Answers To Chapter 7

■ Review Questions

1. **Answer d.** In the household production model, income is assumed to be spent on market-purchased goods and services. Time spent in home production yields commodities that the individual or family consumes, and leisure is also a consumption good. Thus three types of goods enter the utility function: market goods, household goods, and leisure.

2. **Answer a.** Each indifference curve represents a tradeoff between income (market goods) and household production time (time spent producing household goods or consuming leisure).

3. **Answer a.** The magnitude of the slope is given by the wage rate, and the height of the constraint at the maximum amount of time available equals the level of nonlabor income.

4. **Answer c.** The income effect of the wage increase creates an incentive to spend more time in household production (and leisure consumption), while the substitution effect creates an incentive to spend less time in household production activities.

5. **Answer d.** An increase in the wage increases the opportunity cost of both household production and leisure time, creating an incentive to reduce both. On the other hand, for any given amount of work (except zero hours) an increase in the wage leads to an increase in income. This allows an individual to buy more of all goods, including leisure and any commodities produced at home. The greater the demand for household-produced commodities, the greater the incentive to spend time in home production.

6. **Answer c.** If a were true, household production time would have decreased. If b were true, leisure time would have decreased.

7. **Answer d.** In addition, for women’s total market work hours to have increased, the net effect on market work hours resulting from a must have been strong enough to overcome the net effect on work hours resulting from b.

8. **Answer a.** When time and goods are easily substitutable, the substitution effect of a wage change tends to be large. When time and goods are used complementarily or in fixed proportions, the substitution effect of a wage change tends to be small.

9. **Answer c.** A household’s total production will be maximized when the spouse with the lowest net gain from market work stays home. For example, suppose spouse A can earn $12 per hour in the market and produce the equivalent of $6 per hour at home, while spouse B can earn $15 per hour in the market and produce the equivalent of $10 per hour at home. Even though spouse B can earn more in the market, the net gain to the household of having B work is only $5, while the net gain to having A work is $6. For every hour A works and B stays at home, the household produces the equivalent of $22, while having B work and A stay at home would result in only $21.
10. **Answer d.** This condition ensures that the household will attain at least the same level of utility as before the extra hour of work.

11. **Answer c.** If the wife’s increase in work hours increases the husband’s marginal productivity at home, the net gain to the husband from working will decrease and the incentive to substitute household production for market work will increase.

12. **Answer d.** If the husband’s marginal productivity at home does not decrease because of the health problem, the drop in the wage will make him relatively more productive at home, increasing his incentive to work at home. If the husband’s time at home is a substitute for the wife’s, this would decrease her marginal productivity at home and increase the net gain associated with her market work.

13. **Answer d.** The expected wage $E(W)$ is given by the equation $E(W) = \pi W$ where $\pi$ is the probability of finding a job and $W$ is the wage of the job. During a recession $p$ falls, reducing the expected wage of the unemployed person. The change in the expected wage lowers the expected gain from job search. This lowers the opportunity cost of time at home and creates a substitution effect that can cause the person to stop allocating any time to job search activities.

14. **Answer d.** The reduction in the effective wage and the increase in family income creates reinforcing income and substitution effects that will cause more total time to be allocated to household production. However, it is at least possible that with more total time devoted to household production, the husband’s household marginal productivity may increase so much that the wife’s net gain from market work may exceed his. This would create a situation where she would be the one to work for pay, provided the family continues to have an incentive to supply hours to the market.

15. **Answer b.** Although the other factors would also tend to increase the labor force participation rates of married women, those factors have been changing rather steadily, and hence could not explain the large increase observed after age thirty.

16. **Answer c.** If the path of wages is anticipated, workers can form an estimate of lifetime wealth. Then, as anticipated wage changes occur, there will be no change in the estimate of lifetime wealth and no income effect will be experienced. Higher wages do, however, change the opportunity cost of leisure, resulting in a substitution effect in favor of more hours of work.

