution effect dominates, and negative when income effect dominates.
- Further, hours of work is more responsive to changes in the wage the greater the absolute value of σ .
- When σ is less than 1 in absolute value, it is said to be inelastic.

5. Estimates of the Labor Supply Elasticity

- The well studied topic is the labor supply elasticity of men. Since most prime age men participate in the labor force, most studies uses sample of working men to correlate a particular person's hours of work with his wage rate and nonlabor income.
- A typical regression is as follows:

$$h_i = \beta w_i + \gamma V_i + \Omega X_i$$

where β and γ are the coefficient for wage rate and nonlabor income respectively. Ω and X are vectors of coefficients and other variables respectively. In this form, measures the impact of a \$1 increase in wage on hours of work, holding nonlabor income constant. While γ measures the impact of a \$1 increase in nonlabor income on hours of work, holding wage rates constant. **How would you change the regression such that β can be interpreted as σ ?**

- However, studies has not been consistent on the estimate of β which has ranged from large and negative, to zero, to large and positive. There is some "consensus" that the σ (**Uncompensated Wage Elasticity of Supply**) is -0.1, implying a 10% wage increase leads to a 1% decrease in hours of work for men. Further in terms of the decomposition in income and substitution effect, it is generally agreed that substitution effect is 0.1 (**Income Elasticity of Supply**) while income effect is about -0.2% (**Compensated Wage Elasticity of Supply**). So which effect dominates?
- The key points with these findings:
 1. The dominance of income effect has been used to explain the decline among men in terms of labor supply.
 2. Labor supply curve is inelastic.
 3. This pertains to men only. Evidence suggests σ is different for men and women. Substitution effect (0.9%) dominates the income effect (-0.1%). So what is the Uncompensated Wage Elasticity of Supply for women?
- Problems with these estimates
 - Hours of Work:
 1. The results depend on whether we are measuring this variable by week, month, or year. The greater the horizon, the more responsive is hours worked to wage changes.
 2. Measurement error since most individuals are paid an annual salary, and make little effort to really keep track of actual hours of work. This introduces bias to our measure.

→ Wage Rate:

1. Since the typical salaried worker is paid an annual salary, most regressions use the imputed wage rate of annual salary, divided by annual hours worked. But by our previous argument that there is measurement error in hours worked, this would translate into measurement errors in wage rate as well.
2. Further the neoclassical theory defines the wage rate as the marginal wage rate, while the measured wage we have above is the average. If the relevant marginal wage rate has nothing to do with the average wage, we would have introduced another measurement error.
3. Individuals who are not employed do have a desired wage rate, recall our reservation wage rate theory. But unemployed individuals do not report reservation wages, and it is not zero. Most studies try to eliminate this problem by throwing away observations of unemployed individuals. But individuals who do not work have either low wages, or have high reservation wages. This introduces what is typically called selection bias. What is the direction of bias you suspect? Can you prove it?

→ Nonlabor Income:

Ideally nonlabor income must have nothing to do with wages. However, we capture our observation at an instant in time, and do not know if this nonlabor income was derived from savings due to hard work in prior years. If so, such individuals may have higher propensity to work more, and we would falsely conclude that there higher nonlabor income raises hours worked and that leisure is an inferior good (Why?), when in fact it is the individuals preference for more hours worked that raised the nonlabor income (This argument is based on the assumption that individuals who like working, like working at all instances in their lifetime in the labor force). More careful studies has indeed found that nonlabor income do indeed reduce hours of work (leisure is a normal good) by accounting for tastes for work.

6. Labor Supply of Women

- There has been a growing trend towards increased labor force participation rates among women across developed countries. Although there may be minor differences in magnitude that may be attributable to cultural and institutional factors.
- Labor participation rates also increases as women past child bearing ages (or when family size decision is complete)
- Recent cohort of women has also exhibited greater labor participation when compared with similar age groups in previous years.
- Why would this be so? Some reasons are below, can you think of more?

