Chapter Two

Labour Supply: Individual Attachment to the Labour Market

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Learning Objectives

1. Define the key elements of labour force measurement - employment, unemployment, labour force participation, and hours worked - and explain how they are measured and reported by Statistics Canada.
2. Illustrate graphically how the income-leisure model reflects the trade-offs that consumers face in deciding whether and how much to work.
3. Distinguish theoretically between the work choices made by individuals and the economic opportunities that they choose from.

Learning Objectives, cont'd

4. Explain using diagrams how an increase in the wage rate leads to offsetting income and substitution effects, and how this yields an ambiguous effect of wage changes on labour supply.
5. Interpret the economic and other factors affecting a married woman's decision to work, and show how this decision can be captured within the income-leisure (labour supply) model.

Section One

The Theory of Labour Supply

Quantifying Labour Market Attachment

- Labour Force (LF)
  - Individuals in the eligible population (15 years and older) who participate in labour market activities, either employed or unemployed
- Labour Force Participation Rate (LFPR)
  - The fraction of the eligible population that participates in the labour force
  - LFPR = LF/POP

Unemployment

- To be considered unemployed, a person must be in one of the following three categories:

1. Without work but has made specific efforts to find a job within the previous four weeks
2. Waiting to be called back to a job from which he or she has been laid off
3. Waiting to start a new job within four weeks

Labour Force Concepts

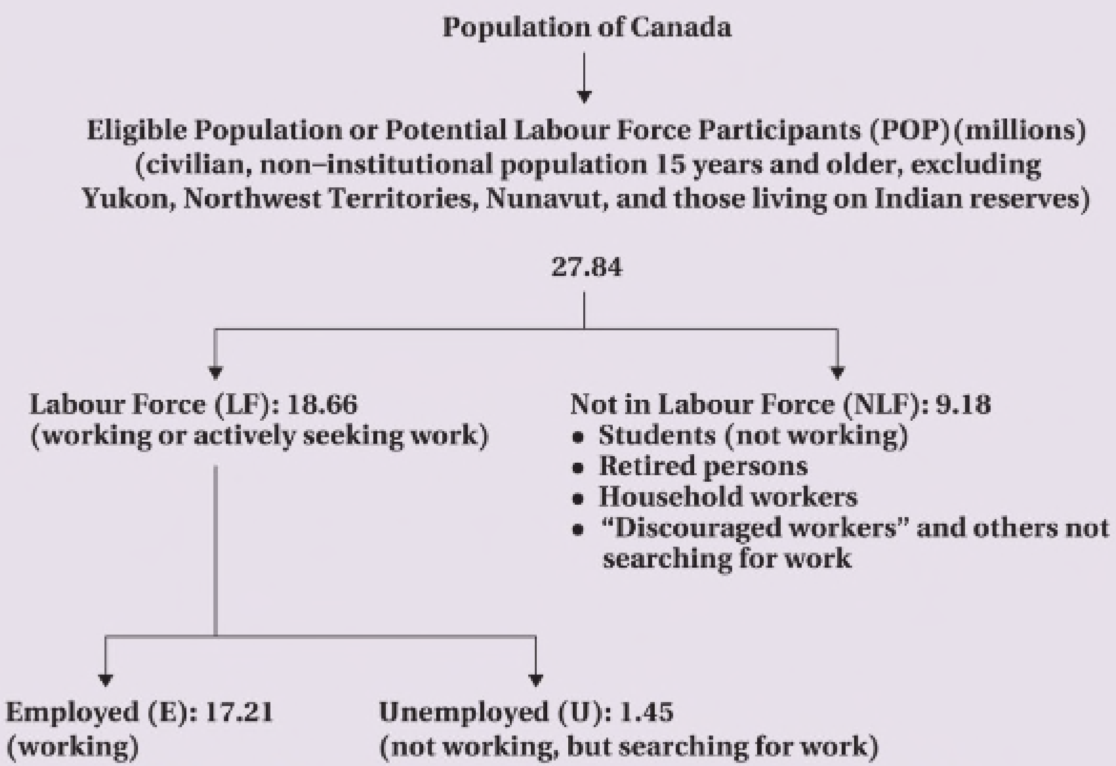


Figure 2.1 Labour Force Concepts (numbers as of January 2016)

Labour Force Participation Rate by Sex, Canada

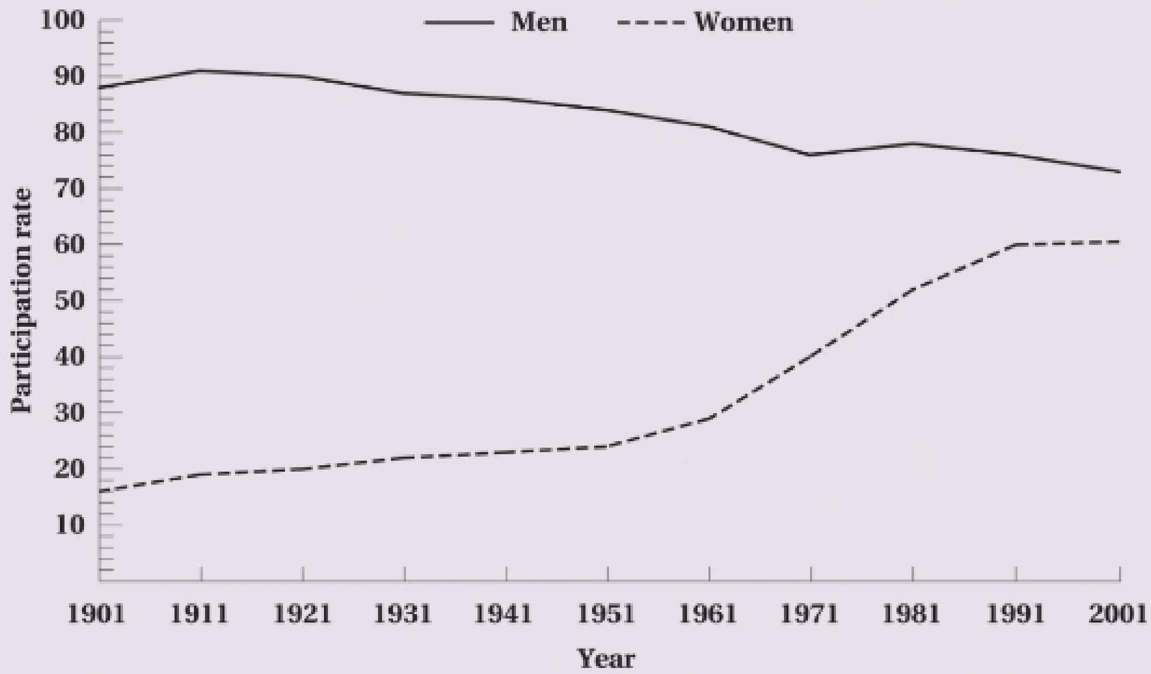


Figure 2.2 Labour Force Participation Rates by Sex, Canada, Census Years 1901–2011

Labour Force Participation Rates by Sex, Selected Countries, 2014

TABLE 2.1 Labour Force Participation Rates by Sex, Selected Countries, 2014

Country	Abbreviation	Overall	Male	Female	Difference
Denmark	DNK	78.2	80.6	75.7	4.9
Canada	CAN	78.2	81.8	74.7	7.1
Germany	GER	77.4	82.7	72.0	10.7
Australia	AUS	76.7	82.8	70.7	12.1
United Kingdom	GBR	76.4	82.2	70.5	11.7
Bangladesh	BGD	73.6	86.6	60.6	26.0
Russia	RUS	73.6	79.0	68.8	10.2
United States	USA	71.8	77.4	66.2	11.2
France	FRA	71.0	75.4	66.8	8.6

Labour Force Participation Rates by Sex, Selected Countries, 2014 (cont'd)

Hong Kong	HKG	68.9	78.9	60.4	18.5
Jamaica	JAM	67.8	74.3	61.5	12.8
Chile	CHL	67.8	80.0	55.6	24.4
Poland	POL	67.3	74.2	60.5	13.7
Philippines	PHL	67.1	81.3	52.8	28.5
South Korea	KOR	66.1	76.2	55.6	20.6
Mexico	MEX	65.0	83.3	48.3	35.0
Italy	ITA	64.2	74.4	54.0	20.4
South Africa	ZAF	56.6	64.3	49.2	15.1
Pakistan	PAK	56.6	85.9	25.9	60.0
Nigeria	NGA	56.3	63.8	48.6	15.2
Egypt	EGY	52.9	79.3	26.0	53.3

Figure 2.3 Male and Female Participation Rates by Level of Economic Development

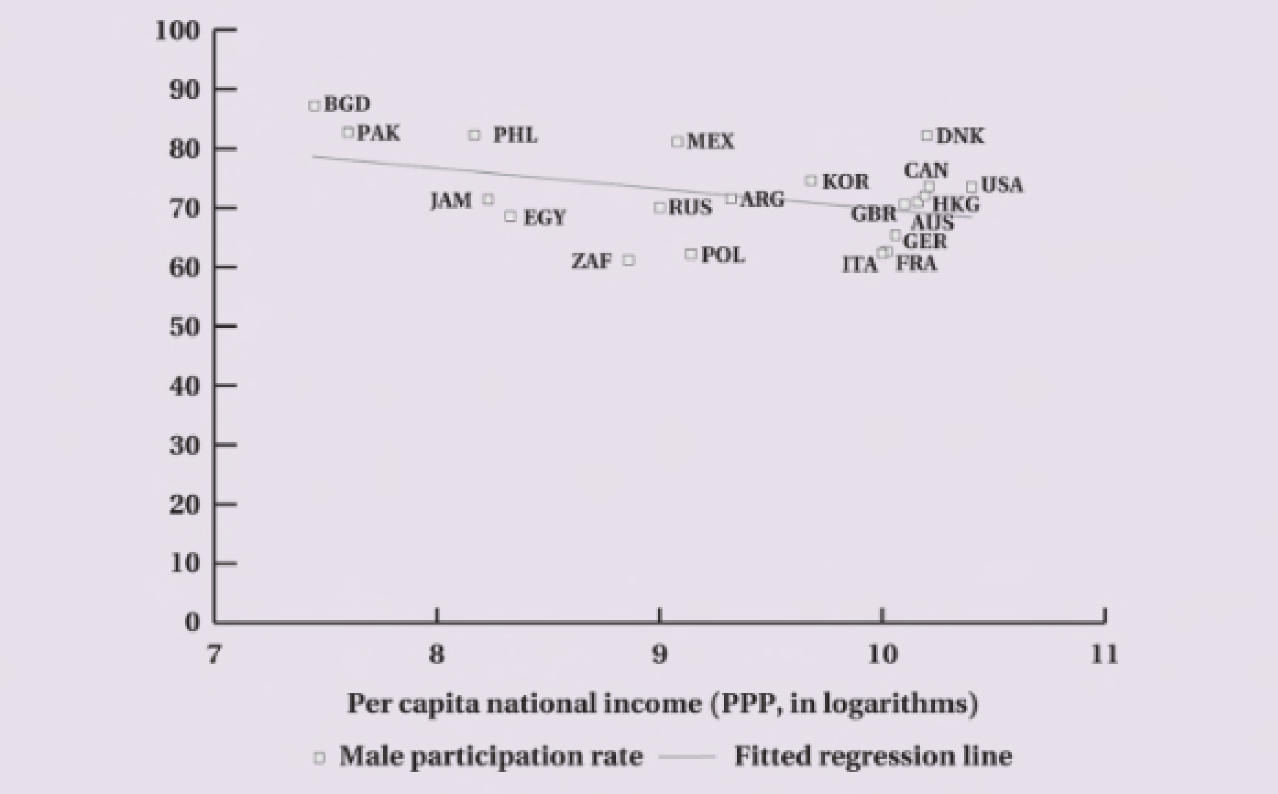
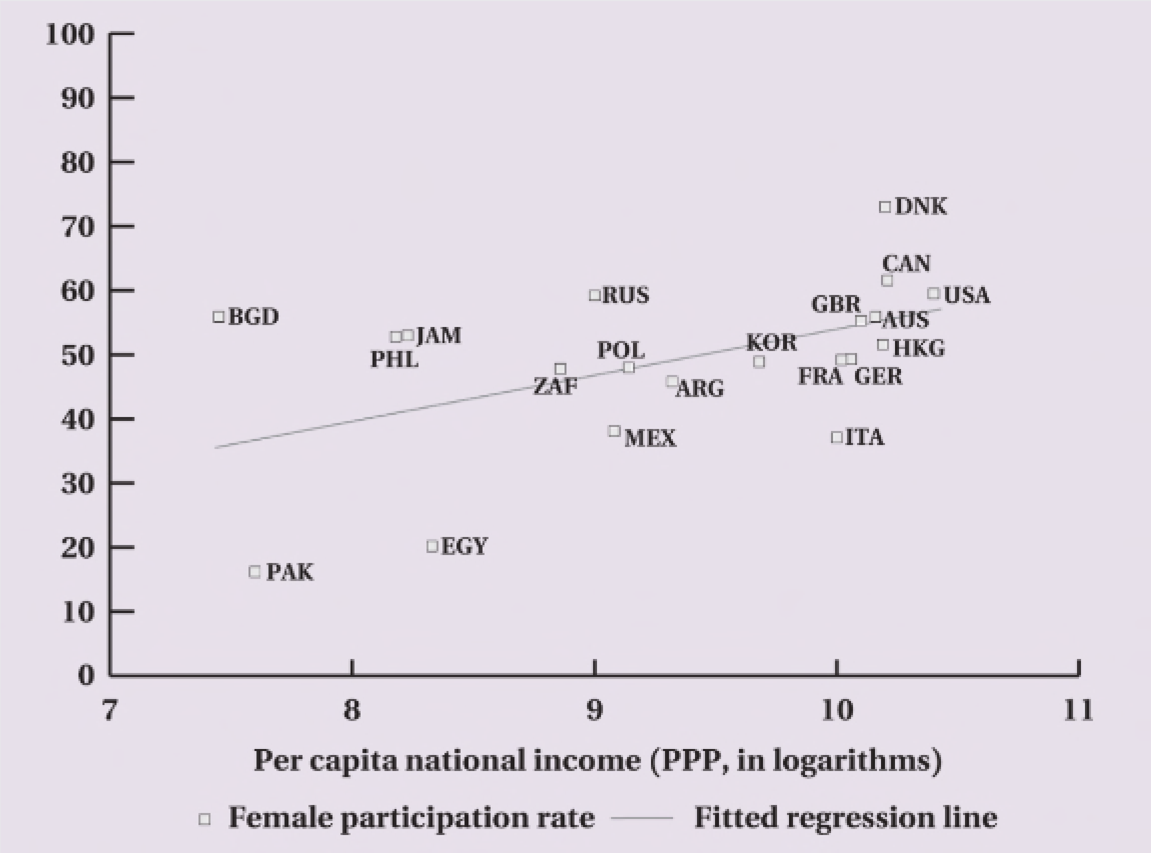


Figure 2.3 Male and Female Participation Rates by Level of Economic Development



Hours

- Hours-of-work
  - Hours per day, days per week, weeks per year
  - It may affect the quantity and the quality of labour supply

