Chapter 6
Supply of Labor to the Economy:
The Decision to Work

Summary

The number of hours an individual actually works is something jointly determined by employers and employees. Chapter 5 discussed factors affecting the number of hours a firm requires its employees to work. This chapter looks at factors affecting the number of hours employees wish to work. While one may not usually think of hours of work as something individuals control, choices can be made which influence the total number of hours worked, particularly over longer time periods. The decision to participate in the labor market, the decision to seek part-time or full-time work, and the number of jobs a person works are important ways in which individuals affect the supply of labor. The choice of occupation will also affect an individual’s total hours, as will vacations, leaves, and absenteeism.

Two notable trends in labor force participation in the U.S. and other developed countries are the increase in the participation of women, particularly married women, and the decrease in the length of working life for men. Other trends include the decrease in the length of the work week and changes in the flexibility of work hours.

Given that individuals have some discretion over the supply of labor, what kinds of factors affect the choices they make? In answering this question the approach that is taken in this chapter is to view the individual’s supply of labor hours as the total time available less the individual’s demand for leisure time. Here, leisure time refers simply to any time not spent working for pay, i.e., it does not necessarily have to be time spent in a relaxing or enjoyable manner. By thinking about labor supply in this way, it is possible to analyze the demand for leisure hours—and inversely, the supply of labor—much like one would analyze the demand for food, clothing, or any other good that households regularly consume.

The standard approach to modeling consumer demand is to assume that an individual chooses between two goods so as to maximize happiness, or utility, subject to a budget constraint. Any particular level of utility can be represented graphically by an indifference curve, a curve that represents all different combinations of the two goods that yield equal satisfaction. The maximization process can be represented graphically as an individual trying to attain the highest possible indifference curve subject to a budget constraint. The result of this maximization process yields the demand function for each good, where this function relates the desired quantity of the good to the opportunity cost of the good, the level of household wealth, and the particular preferences of the person. In the labor supply model, the two goods are assumed to be leisure and income (which represents the consumption of all other goods at fixed prices). The demand for leisure can eventually be expressed in terms of the wage rate, the amount of nonlabor income the individual receives, and certain parameters representing the individual’s willingness to trade off leisure and income.
In constructing the individual’s labor supply curve, we ask: what happens to the number of hours the individual wishes to supply when the wage rate changes, holding all else constant? In the case of a wage increase, the opportunity cost of leisure time increases, so the number of leisure hours demanded decreases, increasing hours of labor supplied. This is called the substitution effect of a wage increase. However, as the wage rate increases, the individual is also wealthier for any given number of hours of work beyond zero. An increase in wealth allows an individual to consume more of all normal goods, including leisure, decreasing the number of hours of labor supplied. This effect of a wage increase is called the income effect.

In general, the substitution effect refers to the individual’s response to a change in the opportunity cost of the good, holding all else constant, while the income effect refers to the individual’s response to a change in wealth, holding the opportunity cost of the good constant. Since for leisure the substitution and income effects of a wage change typically oppose one another, whether the labor supply schedule is upward or downward sloping depends on the relative magnitude of the two effects. What drives the size of the income and substitution effects? Because normal preferences, with convex indifference curves, exhibit a changing marginal rate of substitution between income and leisure, the number of hours a person already works is important. Generally, the more a person is already working, the more valuable a marginal hour of leisure will be and hence the larger the income effect. The substitution effect grows larger when leisure and work hours are viewed as being highly substitutable. This could happen when the individual’s leisure time consists largely of work around the home.

**Example 1**

Suppose an individual ranks combinations of leisure \( (L) \) and income \( (Y) \) according to the formula

\[
U = L^\alpha Y^\beta.
\]

\( U \) denotes the utility level, or happiness ranking (higher levels of \( U \) are better), the individual places on the particular combination of leisure and income. The symbols \( \alpha \) and \( \beta \) are constants greater than zero and represent the relative importance the individual places on leisure and income. Such a formula is called a **Cobb-Douglas utility function**. Letting \( W \) stand for the wage rate, \( H \) the number of work hours, \( T \) the total time available, and \( V \) nonlabor income, the budget constraint an individual faces can be written as

\[
Y = WH + V \Rightarrow Y = W(T - L) + V.
\]

Maximizing \( U \) subject to the budget constraint yields the following expression for the **optimal value of \( L \)**

\[
L^* = \frac{\alpha WT + V}{\alpha + \beta W}.
\]

(For the reader with calculus training, this expression can be derived using the method of Lagrangian Multipliers; or by substituting the budget constraint into the utility function and then maximizing the resulting function.) Note that this expression applies only for the Cobb-Douglas utility function used in this example. If one changes the formula depicting preferences, the expression for the optimal value of \( L \) also changes.