17. **Answer d.** If lifetime benefits remained constant as the retirement age increased, remaining lifetime earnings would rise at a constant rate as the retirement age increased. In terms of Figure 7-1 from the Summary section, the budget constraint connecting points $a$ through $f$ would now be a straight line rather than a concave curve. Although point $a$ would remain the same, the rest of the curve would rotate outward slightly and straighten as the vertical intercept rose from $195,000$ to $220,000$. This would create opposing income and substitution effects. The retirement age would decrease only if the increase in the demand for leisure resulting from the change in the position of the constraint (the income effect) dominated the increased incentive to work coming from the higher effective wage rate (the substitution effect).
### Problems

18a. Notice that the isoquant for family 2 is drawn with less convexity than the one for family 1. This means that for family 2, household goods and market goods are traded off at roughly a constant rate. This means that family 2 sees household goods and purchased goods as easily substitutable. On the other hand, the isoquant for family 1 is relatively convex. This means that family 1 sees household goods and purchased goods as not as easily substitutable.

18b. See Figure 7-5. The substitution effect can be observed by allowing the budget constraint to rotate outward in response to the higher wage, and then pulling it back so the family just attains its old level of utility. The movement along the original indifference curve will reflect the family’s response to just the change in the opportunity cost of time, and therefore can be interpreted as the substitution effect of the wage change.

![Figure 7-5](image)

In Figure 7-5, the substitution effect for family 1 is the movement from point $c$ to point $e$, while the substitution effect for family 2 is the movement from point $c$ to point $d$. Since family 2 sees time and goods as more substitutable, it is not surprising that the change in the opportunity cost of household time resulted in a larger decrease in household hours.

19a. $H = 4 \Rightarrow N = 12$ and $Y = ($10)(4) = $40. $N = 12$ and $Y = 40 \Rightarrow U = 480$.

19b. $Y$ rises to $80$ for an increase of $40$.

19c. With $H$ increasing to 8 hours, $N$ falls to 8 hours. To keep $U$ at 480, $Y$ would have to rise to $60$. This represents an increase in income of $20$.

19d. Since income would only have to rise by $20$ to compensate for the decrease in household hours, the increase of $40$ that actually takes place will make the family better off.
19e. Under the new ranking formula, the original combination of $N = 12$ and $Y = $40 yields a utility level of $(12^2)(40) = 5760$. When $H$ rises to 8 and $N$ falls to 8, $Y$ must rise to $90$ to keep $U$ at 5760. This represents an increase of $50$. Since the increased work hours bring in only $40$, this move would make the family worse off. Given the presence of the child, the extra hour of work makes the family worse off.

19f. If $H$ equals 8, then $N$ equals 8 and $Y$ equals $80$. This means that the original level of utility is now 640. If $H$ increases to 9, $N$ decreases to 7 and $Y$ increases to $90$. Under this utility function, this combination receives a lower ranking of 630.

19g. Under the new ranking formula, the original combination of $N = 8$ and $Y = $80 yields a utility level of $(8)(80^2) = 51,200$. When $H$ rises to 9 and $N$ falls to 7, $Y$ rises to $90$, and the new ranking rises to 56,208. Given the new technology, the extra hour of work makes the family better off.

20a. A household’s total production will be maximized when the spouse with the highest net gain from market work is the one who works for pay. Even though the wife is more productive at home than the husband, the net gain to the household of having the wife work is $5$, while the net gain to having the husband work is $3$. For every hour the wife works and the husband stays at home, the household produces the equivalent of $32$, while having the husband work and the wife stay at home would result in only $27$.

20b. Yes, since an extra hour of market work allows each to buy at least enough goods and services to compensate for the hour of lost production time at home.

20c. An increase in the wife’s wage would decrease her work hours if the income effect of the wage increase dominated the substitution effect. On the other hand, work hours would increase if the substitution effect of the wage increase dominated the income effect. Empirical studies suggest that the latter is the more common occurrence for women. The income effect associated with the wife’s wage increase reduces the husband’s incentive to work for pay provided there are no cross effects on the husband’s household marginal productivity or the marginal utility that the husband derives from household consumption.

20d. If the husband and wife are substitutes in household production, an increase in the wife’s work hours will increase her household marginal productivity, creating an incentive for the husband to spend more time in household production and less time in market work.

20e. If the husband and wife are complements in the consumption of household commodities, an increase in the wife’s work hours will decrease the utility the husband derives from the additional consumption of household commodities and create an incentive to spend more time in market work.

21a. $H = 7 \Rightarrow N = 9$ and $Y = ($5)(7) + $10 = $45$. $N = 9$ and $Y = $45 $\Rightarrow U = 405$.