Distribution of Hours Worked Per Week by Sex, January 2011

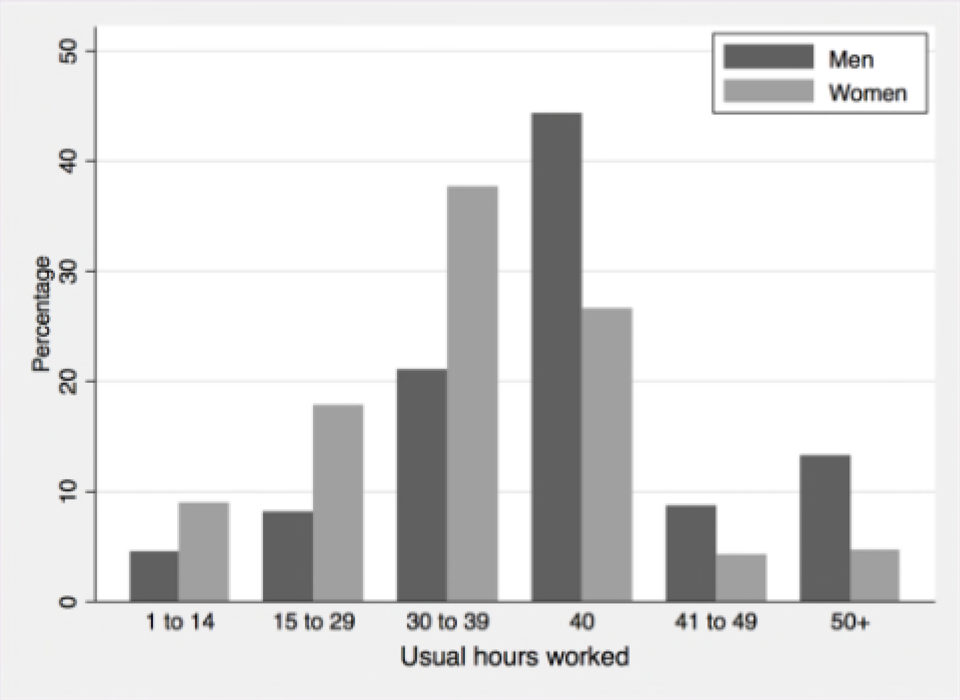


Figure 2.4 Distribution of Hours Worked Per Week by Sex, January 2011

Basic Income–Leisure Model

- The choice of hours worked given opportunities and value of non-market time
  - Preferences and Constraints
  - Individuals choose the feasible outcomes which yield the highest level of satisfaction

Preferences

- Two "goods"
  - Consumption
  - Leisure
- Represented by indifference curves

  (A person is indifferent between various combinations of consumption and leisure on an indifference curve)

Figure 2.5 Consumer Preferences: Consumption-Leisure Indifference Curves (a) Indifference Curve

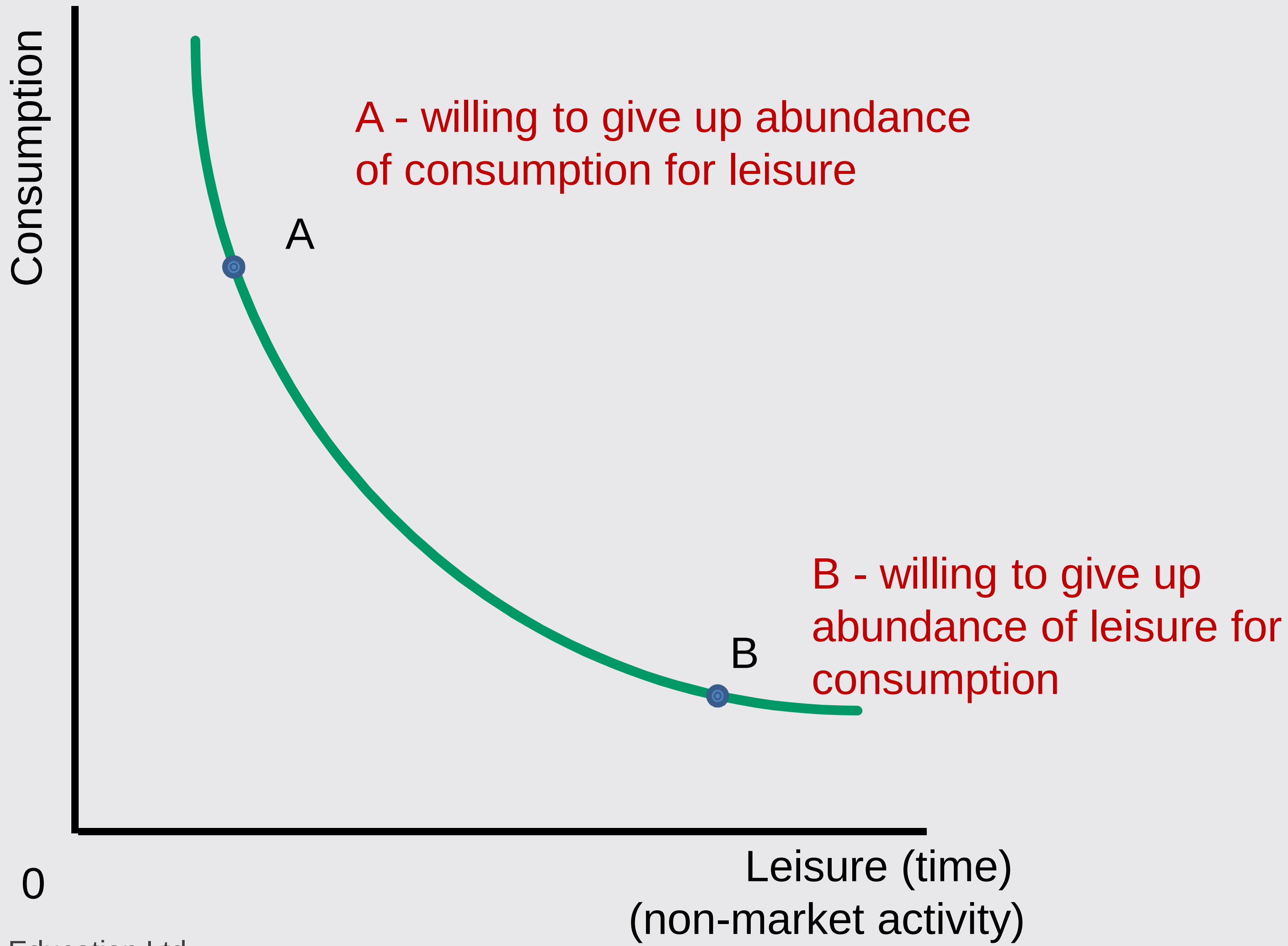
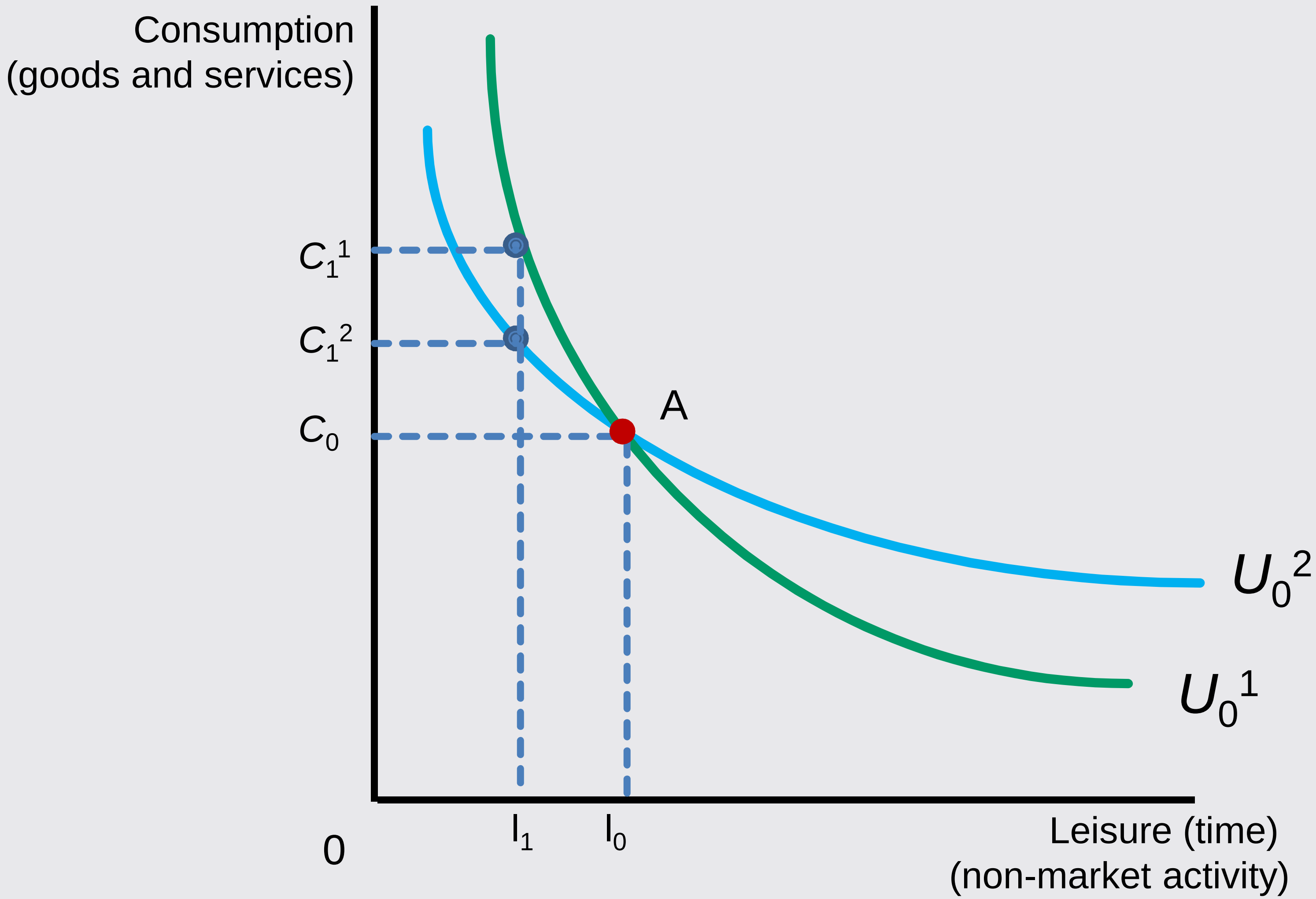


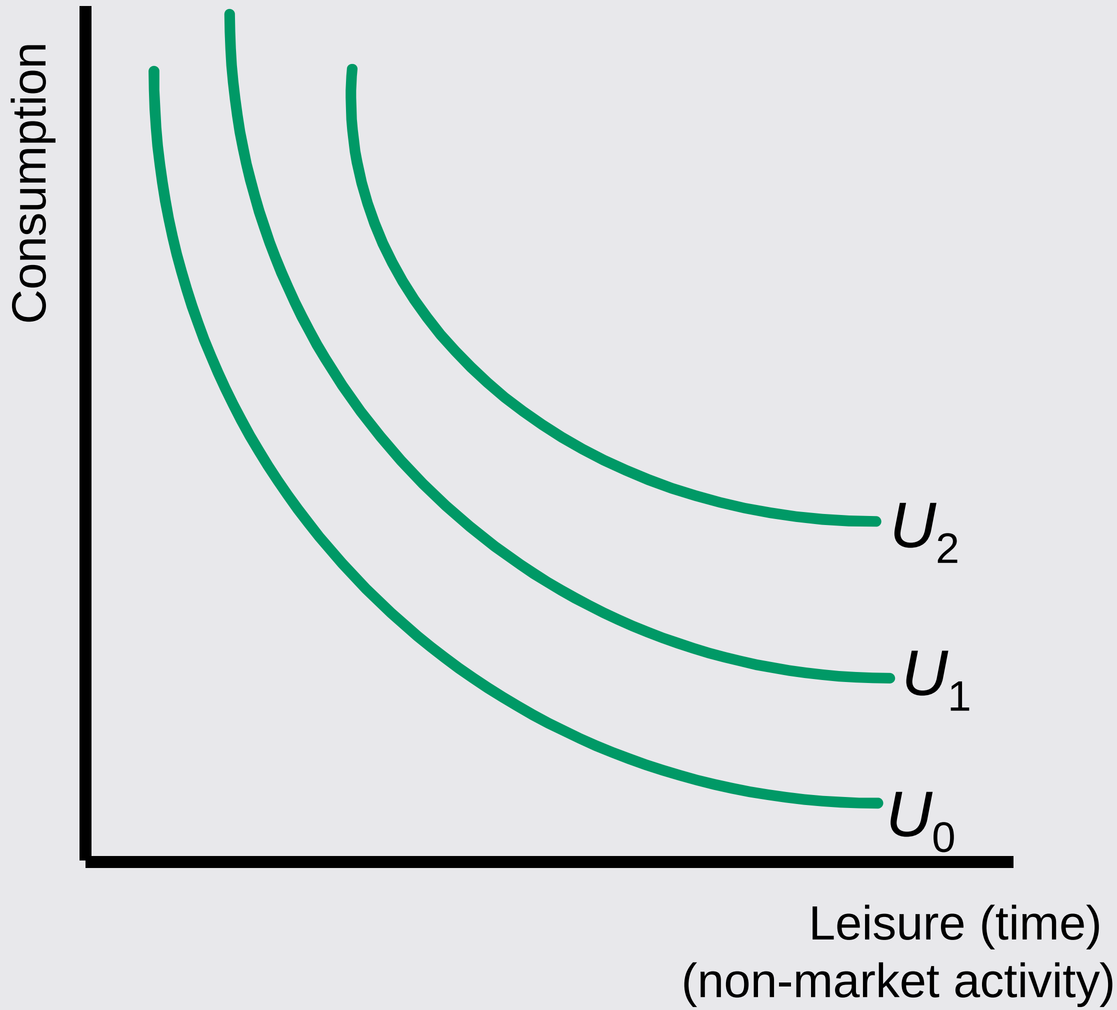
Figure 2.5 Consumer Preferences: Consumption-Leisure Indifference Curves (b) The MRS of Two Different Consumers



Preferences

- Preferences over all conceivable combinations of consumption and leisure
- All combinations lie on some indifference curve
- Represented by an indifference map