Suppose the individual gives equal weight to units of leisure and income and that \( \alpha \) and \( \beta \) are both equal to one. Assuming the analysis pertains to one month and that \( T = 400 \) hours, \( W = 4 \), and \( V = 400 \), then the optimal value for \( L \) is

\[
L^* = \frac{1}{1+1} \frac{(4)(400) + 400}{4} = 250.
\]
This, in turn, implies that the number of hours supplied to the market \(H^*\) is 150, and the total income of the consumer is $1,000 \([4 \times 150] + 400\]. This optimal combination of \(L\) and \(Y\) which yields utility level \(U_1\) is denoted by point \(a\) in Figure 6-1. The highest level of utility in this case is achieved where the indifference curve representing utility level \(U_1\) is just tangent to the budget constraint. Note that the constraint starts at $400 when \(H\) is zero, reflecting the nonlabor income of the individual. Its highest value of $2,000 (called the individual’s full income) is determined by summing the nonlabor income of the individual and his total earnings when working the maximum time of 400 hours at a wage rate of $4. The wage rate is reflected in the slope of the constraint.

![Figure 6-1](image_url)

What happens if the wage rate rises to $8? The slope of the budget constraint increases in magnitude showing the higher opportunity cost of leisure. The constraint also lies further to the right (except at its starting point) since the higher wage rate will imply a higher income (and wealth) at any given level of work hours. Given the preferences in this example, the individual responds by reducing leisure to 225 and increasing work hours to 175 (point \(b\)). The move from point \(a\) to \(b\) is a result of both the opportunity cost change and the income level change.

How much of the move is due to each factor? Holding the opportunity cost constant, suppose the consumer attained the higher level of utility \(U_2\) through an increase in nonlabor income. In this case, the budget constraint would be the dotted line parallel to the original budget constraint (having the same wage and slope), and the optimal choice would have been point \(c\). The movement from point \(a\) to point \(c\) is the income effect of the wage increase. Holding the level of utility constant at \(U_2\) and allowing the slope of the constraint to increase, reflecting the rise in the wage, moves the individual from point \(c\) to point \(b\). This movement represents the substitution effect of the wage increase. Here the income and substitution effects oppose one another, but because the substitution effect is larger, the net effect of the wage increase is for leisure hours to fall and work hours to increase. The reader should note that this need not be the case, since the location of point \(b\) is determined by the preferences of the individual represented by the indifference curves. Point \(b\) must be to the left of point \(c\), reflecting the positive substitution effect. But depending on the preferences (and the shape of the corresponding indifference curves), point \(b\) could, theoretically, end up left, right, or directly above point \(a\).

Allowing the wage rate to vary over the entire range between $0 and $10 yields the individual labor supply schedule shown in Figure 6-2. Note that for any labor hours to be supplied the wage must be greater than one.

The lowest wage that will induce a person to participate in the labor market is called the reservation wage. When there are significant unpaid time obligations (e.g., commuting time) that accompany a job, the reservation wage will be associated with a certain minimum number of work hours.
Also note that for the preferences represented here, the substitution effect always dominates the income effect and so the curve is always upward sloping. (For differing preferences, represented by a differently shaped indifference curve mapping, the results might differ.) The wage and work hour combinations associated with the optimal points depicted in Figure 6-1 are shown again in Figure 6-2 to emphasize the close connection between the two graphs.

The main application of labor supply theory is to the analysis of income replacement and income maintenance programs like workers’ compensation, unemployment insurance, and welfare. By analyzing how these programs change the budget constraints, the work incentive effects of these programs can be analyzed for any given set of preferences.