21b. $H = 0 \Rightarrow N = 16$ and $Y = $10. $N = 16$ and $Y = $10 $\Rightarrow U = 160$.

*21c. The return to taking an hour away from household production activities to look for work is the expected wage $E(W) = \pi W$ where $\pi$ is the probability of finding a job.
*21d. One hour of job search yields an expected payoff of \((0.5)($5) = $2.50\), which raises the expected income to \(Y = $2.50 + $10 = $12.50\). The level of utility associated with \(N = 15\), and an expected value of \(Y = $15\) is \((15)(15) = 225\). When compared to the utility associated with not looking for a job \((U = 160)\), one hour of job search is a good move. When a person is unemployed but looking for a job, he is a member of the labor force.

*21e. One hour of job search now yields an expected payoff of \((0.1)($5) = $0.5\), which raises the expected income to \(Y = $0.50 + $10 = $10.50\). The level of utility associated with \(N = 15\), and an expected value of \(Y = $10.50\) is \((15)(10.50) = 157.5\). When compared to the utility associated with not looking for a job \((U = 160)\), one hour of job search is not a good move. When a person drops out of the labor force because of the reduced probability of finding a job, she is categorized as a discouraged worker.

*21f. One hour of job search yields an expected payoff of \((1/3)($2) = $0.667\), which raises the expected family income to \(Y = $0.667 + $10 = $10.667\). The level of utility associated with \(N = 15\), and an expected value of \(Y = $10.667\) is \((15)(10.667) = 160\). Since the utility associated with not looking for a job \((U = 160)\) is the same, the person will be completely indifferent about looking for a job.

### Applications

22a. See Figure 7-6. The substitution effect can be observed by allowing the budget constraint to rotate outward in response to the higher wage (line \(ad\)), and then pulling it back (line \(ef\)) so the individual just attains his or her old level of utility. The resulting movement along the original indifference curve will reflect the individual’s response to just the change in the opportunity cost of time, and therefore can be interpreted as the substitution effect of the wage change. In Figure 7-6, there is no response to the change in slope since the optimum remains at point \(c\). The substitution effect is zero.

![Figure 7-6](image_url)
22b. See Figure 7-7.

The substitution effect can be observed by allowing the budget constraint to rotate outward in response to the higher wage (line $ac$), and then pulling it back (line $de$) so the individual just attains his or her old level of utility. The resulting movement along the original indifference curve will reflect the individual’s response to just the change in the opportunity cost of time, and therefore can be interpreted as the substitution effect of the wage change. In Figure 7-7, the individual moves from point $a$ to point $e$ in response to the change in slope. The substitution effect is a reduction in household work of the full 400 hours available.

![Figure 7-7](image)

22c. Figure 7-3 is a better model of the choice between market work and leisure because the tradeoff between income (purchased goods) and leisure that underlies the choice is inherently one where the substitution possibilities are limited. Purchased goods and leisure are usually utilized in a complementary manner.

22d. Figure 7-4 is a better model of the choice between market work and household production time because the tradeoff between purchased goods and household production time that underlies the choice is one where goods and services can be readily substituted for household time.

22e. If purchased goods and household production time are highly substitutable, Figure 7-7 shows that wage increases can be associated with very large substitution effects that lead to household production time being reduced dramatically in favor of market work. Since women have traditionally been responsible for most household production activities, it seems likely that as their wages have increased over time, they may have experienced these rather large substitution effects that could easily dominate any income effect associated with the wage increase. For men, who have traditionally been primarily consumers of household production, the wage increases would create primarily an income effect that would lead them to consume, and perhaps help supply, more household production.

At the same time, Figure 7-6 shows that wage increases may be associated with very small substitution effects from the point of view of the labor/leisure choice. For this choice, the income effect will almost surely dominate the substitution effect leading to more leisure and less market work. This should probably be true for both men and women. However, since the increase in market work that comes from the substitution away from household production will be so large for women, it could easily overcome the tendency toward less market work that comes out of the choice between market work and leisure. Given this strong tendency to reduce household work, it seems very clear that women could increase their leisure time and at the same time still increase their market work substantially. For men, however, the income effect appears likely to dominate the substitution effect in the context of both choices, thereby leading to more leisure and household production, and less market work.
23a. The curve is concave because lifetime Social Security benefits do not remain constant as the retirement age increases. Yearly benefits increase with retirement age, but not enough to overcome the reduced number of years over which the benefits will be received, so that older retirees are penalized with lower lifetime benefit levels.