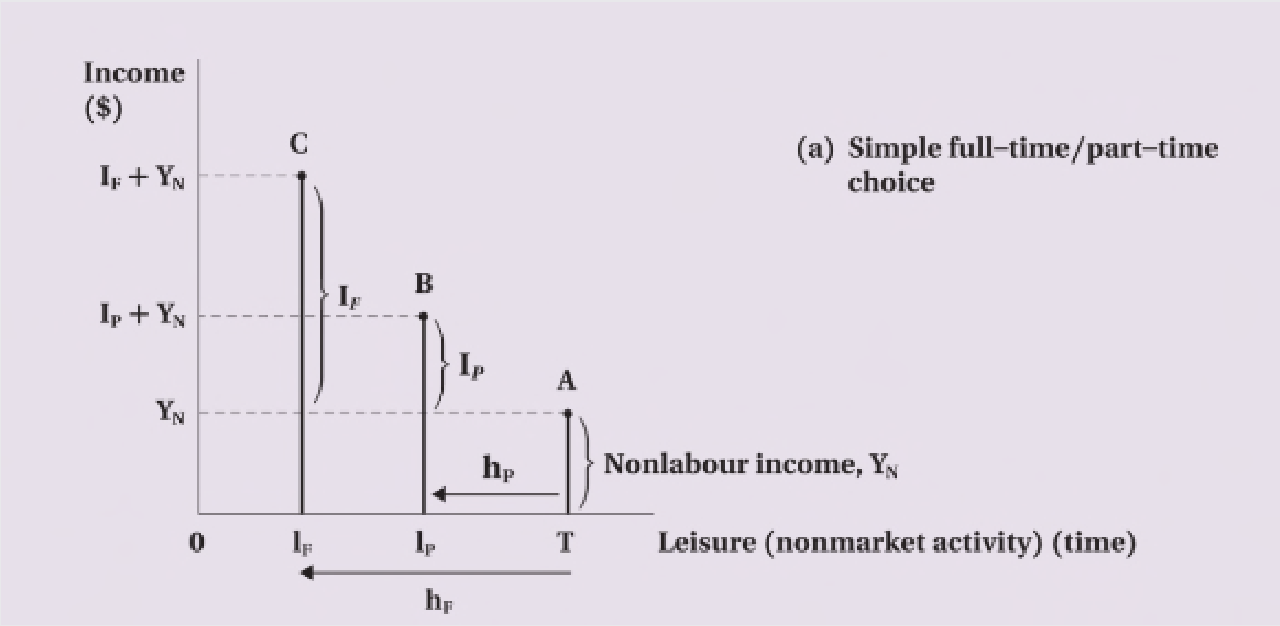
Figure 2.5 Consumer Preferences: Consumption-Leisure Indifference Curves (c) Indifference Curve Map for an Individual



Constraints

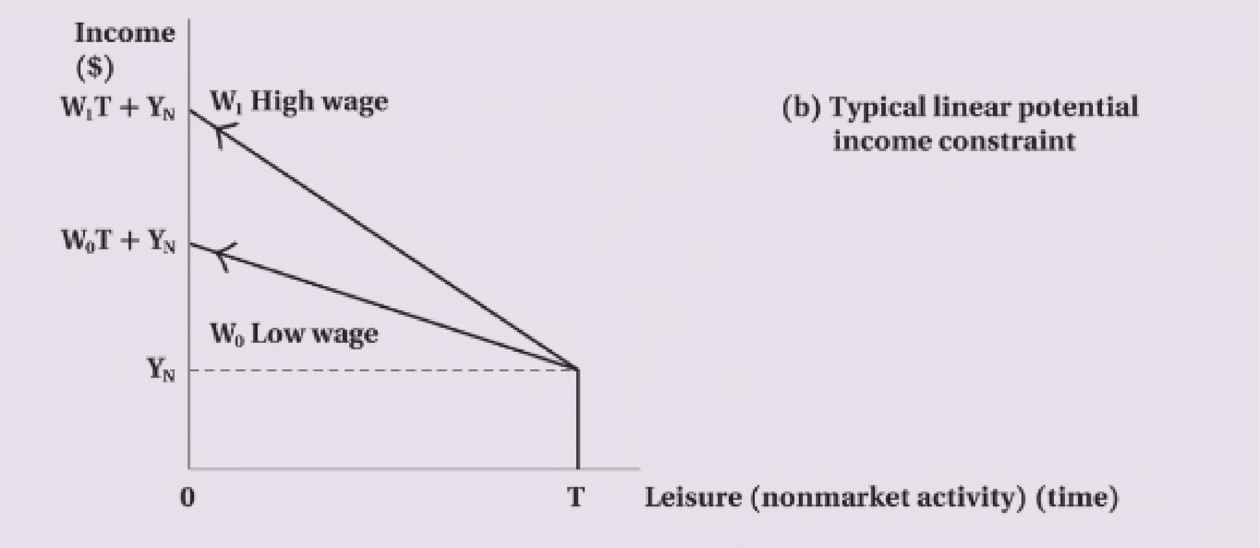
- Constrained are determined by the economic properties of the market, which, in turn, transform consumption-leisure to income-leisure by setting the price of consumption.

Figure 2.6 Potential Income Constraints: Summarizing Individual Market Opportunities



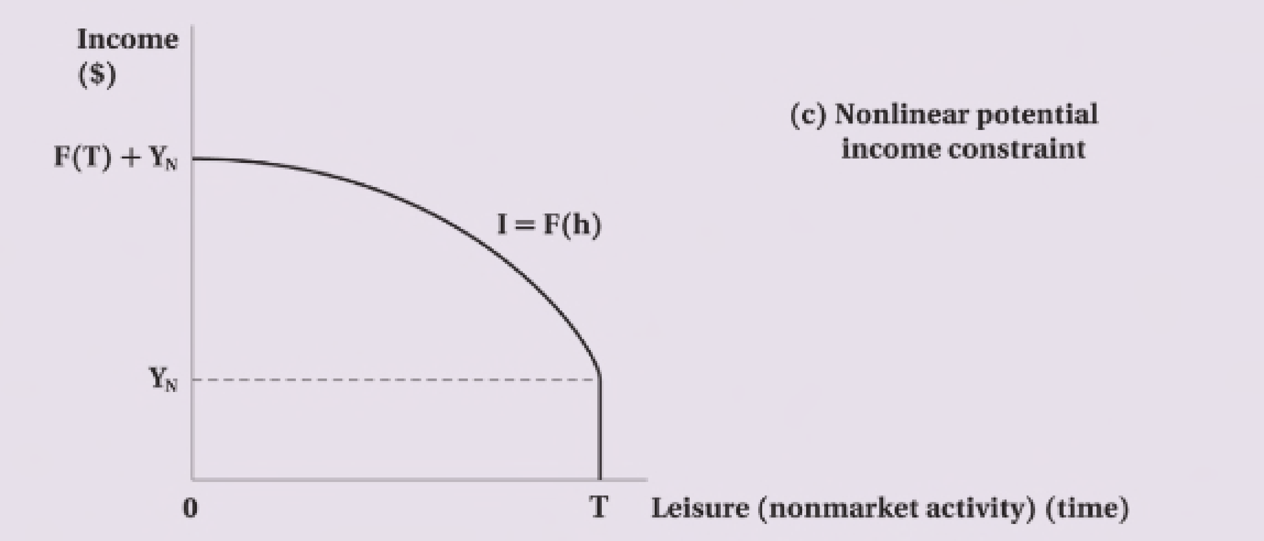
(a) Simple Full-time/Part-time Choice

Figure 2.6 Potential Income Constraints: Summarizing Individual Market Opportunities



(b) Typical Linear Potential Income Constraint

Figure 2.6 Potential Income Constraints: Summarizing Individual Market Opportunities



(c) Nonliner Potential Income Constraint

The Consumer's Optimum

- Optimal amount of income and leisure
- Utility-maximizing equilibrium
  - Highest indifference curve given the income constraint
- Compare MRS with the Market Wage Rate
  - MRS: measures the willingness to exchange leisure for consumption (or income)
  - Market Wage Rate: measures the ability to exchange leisure for income

Figure 2.7 The Consumer's Labour Supply Decision
(a) Equilibrium of Non-Participant

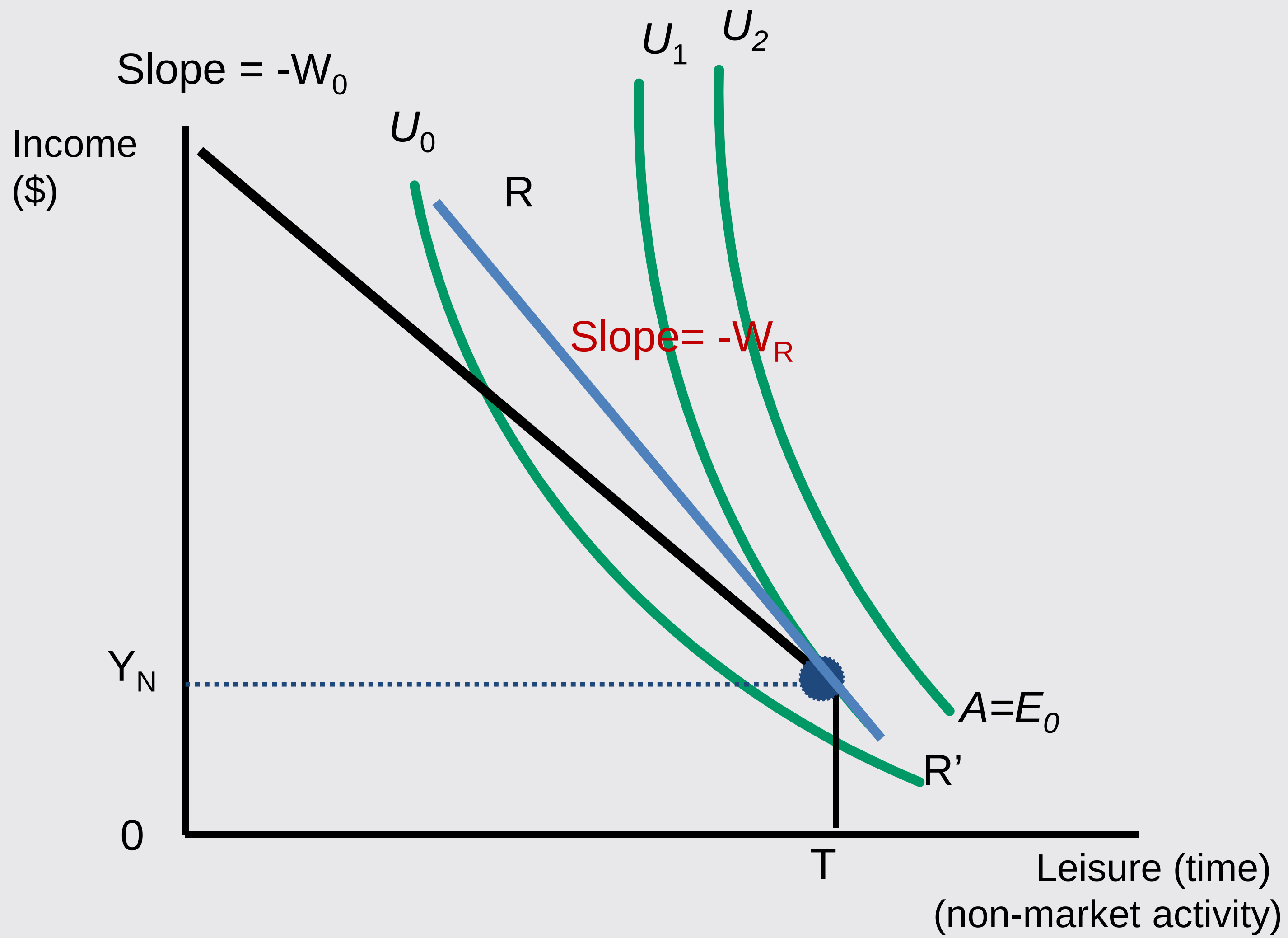
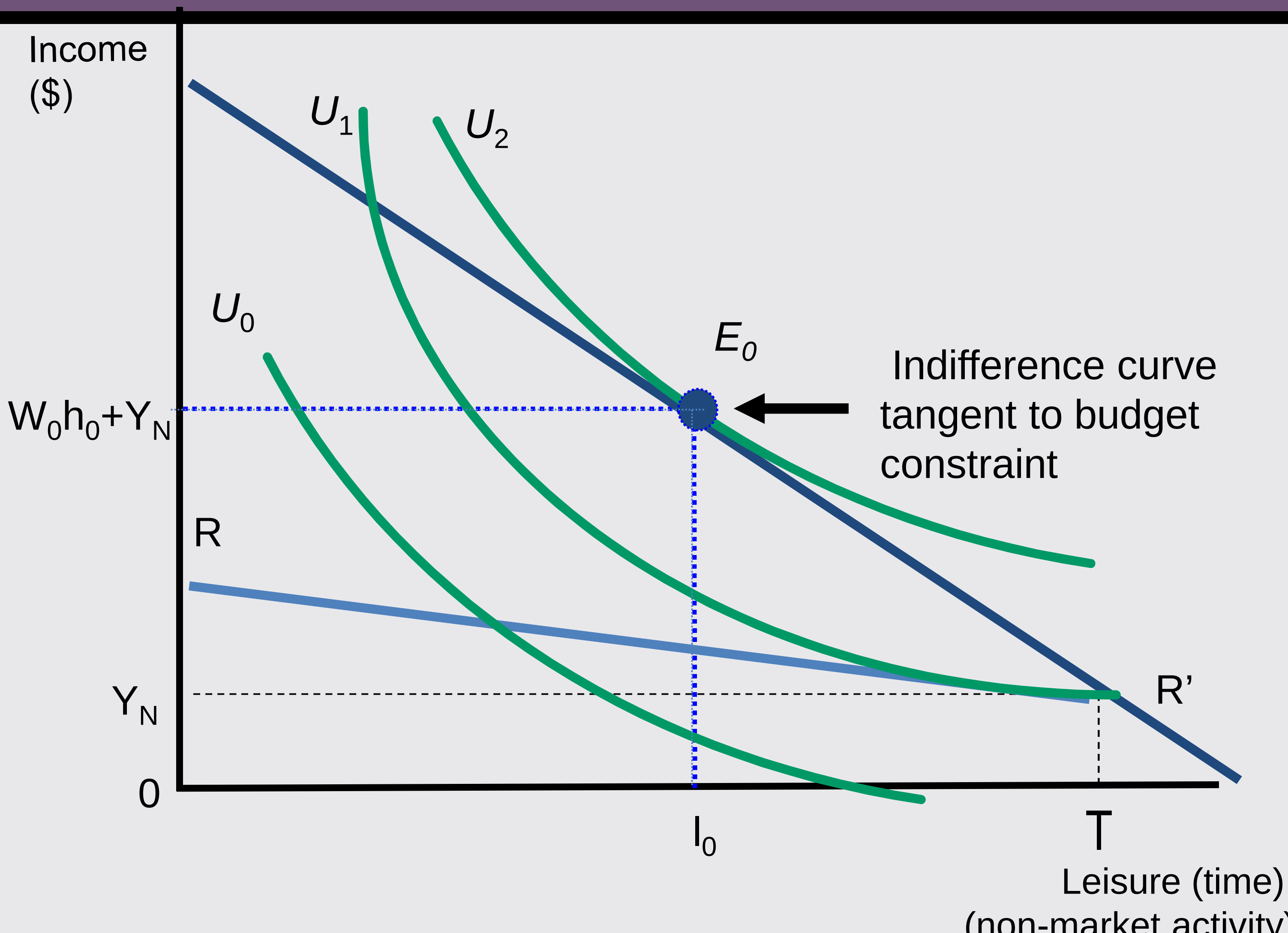