- Reservation wage theory provides some explanation for this as being a result of rising wage rates for women. That is as wage rate rose, women would have found it more viable to reduce that commitment to household work, and enter into the labor force.
- It could also be because women's reservation wage had fallen in the recent decades. But can this really be estimated.
- Lifetime fertility of women has fallen of the past half century, especially in North America. This may have permitted women to reenter the labor force at a younger age, and become more engaged in the labor market. It could very well be that the drop in fertility is a consequence of the rise in wage rate, which effectively raises the cost of each additional child, hence fewer children per household. Can we determine causality?
- Technological advances that reduced the amount of time needed in household sector, hence reducing the specialization within a household.
- Although it is possible that other social factors, such as reduced discrimination, and institutional changes might have had its impact, it has been estimated that 60% of total growth in female labor force between 1890 and 1980 is attributable to rise in wage rate, i.e. economic factors.
- Labor force participation of women is also responsive to shocks to spouse's income realization. An increase in husband's income reduces women's labor participation rates. No evidence that the effect flows from the wife to the husband though.
- It has also been found the advancement in birth control technology, and abortion legalization which has permitted women to raise their human capital accumulation, and consequently delay age of marriage, and increase labor participation, and labor supply. This finding will be revisited later on.

7. Policy Application: Income Maintenance Schemes/Welfare Programs and Work Incentives

- **Income Maintenance Schemes/Welfare Programs** are used to raise the income of certain groups and to supplement low wages.
- **Welfare Programs** has been criticized to encourage recipients to "live of the dole". How can we analyze the workings of a typical welfare program, such the Aid to Families with Dependent Children (AFDC) in the U.S.
- Some problems with designing welfare programs assuming it is necessary is;
 - Should the program be universal (for everyone), or targeted (for the poor, below a poverty line. The latter would involve giving everyone payment of the minimum sustenance, say t . But this would be expensive. The other way is to pay individuals enough to get them above the poverty line, say Y_m . Are there work disincentives?
 - How do we know the real reason why an individual has low income?
 - Could be just pure transitory/temporary bad luck?

- Even if incomes are permanently low, is because of disability that has forced the individual to reduce his work hours, or because the individual has low skill levels such that the wage rate is low.
- The reasons for low incomes could help us decide on the appropriate welfare program and if it is desirable at all.
- **Cash Grants** (Eliminate V now): Cash that is given out if and only if individual is not working. Figure 7 shows that for some individuals who have strong preference against working would choose not to work.