For the points a through f in Figure 7-1 to lie along a straight line, yearly Social Security benefits would have to be set at the levels listed in Table 7-3.

Table 7-3

<table>
<thead>
<tr>
<th>Retirement age</th>
<th>Yearly social security</th>
<th>Lifetime social security</th>
<th>Lifetime earnings</th>
<th>Total lifetime income</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>8</td>
<td>120</td>
<td>0</td>
<td>120</td>
</tr>
<tr>
<td>66</td>
<td>8.57</td>
<td>120</td>
<td>20</td>
<td>140</td>
</tr>
<tr>
<td>67</td>
<td>9.23</td>
<td>120</td>
<td>40</td>
<td>160</td>
</tr>
<tr>
<td>68</td>
<td>10</td>
<td>120</td>
<td>60</td>
<td>180</td>
</tr>
<tr>
<td>69</td>
<td>10.91</td>
<td>120</td>
<td>80</td>
<td>200</td>
</tr>
<tr>
<td>70</td>
<td>12</td>
<td>120</td>
<td>100</td>
<td>220</td>
</tr>
</tbody>
</table>

Plotting the retirement age against the total remaining lifetime income figures in the last column of the table would then yield a straight line. Point a would retain its current position and the vertical intercept (point f) would increase to $220,000.

23b. The rotation of the constraint described in the answer to 23a would create opposing income and substitution effects. The retirement age would decrease only if the increase in the demand for leisure resulting from the change in the position of the constraint (the income effect) dominated the increased incentive to work coming from the higher effective wage rate (the substitution effect).

Using the same ranking formula as in the Example, Table 7-4 was constructed.

Table 7-4

<table>
<thead>
<tr>
<th>Retirement age</th>
<th>Leisure years (L)</th>
<th>Lifetime income (Y)</th>
<th>Utility ranking (U = LY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>15</td>
<td>120</td>
<td>1,800</td>
</tr>
<tr>
<td>66</td>
<td>14</td>
<td>140</td>
<td>1,960</td>
</tr>
<tr>
<td>67</td>
<td>13</td>
<td>160</td>
<td>2,080</td>
</tr>
<tr>
<td>68</td>
<td>12</td>
<td>180</td>
<td>2,160</td>
</tr>
<tr>
<td>69</td>
<td>11</td>
<td>200</td>
<td>2,200</td>
</tr>
<tr>
<td>70</td>
<td>10</td>
<td>220</td>
<td>2,200</td>
</tr>
</tbody>
</table>

Table 7-4 shows that the optimal retirement age increases to 69 (or 70), indicating that the substitution effect of the change dominated the income effect. (If it were possible to retire at half-year increments, the optimal retirement age would be 69.5 since 11.5 remaining years and a remaining income of $210,000 would yield a ranking of 2,415.)
24a. See the line $adefb$ in Figure 7-8. The person receives no benefits when he or she works 1,610 hours (1,390 hours allocated to household production) and earns a total of $32,200 (point $f$).

![Figure 7-8](image)

24b. See the line $adegb$ in Figure 7-8. The person receives no benefits when he or she works 2,160 hours (840 hours allocated to household production) and earns a total of $43,200 (point $g$).

24c. For a person working 1,000 hours (point $h$) the reduction in the implicit tax rate would create counteracting income and substitution effects. The person would receive a higher benefit, creating an income effect which would reduce the incentive to work. However, the effective wage would also rise, creating a substitution effect which would increase the incentive to work. For a person working 1,800 hours (point $i$), the reduction in the implicit tax rate would make the person eligible to receive benefits. This in turn would create reinforcing income and substitution effects. The person would receive a higher benefit, creating an income effect which would reduce the incentive to work. In addition, the effective wage would also be reduced, creating a substitution effect which would further decrease the incentive to work.

24d. Reducing the rate at which benefits are scaled back increases the amount of benefits paid out and so most likely would require increased payroll taxes on all those working. For a worker like the one at point $h$, the increase in taxes should roughly offset the increase in benefits so that lifetime wealth will remain unchanged. The payroll tax, however, decreases the effective wage during the working years, while the reduction in the implicit tax rate increases the wage after retirement. With expected lifetime wealth constant, this should lead the person to reduce market work during their younger years and increase market work after retirement.