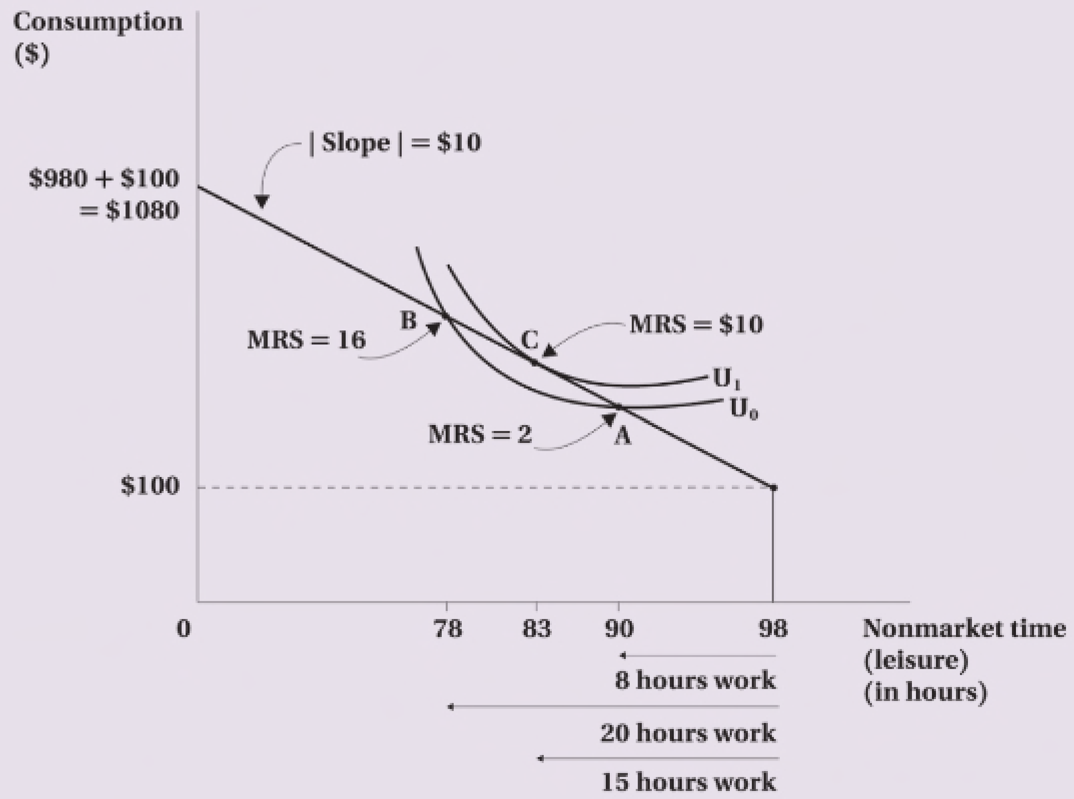
Figure 2.7 The Consumer's Labour Supply Decision (b) Equilibrium of a Participant



Worked Example
Working Part-Time at University

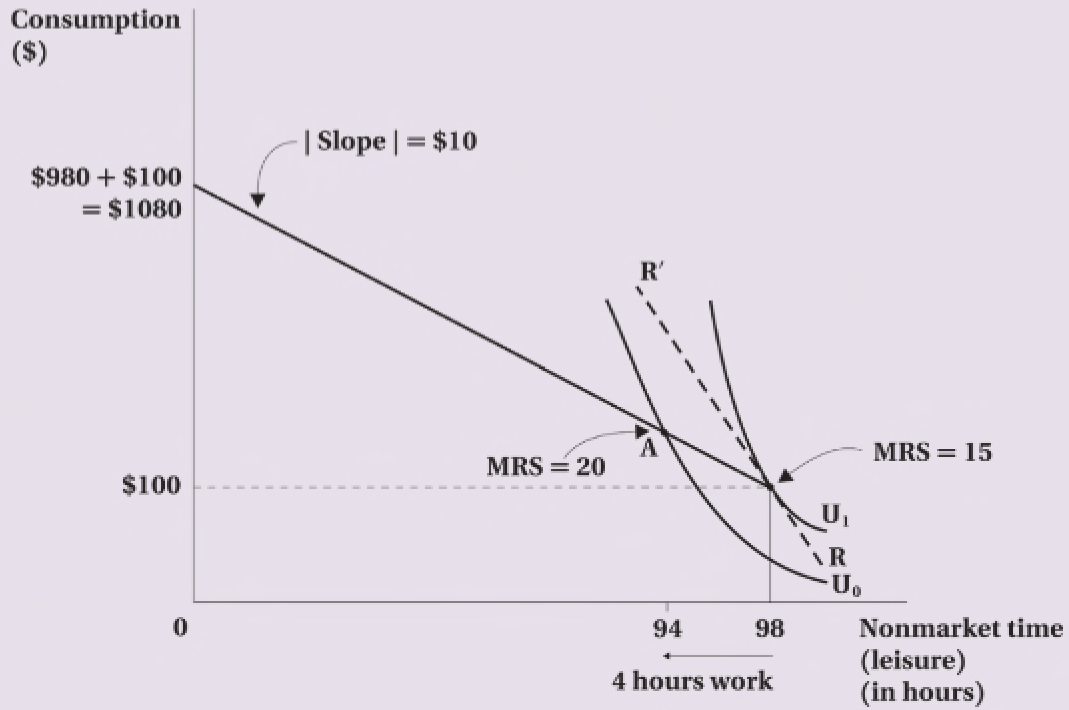
- Jack and Jill attend the same University
- Weekly allowance of $10
- Market wage rate $10.00 per hour
- Total hours for discretionary activities: 98 hours
- Jack and Jill value their time differently

Worked Example
Working Part-Time at University



(a) Jack

Worked Example
Working Part-Time at University



(b) Jill

Comparative Statics

Hours of Work For Participate

Increase in non-labour income results in a parallel outward shift of the budget constraint

- **Leisure, Normal good:**

  More leisure will be consumed resulting in less work hours

- **Leisure, Inferior good:**

  Less leisure will be consumed resulting in more work hours

The Effect of an Increase in Non-Labour Income on Supply

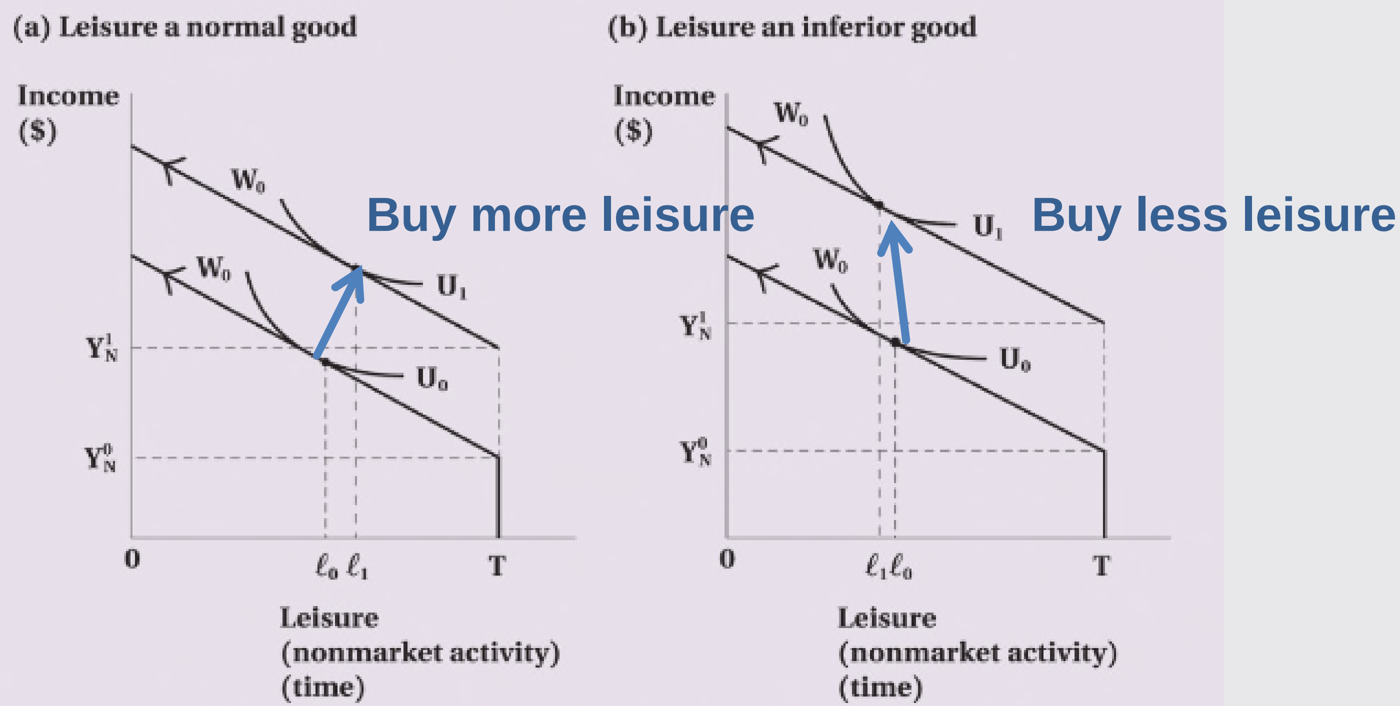


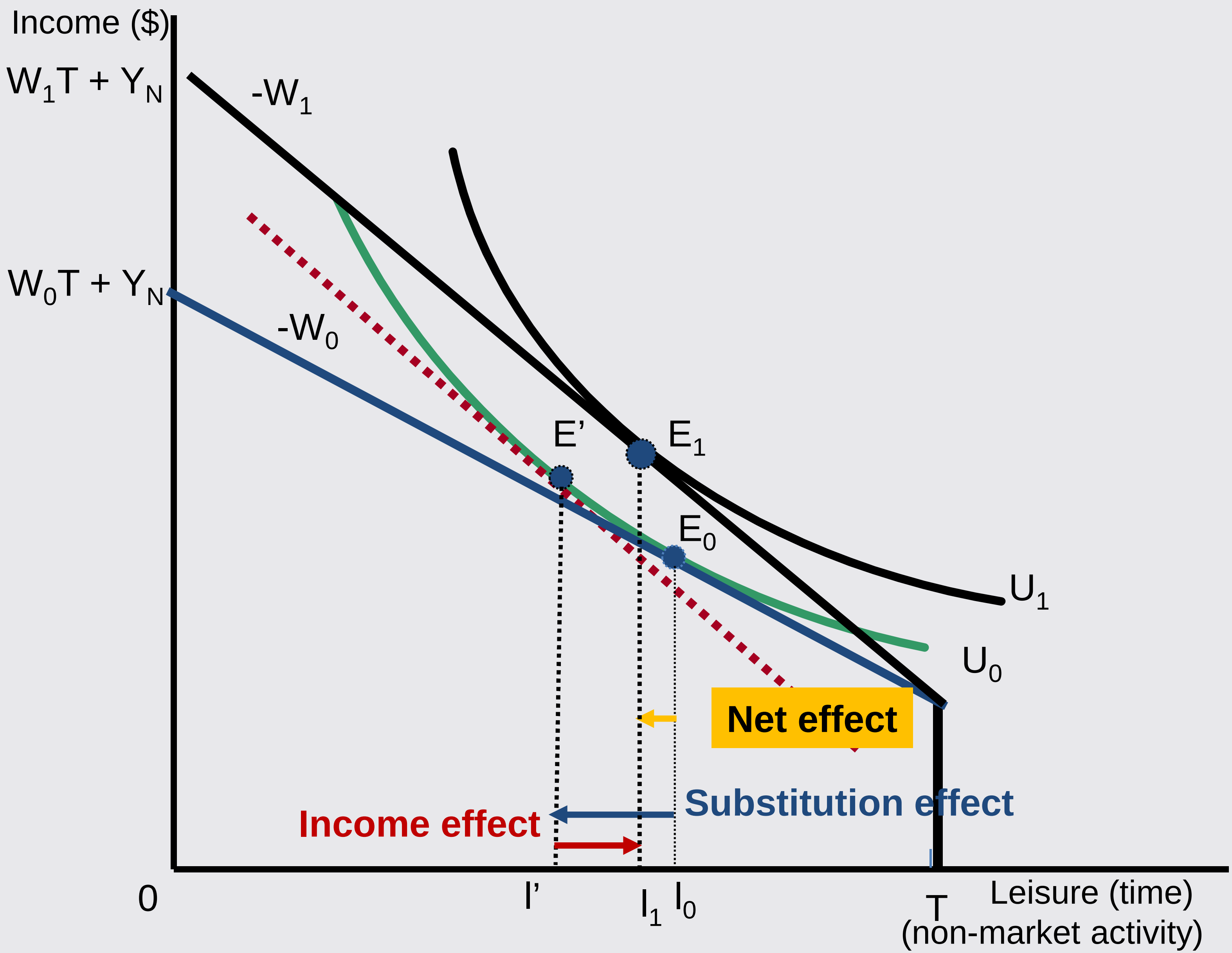
Figure 2.8 The Effect of an Increase in Nonlabour Income on Labour Supply

Change in Wage Rate on Hours of Work

Two effects:

1. Income effect
   The worker has more income to buy more goods including leisure (reduces work hours)
2. Substitution effect
   Individual may work more because the returns are greater substituting away from leisure

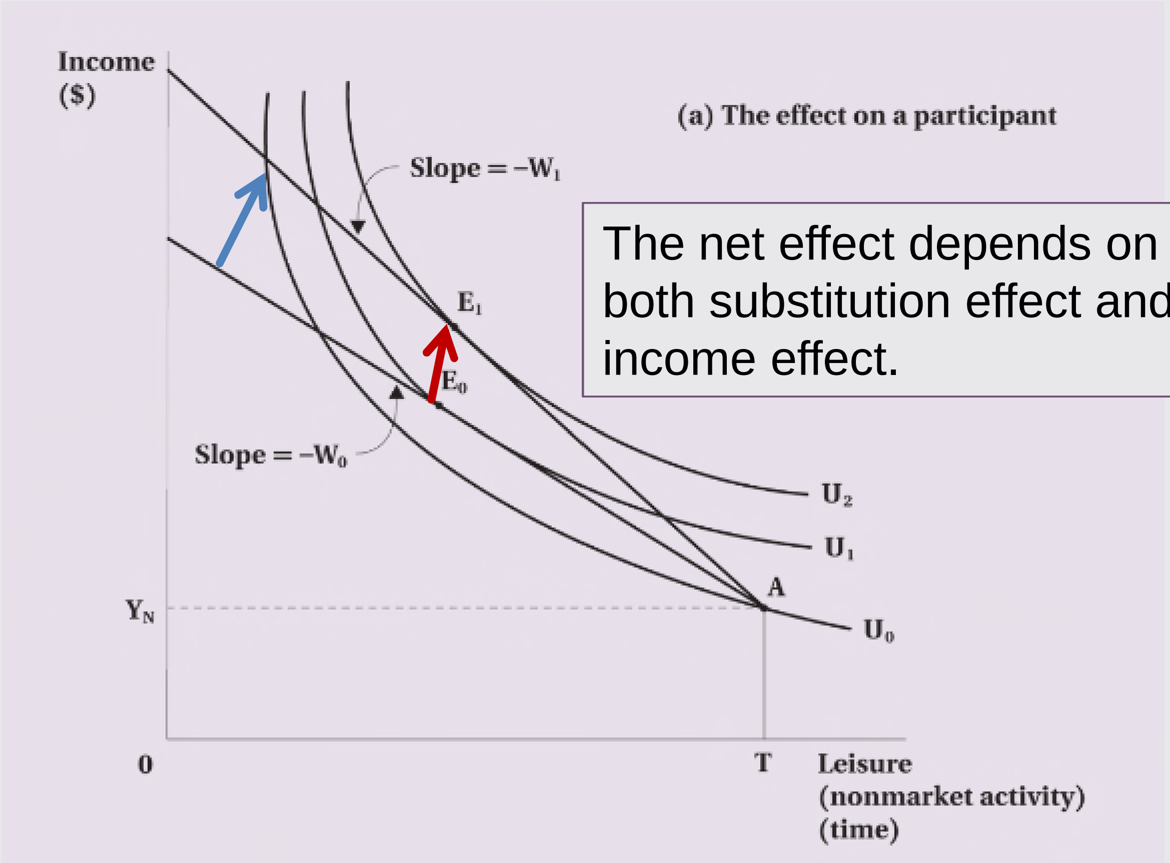
Figure 2.9 Income and Substitution Effects of a Wage Increase