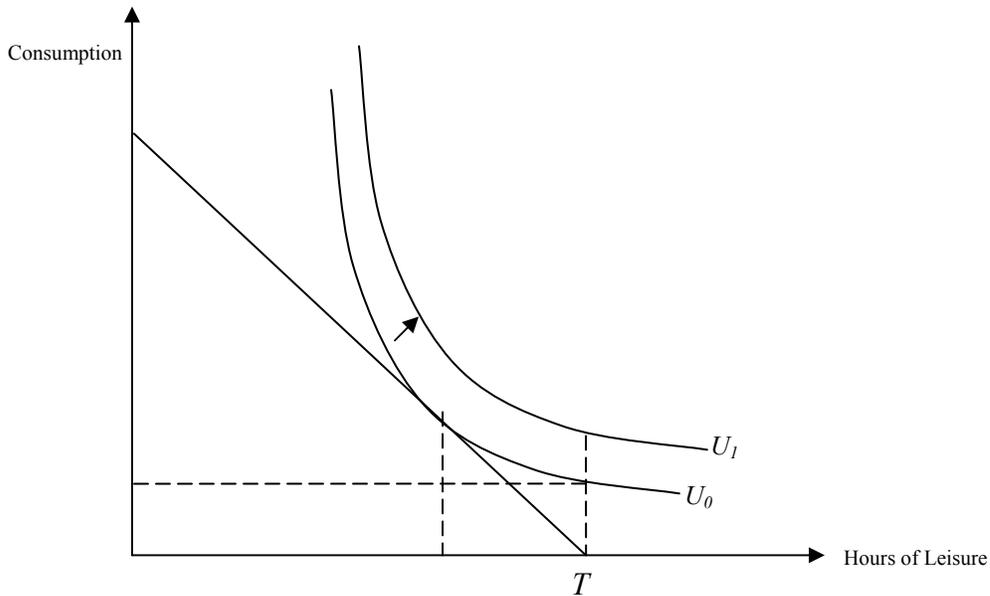


Figure 7: The premise of the argument that welfare reduces labor supply

- One way around this problem is to introduce Welfare Benefits with a "Clawback". The above Welfare policy has a 100% clawback. While the following has one that has less than 100%, say 60% reduction in benefits for every additional hour of work engaged in by the recipient.

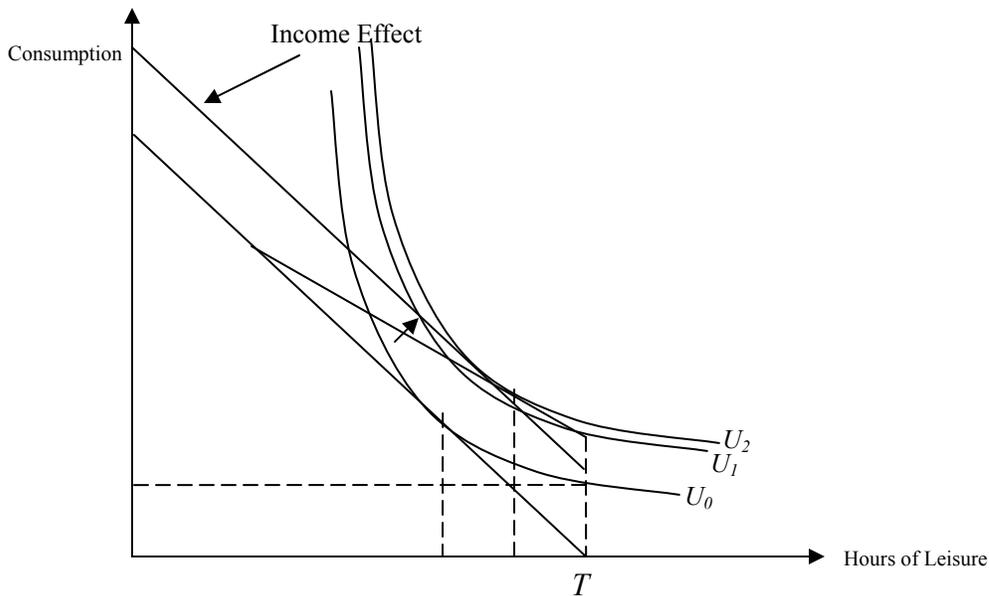


Figure 8: Negative Income Tax

- But note that this policy still has the individual working less than she would have, had there been no welfare program at all. In fact, by the assumption that leisure is a normal good, income effect alone would tell us that welfare must have work disincentive effects. Further, since leisure becomes relatively cheaper, substitution effect must result in even lower labor supply.
- Such a program is known as a **Negative Income Tax** or guaranteed annual income plans involve an income guarantee, and an implicit tax rate of less than 100% applied to labor market earning. Then the income of an individual eligible for the program is $Y = G + (1-t)E$, where Y is total income, G is guaranteed income, and E is earned income from work (Which can also be expressed as wh , that is in terms of income multiplied with hours worked).
- Some argue that there are still other ways to reduce the disincentive to allow the programs to work. Such
 - A reduction benefit
 - Changing preferences
 - Increase in wage rate say. (By legislation?).
- **Wage Subsidy** typically entails the subsidy of the hourly wage rate by the government. The effects are just the same as a rise in wage rates, and the work incentive results are hence ambiguous, since it depends on whether the income effect or substitution effect dominates.
- **Unemployment Insurance (UI) program** protects workers from bouts of bad luck. However, to qualify in Canada, the individual must have worked 12-20 weeks in the year, and the benefit duration last for 14 to 45 weeks depending on the rate of unemployment in the region.
- Consider an example where the UI gives recipients 60% of their weekly pay for a maximum of 20 weeks, and requires a minimum of 14 weeks of employment in order to qualify for benefits.