For example, in some income maintenance programs, the person who does not work at all receives a subsidy $S$ from the government, perhaps as compensation while injured or as payment of unemployment benefits. This causes a “spike” in the budget constraint, because the person receives income even when supplying zero hours of work. This program clearly has serious work disincentives; when the worker goes from zero hours to some positive number of hours, income initially drops. Also, it allows the worker to consume a bundle that contains the same amount of income but more leisure than at least one point on the original budget constraint, and that may well be preferred to other possibilities. Thus these programs stop or slow the return to work by injured or unemployed workers.

Programs such as welfare are needs-based; they pay the recipient the difference between what he earns and some standard. Thus the more income the worker earns, the lower the amount of benefits received. Benefits are scaled back by some fraction for every dollar individuals earn on their own. Letting this fraction, called the implicit tax rate, be denoted by $t$, where $0 \leq t \leq 1$, then the basic budget constraint can be written as

$$Y = S + WH - tWH + V$$

$$Y = S + (1 - t) WH + V$$

$$Y = (1 - t) W(T - L) + S + V.$$  

Notice that the effective wage rate (the slope of the budget constraint) becomes $(1 - t) W$ and the total level of nonlabor income (the initial height of the budget constraint) is $S + V$. The lower the level of $t$, the higher the opportunity cost of leisure, and in most instances, the stronger the incentive to work. However, the lower the level of $t$, the longer people remain eligible for the program, thus increasing the number of people receiving payments and thereby increasing the cost of the program. This tradeoff between work incentives and program costs is a fundamental tension running through all income replacement and income maintenance programs.
The point on the budget constraint separating those who receive benefits from those who do not is called the **breakeven point**. Given the type of program structure mentioned above, the level of income associated with the breakeven point could be computed by finding earnings such that

\[ S - tWH = 0 \Rightarrow WH = \frac{S}{t}. \]

The actual level of income at the breakeven point, of course, would be \((S/t) + V\).

**Example 2**

Consider an individual with preferences given by the formula

\[ U = L^{3/4}Y^{1/4}. \]

Assume the going wage rate is $4 per hour and that the maximum time available per month is 400 hours. Also assume initially that the person has no nonlabor income. Now suppose a welfare program provides low income individual’s with a benefit of $200 if they do not work at all. As the person earns income, however, benefits are scaled back 20 cents for every dollar earned. What would be the breakeven point of the program and what effect would such a program have on the work incentives of this individual?

The breakeven level of income would occur when the person earned enough to have the initial $200 subsidy “taken away,” that is, the total subsidy received should be zero. Algebraically, this occurs when

\[ 200 - 0.2(WH) = 0 \Rightarrow WH = $1,000. \]

This would occur when the person worked 250 hours and leisure was 150 hours.

Substituting the appropriate values into the expression for the optimal level of \(L\) yields a choice of \(L^* = 300\) before the welfare program. This implies 100 work hours and a total income of $400. After the adoption of the welfare program, however, the person’s nonlabor income effectively becomes \(S + V = $200\), and the effective wage rate becomes \((1 - t)W = $3.20\). Substituting these values into the demand function for \(L\) yields \(L^* = 346.875\) which implies work hours of 53.125. This yields total earnings of $212.50, plus a subsidy of $157.50, for a total income of $370.