Effect of Wage Increase on Participation

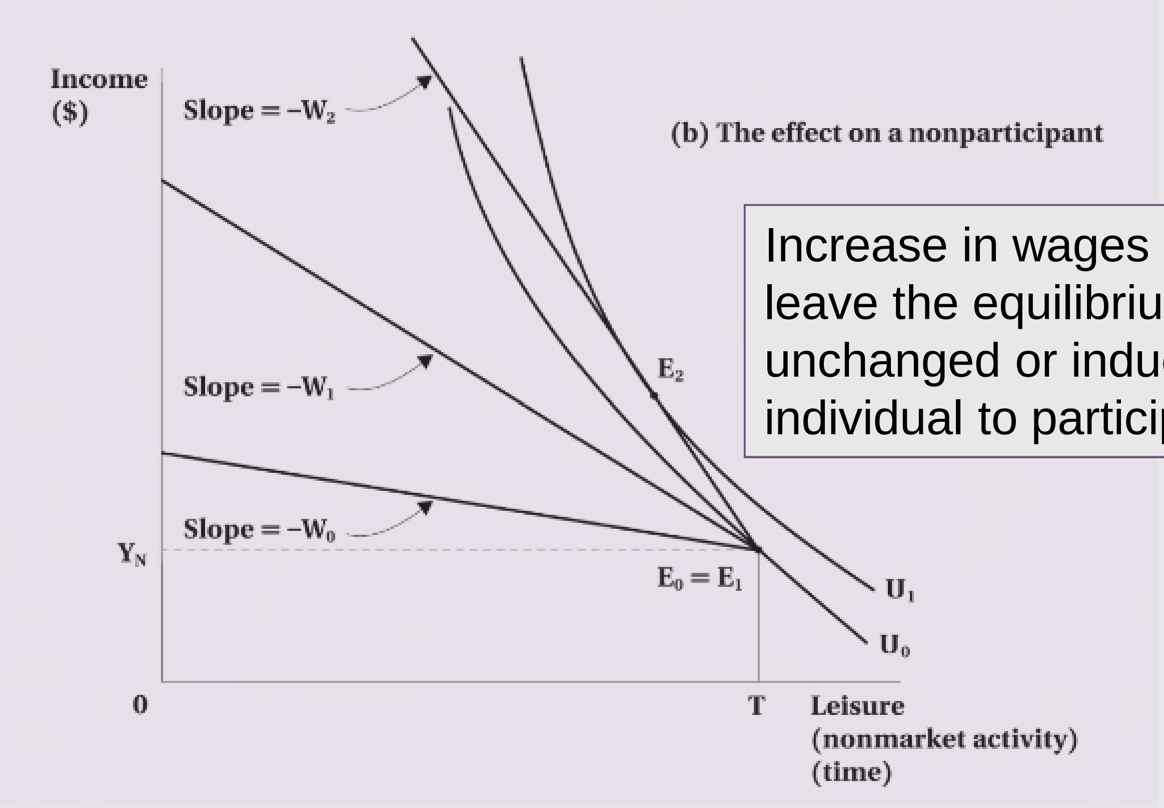
- The net effect depends on both substitution effect and income effect.
- If income effect dominates, hours of work may decline.
- For a non-participant an increase in wages may leave the equilibrium unchanged or induce the individual to participate.

Figure 2.10
The Effect of a Wage Increase on Participation



The net effect depends on both substitution effect and income effect.

Figure 2.10
The Effect of a Wage Increase on Participation



Increase in wages may leave the equilibrium unchanged or induce the individual to participate.

Individual Supply Curve

- If substitution effect dominates,
  - Increase in wages leads to increase in labour supplied
  - Wages continue to increase until a point where substitution effect and income effect offset each other
- Supply curve bends backward when income effect dominates substitution effect

Figure 2.11
Deriving the Individual Supply Curve of Labour

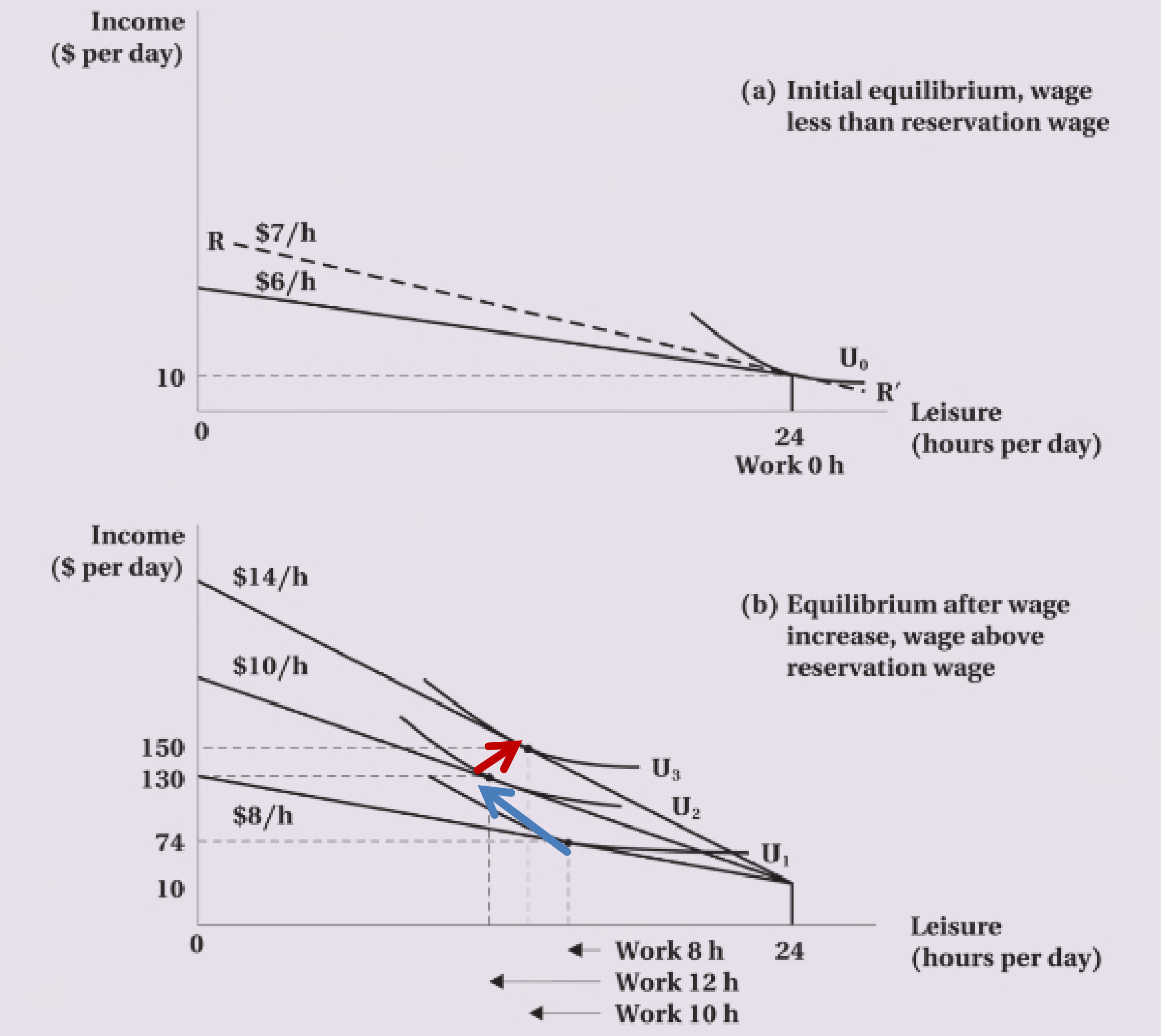
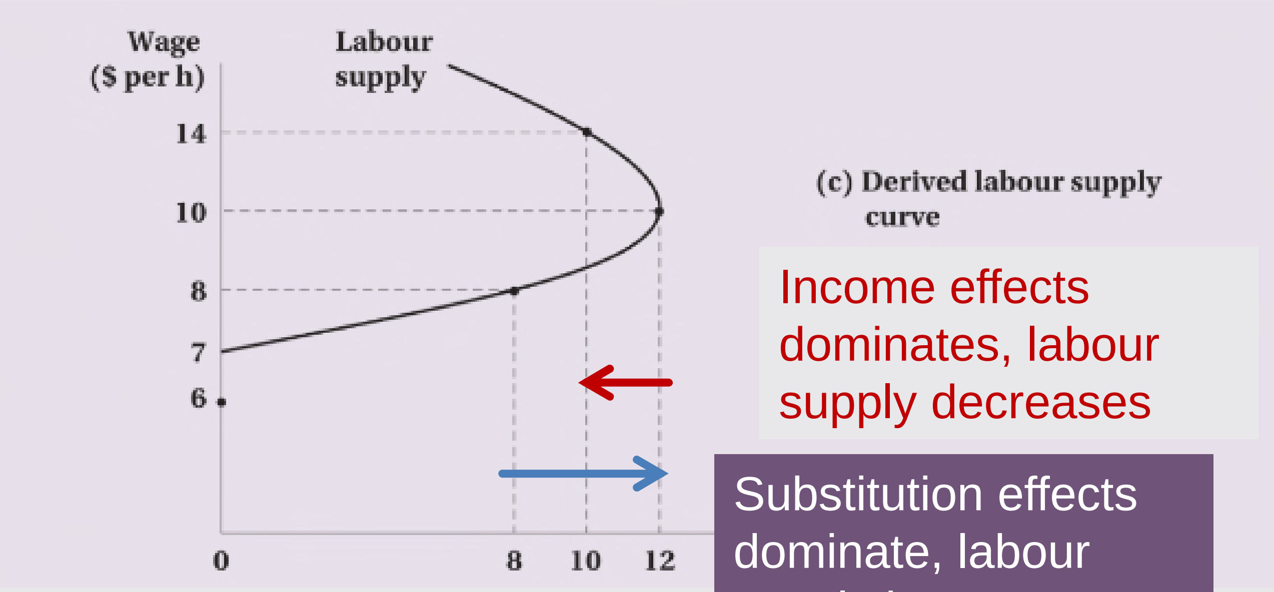


Figure 2.11
Deriving the Individual Supply Curve of Labour



Income effects dominates, labour supply decreases

Substitution effects dominate, labour supply increases

Empirical Evidence

- Testing the Model of Labour Supply
- Two Research Questions
  1. Does labour supply behaviour conform to the predictions of economic theory,
  2. How responsive is labour supply to changes in the wage?

Table 2.2

Labour Force Participation Rates of Married Women, Canada 2011

	Percentage of Married Women	Participation Rate[a]	Raw Difference from Base Group[b]	Adjusted Difference from Base Group[c]
All Women, Total		**76.0**		
Age				
20–24	1.8	86.1	N/A	N/A
25–34	19.4	88.0	1.9	0.6
35–44	23.5	86.2	0.1	1.2
45–54	26.8	84.9	-1.3	-2.0
55–64	21.2	60.2	-25.9	-26.7
65–74	7.3	22.8	-63.3	-61.8
Children, under 18 years old, at home				
No children	55.7	69.2	N/A	N/A
One child	16.7	87.6	18.3	−1.3
Two children	19.9	86.1	16.9	−4.5
Three children	5.8	77.3	8.0	−13.1
Four or more children	2.0	64.7	-4.6	−24.5

Table 2.2

Labour Force Participation Rates of Married Women, Canada 2011 (cont'd)

	Percentage of Married Women	Participation Rate[a]	Raw Difference from Base Group[b]	Adjusted Difference from Base Group[c]
Education				
Less than grade 9	3.6	34.4	N/A	N/A
Some high school	7.0	58.7	24.3	12.0
High school graduate	15.4	65.7	31.2	15.5
Some post secondary	9.8	75.9	41.5	19.7
Non-university, post-secondary certificate	37.8	81.6	47.2	26.7
Bachelor's degree	18.7	83.2	48.8	26.4
Higher than bachelor's degree	7.8	86.9	52.5	30.3
Husband's income				
Under $10,000	7.8	70.1	N/A	N/A
$10,000–$19,999	9.0	68.4	−1.7	8.9
$20,000–$29,999	9.7	67.3	−2.8	4.6
$30,000–$49,999	23.8	75.0	4.9	7.3
$50,000–$74,999	21.0	80.2	10.1	7.4
$75,000–$99,999	14.4	81.5	11.4	5.7

Empirical Evidence

- Evidence of the Elasticity of Labour Supply
  - Uncompensated elasticity
  - Compensated elasticity
  - Income elasticity

Table 2.3
Estimated Elasticities of Labour Supply

Sex	Uncompensated (Gross, Total) Wage Elasticity of Supply	Compensated (Substitution) Wage Elasticity of Supply	Income Elasticity of Supply
Both sexes	0.25	0.40	−0.15
Men	−0.10	0.10	−0.20
Women	0.80	0.90	−0.10

Section Two

Extensions and Applications

Added and Discouraged Worker Effects

- Discouraged worker effects
  - In periods of high unemployment, people may become discouraged from looking for work and drop out of the labour force
- Added worker effects
  - In periods of high unemployment, some may enter the labour force to supplement family income that may have deteriorated with the unemployment of other family members.

Hidden Unemployment

- The discouraged worker effect and the problem of hidden unemployment
- “Secondary” or “marginal” workers

Moonlighting, Overtime, Flexible Work Hours

- Why do some people moonlight at a second job at a wage less than their market wage on their first job?
- Why do some people require an overtime premium to work more?