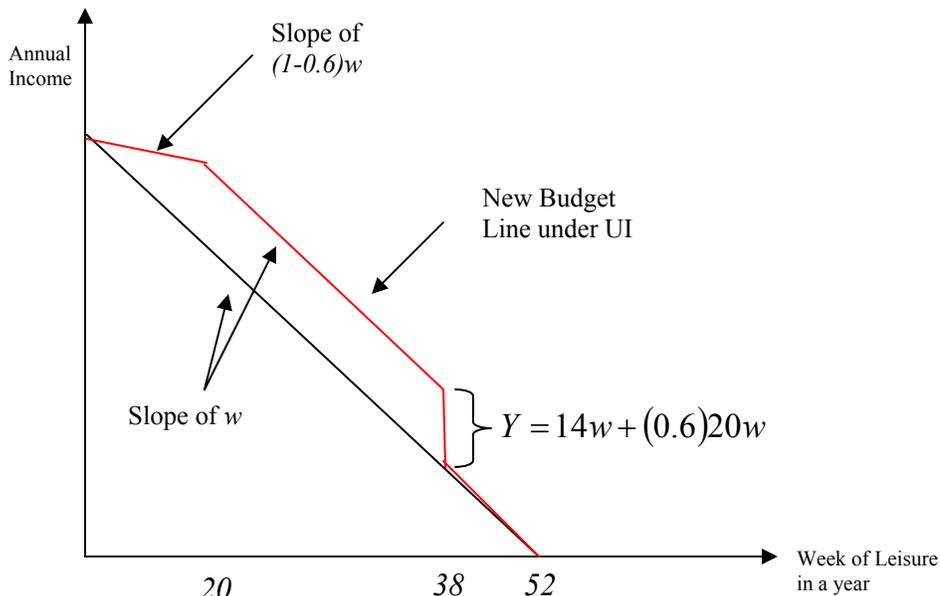


Figure 9: Unemployment Scheme

- What are the work incentive effects? It depends on which segment the worker existed on prior to the implementation of such a program. If the individual here had previously worked less than 32 weeks but more than 14 weeks, the program leads to a pure income effect which would reduce the amount of weeks worked. For individuals who worked more than 32 weeks, both substitution effect (since leisure is relatively cheaper), and income effect work in tandem, and individuals would reduce weeks worked. However, for individuals who previously worked less than 14 weeks a year, they may be induced to work. This analysis is technically correct. Read your text for why this may just be a possibility, such that in truth workers would not change their work pattern at all. Note that this analysis implies that unemployment rate may be raised. Why?
- Unemployment Insurance Assisted Worksharing programs encourage workers to share unemployment rather than having it shared by a few. The argument for such a program is that it is far more equitable. This was attempted by Canada on an experimental basis in 1977 and 1982. Such a program is depicted in figure 10 below where work days are reduced from 6 to 4 days, with 50% of pay covered by UI.