An indifferece curve/budget constraint graph showing these results is plotted in Figure 6-3. The budget constraint before the welfare program is denoted by the line \(ab\). After the welfare program is established the constraint becomes the line \(acdb\). Note that the breakeven point of the program occurs at point \(d\). The individual’s optimal combination of \(L\) and \(Y\) before the program was at point \(e\), leading to a utility level at \(U_1\). After the program is enacted, the individual’s optimum is at point \(f\) and involves more leisure and less work (and just slightly less total income). The large gain in leisure at the cost of little income leads to the higher level of utility \(U_2\). This tendency to consume more leisure makes sense since the program creates income and substitution effects that in this case both work in the same direction to reduce work hours. Notice how the program shifts the constraint out, thus making individuals eligible for the program richer. When people are richer they typically consume more of all goods, including leisure. Notice also that the constraint is flatter, representing a lower effective wage rate, and hence a lower opportunity cost to leisure time. When the opportunity cost of a good is lower, people typically respond by substituting more of that good for the other, in this case, more leisure for less income.
While this program does reduce work incentives, it is also important to note that it does not eliminate them. This would occur, however, if the program were set up with an implicit tax rate of $t = 1$. The constraint then would be $acgb$ and the person would maximize utility at point $c$ by dropping out of the labor force entirely. As the effective wage rate goes to zero, notice the $L'$ expression gets extremely large, but since $L$ has a maximum of 400, that is where the optimum occurs. This is an example where the optimum does not occur at a tangency between the indifference curve and the budget constraint. Graphically, while a tangency has not been attained, the person still has reached the highest possible indifference curve consistent with the budget constraint. Notice that by dropping out of the labor force the individual would actually increase utility from $U_1$ to $U_2$. In general, when analyzing the work incentive effects of income maintenance programs, be sure to watch for the tendency of individuals to cluster around sharp corners on the constraint like point $c$. Also, note that such corner points do not necessarily occur at the end of the constraint, and sometimes the corners lack the accompanying horizontal segment between points $c$ and $g$. When there is no such horizontal segment (i.e., the program pays out a subsidy only at one specific leisure value) the point is characterized in the text as a budget constraint spike.

While for many individuals the program in this example will reduce work incentives, it does not follow that all individuals will respond in this way. For example, if someone inherently placed more value on units of income such that his preferences could be depicted by the equation $U = L^{1/4} Y^{3/4}$, then the original optimum would occur at $L = 100$ and $Y = $1,200 (point $h$), and the program would have no effect on his behavior. The program does not enable the individual to attain a higher level of utility than the original $U'$. (Note how the shape of the $U'$ reflects the new preferences relative to the original set of indifference curves—its flatness shows the stronger emphasis on income over leisure.) This is not to say that a person above the breakeven point could never be affected by an income maintenance program, however. If the initial optimum is close enough to the breakeven point, the individual can be pulled into the program. This possibility, and many others, will be explored in the problems and applications that follow.

Another possibility is to create work incentives. An illustration of this type of program is the Earned Income Tax Credit (EITC). Under this program, a tax credit of $1 reduces the workers tax liability by $1, and for workers with sufficiently low incomes, this can result in an actual increase in earnings (if the tax credit exceeds the tax liability, the government pays the worker the difference). The actual amount of the tax credit depends on both earnings and number of dependent children and are phased out as income rises. Thus there are a variety of effects, depending on the worker’s original income. For workers who work few or zero hours, the tax credit is the greatest, making the after-tax wage greater than the market wage.
while there are both income and substitution effects, it is likely that income effects will dominate and thus that some workers will enter the labor force or work more hours. For the middle income range, the net wage is equal to the market wage, so there is an income effect but not a substitution effect. Thus workers may actually work less. In the upper income range, the net wage is less than the market wage, as the credit is phased out. Thus the implicit reduction in the wage will create income and substitution effects, both of which will cause workers to supply less labor (because the opportunity cost of leisure has fallen while income has increased), and thus it is likely that workers at that income range will choose to work less.

### Review Questions

Choose the letter that represents the **BEST** response.

#### The Labor/Leisure Choice: The Fundamentals

1. Although firms have an important say in how many hours an employee works, workers can adjust their hours through
   a. choice of occupation.
   b. choice of full-time or part-time work.
   c. absenteeism.
   d. all of the above.

2. Indifference curves representing preferences for leisure and income should be drawn in such a way that they do not cross. If they do, it can be inferred that
   a. the steeper curve represents an individual who places a low value on an extra hour of leisure.
   b. the individual is inconsistent in his ranking of different income and leisure combinations.
   c. the indifference curves that cross pertain to different individuals.
   d. either b or c.

In answering Questions 3 and 4, please refer to Figure 6-4. The budget constraint is represented by line abc.

![Figure 6-4](image)

3. Which of the following is true in Figure 6-4?
   a. The wage rate is $4.
   b. Nonlabor income is $400.
   c. The optimal number of hours to supply is zero.
   d. All of the above.