Figure 2.12:
Fixed Hours Constraint, Underemployment, and Moonlighting
(a) Fixed Hours Constraint

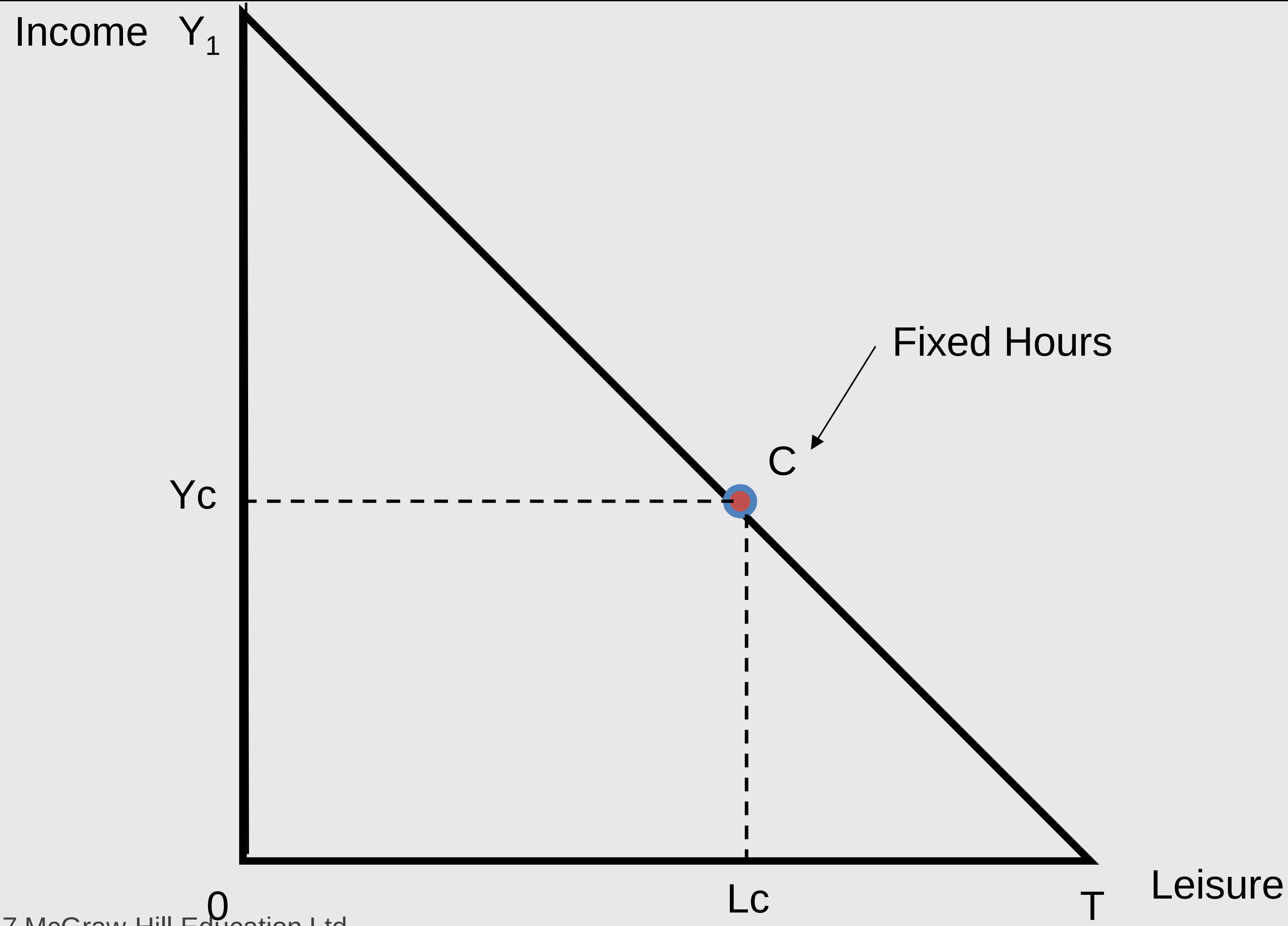
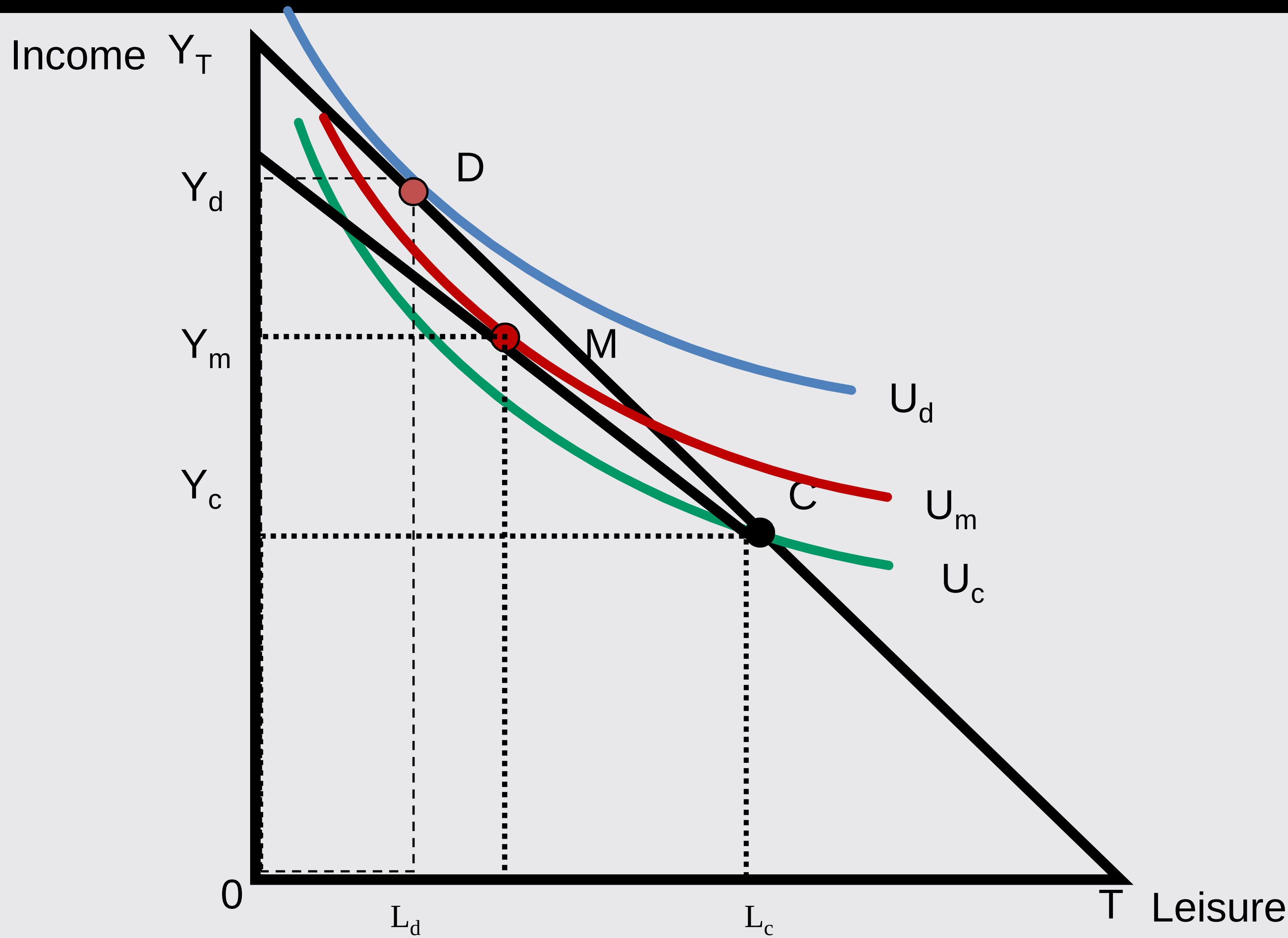


Figure 2.12:
Fixed Hours Constraint, Underemployment, and Moonlighting
(b) and (c) Unemployment and Moonlighting



Overtime and Overemployment

- Workers prefer to work fewer hours at the going wage rate
- Workers are induced to work more hours through an overtime premium

Figure 2.13
Overemployment and Overtime
(a) Overemployment

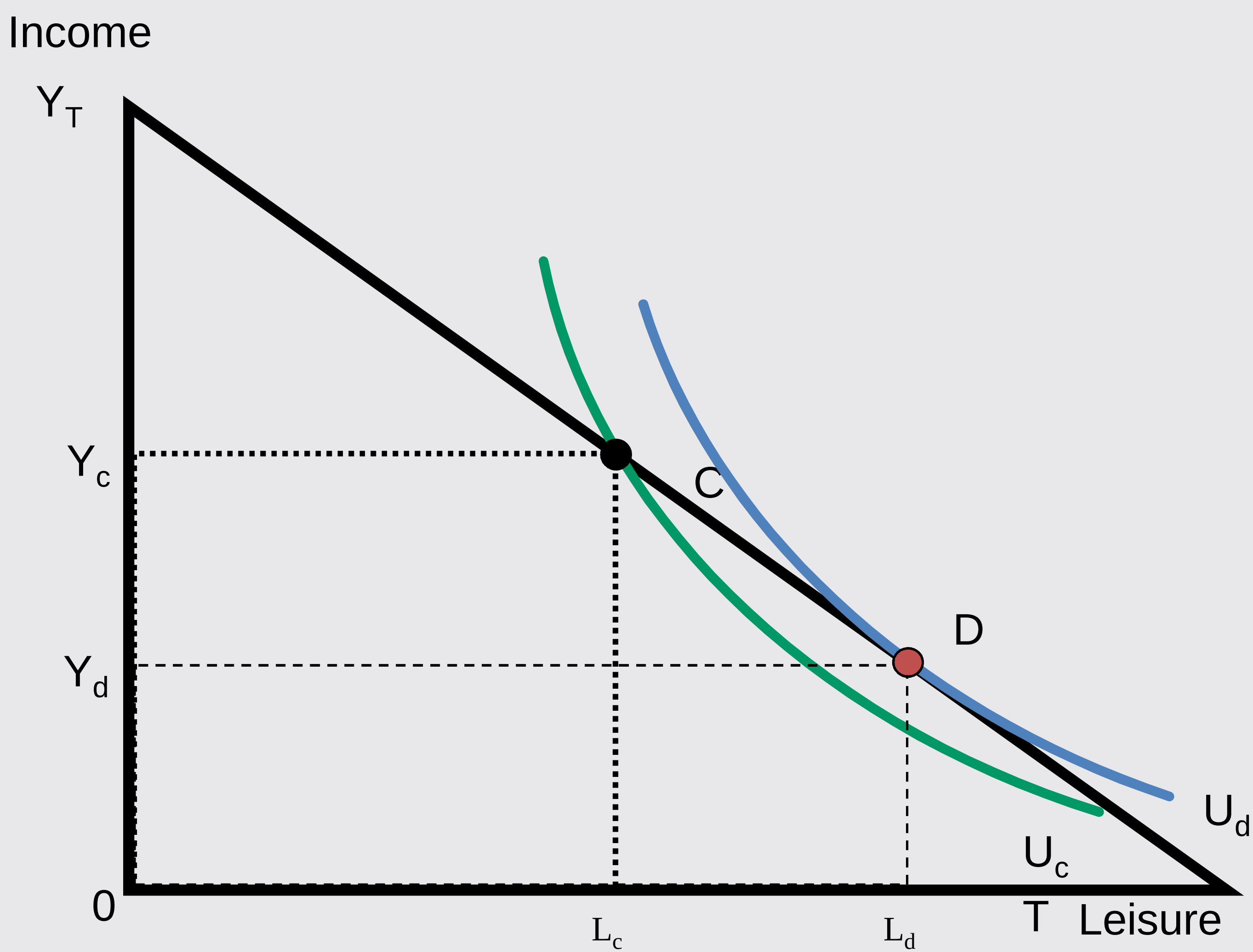


Figure 2.13
Overemployment and Overtime
(a) Overtime

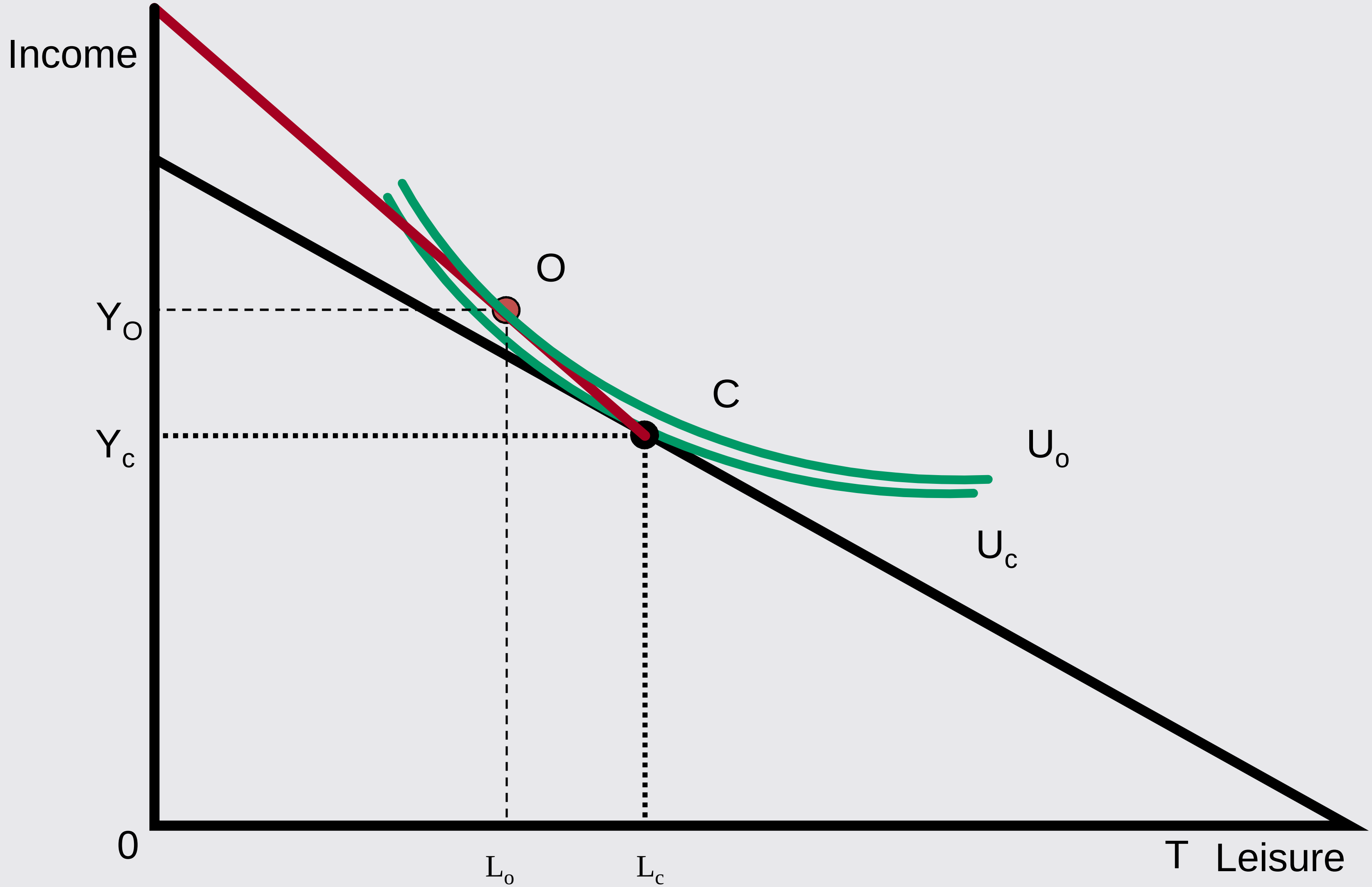
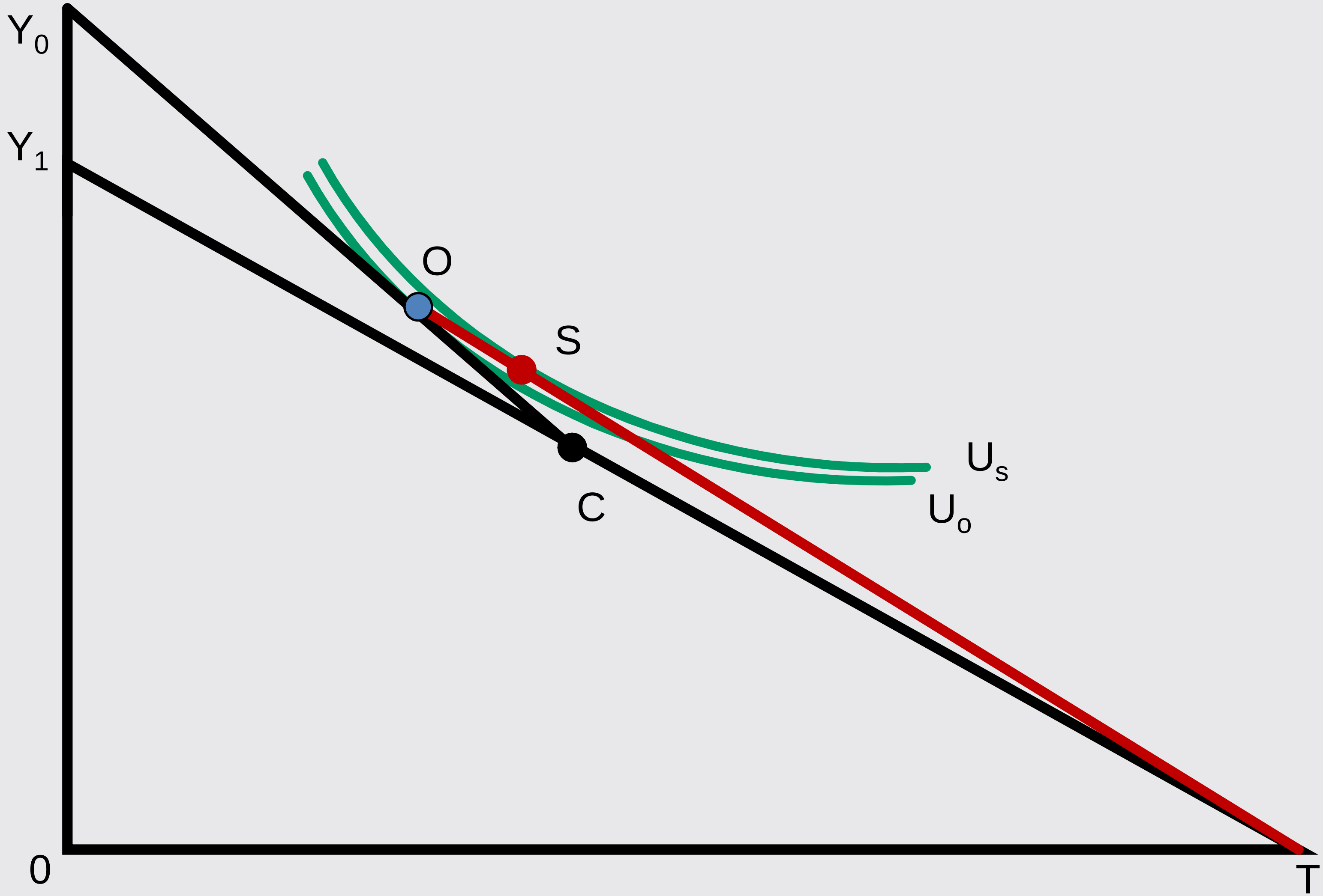