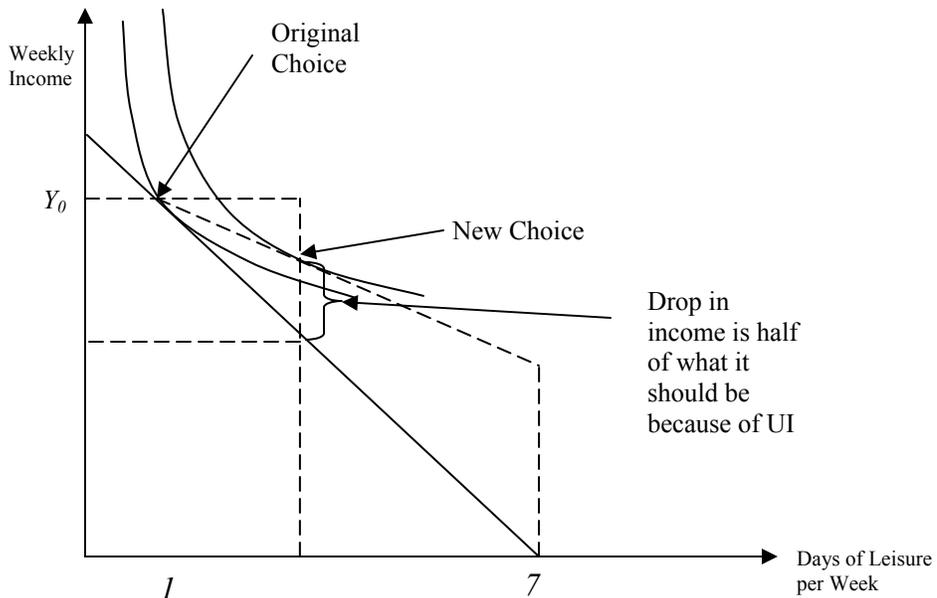


Figure 10: Unemployment Scheme with Worksharing

- Child Care Subsidy is a much debated social program as child care has been deemed a binding constraint that has subjugated women, and prevented from attaining their potential. First note that child care cost is incurred only if the woman enters the labor force, and is equivalent conceptually to a drop in the consumption set due to the fixed cost of child care. Then a woman with child care concerns would have a higher reservation wage than one who does not. To encourage the former to enter the labor force, they must then be paid a wage rate higher than her reservation wage.

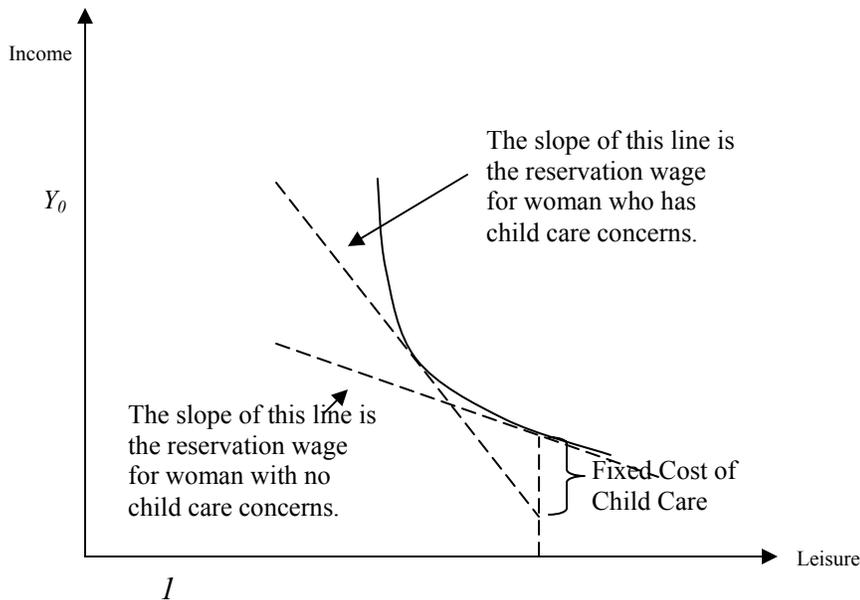


Figure 11: Why we need higher wage rate to induce women with children to join the labor force

- Even if the wage rate is sufficiently high, the fixed cost of child care causes a parallel downward shift in budget line. Assuming leisure is a normal good, this pure income effect would imply that the lady would have to supply more labor than she otherwise would have.
- Further, the reservation wage of a working mother determines the minimum level of labor supply below which we would not observe any labor participation.
- The complete elimination of this cost would then reduce reservation wage rate, and encourage participation by women, including part-time work which may not be encouraged based our previous argument when we simply raised the wage rate. Note also by our previous argument, women who were already working would choose to work less with the subsidy of child care cost.
- The gross effect of women's labor supply is unclear hence, unless the subsidy is awarded to non-participants. But it would create inequities. Note that this arguments negate the joint decision making process within the family. Special needs of children below the ages of 7 which may be better served by structured care (As in France, and Scandinavia) as some would believe, while others would emphasize the necessity of bonding between mother and child.