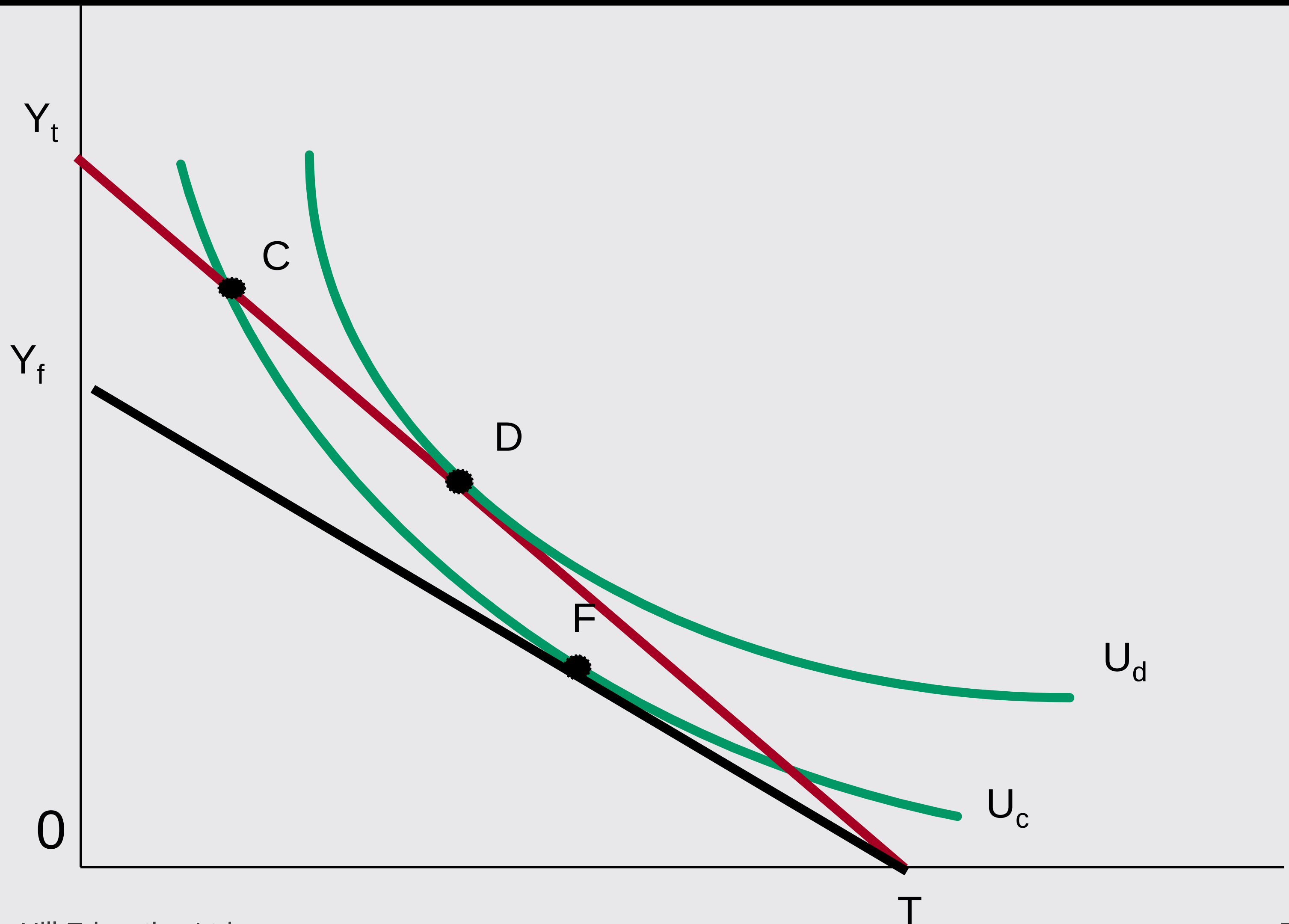
Figure 2.14
Overtime Premium versus Straight-Time Equivalent



Choice in Working Hours

- Different groups with different preferences for work-time arrangements
- Allowing workers to work desired amount of hours saves on costs
- Flex-time and compressed work week

Figure 2.15
Gains from Alternative Work Schedules



Summary

- Two ways of measuring individual attachment to the labour market
- Use of consumer choice theory and income-leisure model to explain labour supply behaviour
- Reservation wage; income and substitution effects
- Labour supply curve
- Extension of the income-leisure model to explain moonlighting, overtime, and flexible working hours

CHAPTER 2

Labour Supply: Individual Attachment to the Labour Market

Answers to End-of-Chapter Questions

1. (LO2, 4) If leisure were an inferior good, which is pretty inconceivable, then there would not be a backward sloping portion to the labour supply curve, even for high wages. Note that according to this question, leisure is still a good; it is not a bad. Whether leisure is a normal or an inferior good is reflected in the form of the indifference map. As the wage rate is increased progressively, the budget line rotates clockwise. In this particular case, the points of tangency move successively to the left, approaching the vertical axis. Referring to figure 2.11b, imagine the tangency with indifference curve U_3 lying to the left of the tangency with indifference curve U_2. The tangency with indifference curve U_4 , which does not appear in the diagram, would lie to the left of the tangency with indifference curve U_3. This implies that the labour supply curve will always slope upwards, as higher wage levels always generate lower levels of leisure.
   (See diagram 2.11of the text).

2. (LO1) The labour force is calculated as the sum of the employed and the unemployed, which in this case is 22,000,000 + 1,000,000 = 23,000,000. The labour force participation rate is calculated as the ratio of the labour force to the working age population: 23,000,000 / 30,000,000 = 77 %. The unemployment rate is calculated as the ratio of the number of unemployed workers to the size of the labour force: 1,000,000 / 23,000,000 = 4.3 %.

3. (LO2, 3) Forget about the indifference curves for this question.

   a. Assuming that you have discretion over how to spend 16 hours out of each day, your time endowment is 16*7 = 112 hours per week. That would be the answer to the first question. Your pre-determined, non-labour income gives the position of the lower right-hand corner of your budget constraint. That indicates how much consumption you can support without working. 122 hours multiplied by your wage plus the non-labour income gives the Y-intercept of your budget constraint. That is the maximum level of income that you can receive. The slope of your budget constraint is the negative of your hourly wage.

   b. Assuming that you have discretion over how to spend 52 weeks per year, that is your time endowment. That would be the answer to the first question. From that information you have to decide how many weeks of vacation you are going to take. Your pre-determined, non-labour income gives the position of the lower right-hand corner of your budget constraint. That indicates how much consumption you can support without working. 52 weeks multiplied by your weekly earnings plus the non-labour income gives the Y-intercept of your budget constraint. That is the maximum level of income that you can receive. The slope of your budget constraint is the negative of your weekly earnings.

4. (LO2)

a. The poor who are at minimum subsistence and who aspire to middle class consumption patterns: This group values income highly relative to leisure, so the indifference curve is relatively flat. As the wage increases, the income constraint line rotates clockwise, and we would expect a relatively large increase in hours worked. This response is dominated by a substitution effect, but there may be a small income effect working in the direction of increased leisure.

b. The wealthy who have acquired an abundance of material goods and who now aspire to be members of the idle rich: This group values leisure highly relative to income earned from wages, so the indifference curve is relatively flat. They would presumably have high non-labour income, which would shift the income constraint line upward in parallel fashion from the bottom right-hand corner. As the wage increases, the income constraint line rotates clockwise, and we would expect a decrease in hours worked. In this income range -- high up and to the left in the leisure-income diagram -- very strong income effects work to outweigh the substitution effect. Recall that for this labour supply model, the two effects always work in opposite directions. This group is on the backward bending part of their labour supply curve.

c. Workers who have a strong attachment to the labour force and who are reluctant to change their hours of work: This situation can be depicted by the intersection between the upper left-hand corner of the income constraint and the highest indifference curve along the vertical axis (provided that the total time endowment available for working is feasible). The indifference curve is flatter than the income constraint line, so the marginal rate of substitution exceeds the wage. For a certain range, an increase in the wage will not cause a change in hours worked, and we could say that the wage elasticity of supply is perfectly inelastic.

d. Workers who have a weak attachment to the labour force and have viable alternatives to labour market work: This case is very similar to case b. If the wage falls, they might drop out of the labour force.

e. Workaholics are defined as those who have very strong preferences for labour market work: They have very flat indifference curves. One can expect a tangency near the vertical axis.

5. (LO4) The basic idea behind this question is that given smoothly sloped indifference curves which are tangent to the wage constraint line at an interior solution (neither all hours devoted to work nor all hours devoted to leisure), changes in the wage rate should

cause marginal and predictable changes in hours worked. For this problem, one is dealing with a situation in which the indifference curve has a kink or bumps in it. Changes in the wage can produce rather abrupt changes in the equilibrium hours worked and income earned. A wage change in one direction (toward the smooth side) will have a marginal effect on the hour's choice, but a wage change in the other direction will have a large effect on the hour's choice. Think of the equilibrium jumping around as you rotate the wage constraint line.

6. (LO4) Any increase in non-labour income shifts the wage constraint line upward. The wage constraint line does not change its slope because there is no change in the wage. Instead, there is a vertical translation (shift) upward. The left-hand vertex intersects the vertical axis at a higher point, while the wage constraint line does not intersect the horizontal axis at all. Recall as well that the reservation wage is the slope of the indifference curve at the point of zero hours worked. Picture a normal indifference map in which the indifference curves are (more or less) radial expansions of each other -- sort of parallel. Now go over to the right-hand edge of the graph, where work hours are zero, and leisure is equal to the entire time endowment. As non-labour income increases, we move to higher and higher indifference curves, and the slope at the edge of these indifference curves increases. In other words, the marginal rate of substitution is increasing as we move up to higher indifference curves and higher income constraint lines. This can be seen because as we reach higher and higher indifference curves along the same vertical line, we move closer to the middle portion of these curves, and as we move from right to left along indifference curves, they become steeper. This result makes intuitive sense. Remember that as we move up in the diagram, people get richer, so their reservation wage can be expected to increase.

7. (LO2, 3, 4) Recall that an under-employed worker is working fewer hours than he/she would like at the going wage. The equilibrium will not be at a point of tangency. Instead, the indifference curve will cut through the budget line to the left of the unconstrained equilibrium (the point of tangency).

   a. An offer to work as many hours as the worker would like at the going wage: she would move back to a tangency between the wage constraint and the highest possible indifference curve, like point D on panel c.

   b. Payment of an overtime premium for hours of work beyond C: An overtime premium implies a kink in the wage constraint at point C. To the left of it, the wage constraint line becomes steeper (not like panel c). If there were no constraint on the number of overtime hours that could be worked, this would probably lead to an equilibrium that dominates D (corresponds to a higher indifference curve than U_d), not to mention the improvement over the constrained equilibrium (the under-employment one) at C in panel d.

   c. An offer to work an additional fixed number of hours, as determined by the employee at the going wage rate: If the employee gets to choose, the equilibrium is the same as in part a.

8. (LO 2, 3, 4)

a. An offer to work as many hours as the worker would like at the going wage: She would move back to a tangency between the wage constraint and the highest possible indifference curve, like point D on indifference curve U_d.

b. Payment of a moonlighting rate for hours of work beyond C: If the moonlighting wage rate is lower than the going wage, there is a kink in the wage constraint line at point C, and the portion to the left rotates downward. This should have no impact on the worker's choice, which would still be D with no constraints and C with the institutionalised work-week. The moonlighting opportunities do not allow him to reach higher indifference curves. Intuitively, at the going wage, he wanted to cut his hours. With a lower wage, he is not likely to want to work these hours.

9. (LO 2, 3, 4) For all three cases, there is at least one kink in the wage constraint line, starting at point C. Consider the slope of the wage constraint line between the right-hand corner and point C. In each case, the wage constraint line becomes steeper. Since we are given no information concerning preferences, for this question we can draw no conclusion regarding what the worker will do. This question concerns only her *opportunities* in the labour market.

a. To the left of the kink, the slope of the wage constraint line is multiplied by 1.5, and is constant until we reach the vertical axis.

b. To the left of the kink, the slope of the wage constraint line is multiplied by 2.

c. There are two kinks in the wage constraint line. The first occurs at point C, and for the next two hours moving from right to left, it looks like the wage constraint line in part a. At that point, there is a second kink, and the wage constraint line gets steeper again. It resembles the one in part b.

Answers to End-of-Chapter Problems

1. (LO 2, 3, 4) This is a neat and doable problem

a. The intercept for the lower, right-hand side of the budget constraint is $5,000. The intercept for the upper left-hand side of the budget constraint is 5,000 + 15*4,160 = $67,400. The slope of the budget line is -$15.00. The equilibrium occurs at the tangency point with coordinates (4,160 – 2,000 = 2,160 hours, 5,000 + 15*2,000 = $35,000).

b. The intercept for the lower right-hand side of the budget constraint is still $5,000. The intercept for the upper left-hand side of the budget constraint is 5,000 + 18*4,160 = $74,880. The slope of the new budget line is -$18.00. The new equilibrium occurs at the tangency point with coordinates (4,160 – 2,040 = 2,120 hours, 5,000 + 18*2,040 = $41,720). In order to obtain the income effect, draw another budget line reflecting a wage of $18.00, which will be parallel to the new budget line but below it, that is tangent to the old indifference curve at a point whose abscissa is 4,160 – 2,200 = 1,960 hours. We do not need to know the income level; we only need to know the values for the number of hours worked. The total effect is 2,040 – 2,000 = + 40 hours. The income effect is 2,040 – 2,200 = -160 hours. That is the difference between the new choice and how many hours he/she would have worked at the old indifference curve had the wage been $18.00. The substitution effect is given as the residual: (2,040 – 2,000) – (2,040 – 2,200) = +200. The general expression for the wage elasticity of supply is the % change in hours worked divided by the % change in the wage. In both cases the % change in the wage is about 18 [(18 – 15)/16.50]. The raw, or the uncompensated wage elasticity of supply, is the total observed % change in hours is: 40/2,020) = 1.8 divided by 18. This elasticity is about 0.1, which is positive but inelastic. The compensated wage elasticity of supply is the change in hours attributed to the substitution effect = (200/2,020) = 10 divided by 18. This elasticity is about 0.54, which is positive, inelastic, but much higher than the raw elasticity. We have netted out the income effect.

2. (LO3, 4, 5) This question pertains to the estimated linear equation of aggregate labour force participation for women. You are asked to interpret the coefficients. It is important to pay attention to the units that are given for each variable, which in turn is very important for the interpretation of the coefficient.

   a. Ceteris paribus, this effect is -7 percentage points. As the husband's expected earnings increase, there is a fairly strong negative effect on the wives' participation rate, which is called a cross-income effect.

   b. Ceteris paribus, this effect is +18 percentage points. As the wife's expected earnings increase, there is a very strong positive effect on the wives' participation. This is primarily attributable to a substitution effect.

   c. We can interpret the effect of the husband's income as a pure effect stemming from non-labour income. Assuming that this cross-income effect is the same as the wife's own-income effect stemming from her own earnings, the substitution effect is +25 percentage points, which is partially offset by an income effect of -7 percentage points. This means that as the wife's earnings increase, the opportunity cost of them not working increases, which induces her to work longer. At the same time, they become richer, and can maintain the living standard while purchasing more leisure. That effect pushes her to work less. The net effect of +18 induces them to work more.

d. According to this equation, it would lead to a net increase of 25 percentage points. The pay cut for the husband would increase the labour force participation of wives, as they have to work more to maintain living standards.

e. We are given no information on the hourly wage, so technically we cannot answer this question. The variables which appear in this equation for expected earnings include both wages and hours worked. For the less precisely defined quantities of uncompensated and the pure elasticities for expected income, the former is 18*(6/35), and the latter is 25*(6/35). We use only the coefficient pertaining to the wife for these 'own' elasticities.

f. Yes it does. The total effect of the expected earnings of women on their labour force participation far outweighs the negative income effect of non-labour income earned by their husbands. As the returns from working for women increased a lot in recent decades, the labour force participation rate increased. The main reason is a substitution effect that dominated the income effects from both earners on women's labour force participation.

3. (LO2, 3, 4) Consider the income-leisure trade-off diagram, as in Figure 2.6a In this case, the horizontal axis runs from 0 to 60 hours per week, which are to be allocated between market and non-market activities. Leisure increases as we move from left to right, while work increases as we move from right to left. The variable on the vertical axis is income. The budget constraint consists only of 2 points for the time being; there is no line segment.

a. Now you can draw a budget constraint whose slope is -7.5. Worker A voluntarily chooses to work 40 hours per week. He/she reaches his/her highest possible indifference curve (call it U_a) at the point (20, $300), with 20 hours of leisure. Left to his/her own devices, worker B would choose the point (40, $150), which is where the income constraint is tangent to worker B's highest possible indifference curve (call it U_b). If he/she is forced to work 40 hours per week, he/she is at the same point as worker A (20, $300), but worker B's indifference curve is not tangent to the income constraint at that point. It must be lower than U_b because we are told that he/she is better off at the point (40, $150). When worker B is forced to locate at (20, $300), there is an indifference curve (call it U_b') that cuts through that point that is lower than U_b. U_b' intersects U_a at (20, $300), and it is steeper, so the marginal rate of substitution is higher for worker B than for worker A. This new indifference curve U_b', however, is higher than another of worker B's indifference curves (call it U_b^*) cutting though the point (60, $0), which corresponds to the point of no work. For worker B, the marginal rate of substitution at the point (20, $ 300) is greater in absolute value than the slope of the income constraint (which is - 7.5) at the point (20, $300). Since it lies above U_b*, we know that this worker will prefer working 40 hours per week to working 0 hours per week, but his/her unconstrained choice is working 20 hours per week. One point to note is that the only time that we obtain a tangency equilibrium is if the worker is not constrained in his/her choice of hours to work, but does decide to work a positive number of hours.

b. It is a common practice in the real world for the contractual part-time wage to be lower than the full-time wage. In this model, note that the indifference curve is flatter at the equilibrium for part-time work than is the case for full time work. Recall that the slope of the indifference curve gives the marginal rate of substitution between income and leisure for the worker in that range of weekly hours. At the part-time point, the worker values one more hour of leisure less than is the case at the full time equilibrium, so consequently he/she is willing to pay less for that extra hour of leisure in the form of the forgone wage. This translates into a lower a lower wage as far as the worker's choice is concerned. In order to generate a lower market wage, however, one would still have to analyse the demand side of the labour market, which emanates from employers.

4. (LO3, 4) We are given the formula for the marginal rate of substitution of leisure for income (or consumption, since there is a one-for-one trade-off between the two of them). The MRS is the slope of the indifference curve. The formula that appears is actually the absolute value of the MRS, since that expression must be positive (A(x) must always be positive, and C and l must always be non-negative), and the indifference curves have a negative slope.

a. As we move from left to right, the amount of leisure increases, while A(x) remains constant, and the value of C falls. This implies that the value of the MRS decreases. The interpretation is that as the worker consumes more and more leisure, he/she values the marginal hour of leisure less and less, and is willing to trade off less and less income. The variables (labelled X) which might affect the MRS are the number of children that the woman has, as well as their ages, her level of education, and her marital status (tied with her husband's income).

b. Recall that the reservation wage is equal to the slope of the indifference curve at the lower right-hand corner solution, which corresponds to the situation in which no hours are worked. If $h = 0$, the number of hours worked, then all of the time endowment T goes to leisure. We can thus write: $MRS = A(x) C / T = w^*$. In order for this woman to participate in the labour market, the market wage has to exceed the reservation wage, so we can write: $w > A(x) C / T$. Taking the natural logarithm of both sides of the equation yields: $\ln w > \ln (A(x)) + \ln C - \ln T$. Since the logarithmic operation is the inverse of the exponential operation, and at the corner solution, C = non-labour income (y), and we obtain the desired result. The log of the time endowment T can probably be interpreted as a constant across almost all women, and so it can probably be ignored at this stage of the problem.

c. We treat Z as a random variable which is distributed normally. That means that it has mean zero and a variance of unity. The graph has a bell shape on a diagram with the probability density of the vertical axis and the values of Z on the horizontal axis. Any factor which raises Z makes labour force participation more likely. The form of that distribution, however, is not really the focus of this question. An increase (decrease) in non-labour income ln Y would shift the income constraint upward (downward), making participation less (more) likely. An increase (decrease) in ln W would rotate the income constraint upward (downward), making participation more (less) likely. The impact of the taste shifters depends on whether the sign of the beta coefficient is positive or negative. They have the effect of changing the slope of the indifference curve.

5. (LO5)

a. An increase in the education of women: this should increase their labour supply. As they become more educated, their labour market opportunities improve, and their potential wage level increases. We would expect more women to join the labour force. For those already working, until a certain income threshold has been reached, the opportunity cost of not working has increased. A substitution effect should lead to an increase in labour supply.

b. A more equal sharing of household responsibilities between husband and wife: this should lead to an increase in labour supply as the time endowment for them to allocate between market work and leisure has increased.

c. A reduction in the average number of children: this should lead to an increase in labour supply as the time endowment for them to allocate between market work and leisure has increased.

d. An increased tendency to have children spaced more closely together: this should lead to an increase in labour supply as the time endowment for them to allocate between market work and leisure has increased (at least over the longer time horizon of their working life. In the immediate term, it might reduce their labour supply.)

e. An increase in the earnings of husbands: in theory, this should reduce their labour supply by increasing their own non-labour income. An income effect would work to reduce the number of hours worked.

f. Day care paid out of general tax revenues: this should greatly increase labour supply as the opportunity cost of not working has increased a lot. No longer does a substantial share of the wage earned by the mother go to the care-giver. In effect, they receive a big pay raise. There should be a strong substitution effect giving rise to more hours worked.

g. Allowing day care expenses to be tax deductible: basically the same response as part f, although not quite as significant.

h. Paying housewives a fixed sum out of general tax revenues for household work: this increases non-labour income earned away from the labour market. The slope of the wage constraint line does not change, but the time endowment decreases. One would expect a reduction in labour supply.

6. (LO5)

a. For this case, we assume that the husband continues to work 40 hours per week, or 8 hours per day. This implies that his labour income falls from $160 to $120 per day. For the income-leisure choice diagram of the wife, refer to figure 2.7b. The initial value of Y_n is $160, and the coordinates of point A are (T, $160). The budget line has a slope of - 10. There is a solution at point E_0. Next, the budget shifts down in parallel fashion such that the coordinates of the right endpoint are (T, $120). There is a new equilibrium that lies to the south-west of the original one. It involves a lower amount of labour income and a higher number of hours worked for the wife.

b. In this case, we allow for the possibility that the husband might react to having his wages cut by altering the number of hours that he works. In his income-leisure choice diagram, the slope of the budget line changes from -20 to -15, which means that it becomes flatter. If the substitution effect dominates the income effect, he will work fewer hours, and he will earn much less income than before. If the income effect dominates the substitution effect, he will work longer hours, and he will be able to recoup some or all of his lost income. We are not given the information that is required to solve this problem. Until we know what his labour income is, we do not know what the wife's non-market income is, so we cannot say much about how she reacts to the wage cut that is imposed on her husband.

c. If the husband collects unemployment insurance (UI), he has to stop working on the labour market. The wife's non-labour income falls from $160 to $40 per day, and we repeat the analysis in part a) with a major downward shift in the wife's budget line. She is likely to work many more hours. On the other hand, the husband does gain 8 hours of leisure per day by going on UI.

7. (LO4) Susan is wrong. Although she does not know it, she is essentially saying that income effects are extremely important for her labour supply choice, as she will work as many hours as required in order to maintain a certain level of earnings. The graph will resemble the one in figure 2.9, except that the new equilibrium point E_1 lies to the right of the original equilibrium point E_0 at the same horizontal level (so as to give the same income level as before). The original equilibrium is E_0, where the income constraint is tangent to indifference curve U_0. Given the wage increase, the income constraint rotates clockwise, and is tangent to the higher indifference curve U_1 at the equilibrium point E_1. Retain the same upper budget line that you see in the figure, but picture the indifference curve U_1 such that its tangency lies further down on the budget constraint such that E_1

lies on the same horizontal as E_0. Draw a vertical line down from this point such that l_1 lies to the right of l_0. She is better off with the wage increase, as U_1 lies above U_0. The total effect on work hours is negative in this case, as leisure hours rise from l_0 to l_1 on the horizontal axis. To decompose this total effect of a wage increase into the substitution effect and the income effect, create a notional budget constraint that is parallel to the new one (the dotted line in that diagram), and place it along the first indifference curve U_0. E' gives the notional equilibrium. The distance along the indifference curve U_0 between the old equilibrium point E_0 and E' gives the substitution effect (l_0 to l', as in the diagram), while the distance between the final equilibrium E_1 and the notional equilibrium E' gives the income effect (l' to l_1). Note that the income effect is in the opposite direction (as usual, because leisure is a normal good), and that in this case it greatly outweighs the substitution effect. This means that Susan can and will work fewer hours following the wage increase in order to satisfy her needs and desires.
(See Figure 2.9 of the text)

8. (LO2, 3, 4)

a. For the income-leisure choice diagram, refer to figure 2.7b in the textbook and the accompanying graph. The initial value of Y_n is \$100, and the coordinates of point A are (T = 60, \$100). The budget line has a slope of -5. There is a solution at point E_0, which in this case is the point (leisure = 20, \$300) Labour market income is 40*5 = \$200.

b. For the income-leisure choice diagram, refer to figure 2.7b in the textbook. As the effective wage is now cut in half, the budget line has a slope of -2.5, but it still has the right endpoint (T = 60, \$100). There will be a tangency at an indifference curve which is lower than the original indifference curve. Call this final point of tangency E_1. We do not know exactly what the resulting number of hours worked will be, but we do know that he will be worse off than before. Draw a hypothetical (dashed) budget line with slope -2.5 which is tangent to the higher, original indifference curve at point E'. The horizontal distance between the two points of tangency on the higher indifference curve gives the substitution effect, and its direction is left to right. The horizontal difference between the final tangency E_1 and the hypothetical tangency E' is the income effect, and its direction is right to left. The horizontal distance between the original and the final tangency points is the total effect of the wage cut on his labour supply, or the difference between the two equilibria that we observe.

c. This event is not depicted on the graph because it becomes very crowded. George will pay only one of these taxes at a time, so the problem asks us to compare their effects on his labour supply using the same diagram. The poll tax has the effect of shifting the original budget line down in parallel fashion. It is the equivalent of cutting George's allowance. Taking the original budget line with a slope of -5, shift it down by the amount of taxes that George was paying in part b). This is given by the net income level that he was earning in part b). (Recall that he kept half of his earnings and forked over the other half to his caretaker.) The equilibrium should lie to the left of the equilibrium in part b), with more hours worked and less leisure taken. George will be worse off than he was in part a. The idea is that the poll tax gives George greater incentives to work. It produces only an income effect, which will actually raise work effort if leisure is a normal good. There is no substitution effect in this case.