Chapter 4
Labor Demand Elasticities

Summary

Chapter 3 presented a framework for thinking about the demand side of the labor market. The framework explained why the quantity of labor demanded is inversely related to the wage both in the short run and the long run. It also explained what causes labor demand to increase or decrease when the prices of other inputs change. Knowing why these things happen provides a foundation for correctly analyzing the effects of different policies (e.g., payroll taxes) on the direction of employment and wages. Chapter 4 extends the labor demand framework to look at the issue of how responsive the quantity of labor demanded is to changes in the wage or the price of other inputs. Does the quantity firms demand change by a little or a lot when the wage changes? Under what circumstances is the substitution effect accompanying a change in the price of capital likely to be large and the scale effect small? These are the types of questions taken up in Chapter 4.

The main measure of how responsive employment is to changes in the wage or the price of other inputs is the elasticity of demand, which is denoted by the Greek letter eta ($\eta$). An elasticity is simply the ratio of two percentage changes. If the focus is how responsive the quantity of labor demanded is to a change in the wage rate, the elasticity is called the own-wage elasticity of demand. Letting $E$ stand for employment, $W$ the wage, the subscript $i$ a particular category of labor, and $\% \Delta$ a percentage change, the own-wage elasticity is defined as

$$\eta_i = \frac{\% \Delta E_i}{\% \Delta W_i} = \frac{\Delta E_i / E_i}{\Delta W_i / W_i}.$$

The elasticity can be interpreted as the percentage change in employment induced by a one percentage point change in the wage. Since the own-wage elasticity will always have a negative sign (since demand curves slope downward), usually reference is made to just the magnitude (the absolute value) of the elasticity. When the magnitude of $\eta$ is less than one, demand is said to be inelastic, meaning employment is relatively unresponsive to changes in the wage. A magnitude greater than one is called elastic and means that employment is relatively responsive to changes in the wage.

What factors lead the own-wage elasticity to be elastic or inelastic? In the case of a straight line demand curve, whether the own-wage elasticity is elastic or inelastic depends in part on the current position along the curve. Straight line demand curves exhibit the same unit changes throughout the entire curve. For example, a demand curve with a slope of $-1$ will show an increase of employment by one unit for every one-unit fall in the wage. The same curve, however, will have changing elasticities as wages change. In particular, demand will be more elastic toward the top and get less elastic as wages fall. The logic behind this is simple: When wages are high and employment low (at the top of the curve), any given wage change will be small in percentage terms while a given change in employment will be large in percentage terms. The reverse is true when wages are low and employment high (at the bottom of the curve). So although slope alone is not a good universal indicator of elasticity, when comparing two demand curves, it is still...
usually possible to generalize whether one tends to be more elastic than another. For example, in Figure 4-1, for any small change at a given wage rate, say from $25 to $26, curve $D_1$ will always be more elastic ($\eta_1 = -1.67$ at $25$) than curve $D_2$ ($\eta_2 = -1$ at $25$), even though each will eventually exhibit an inelastic range if the wage goes low enough.

Secondly, the size of the own-wage elasticity can be explained by the size of the substitution and scale effects resulting from a change in the wage. The size of the substitution and scale effects, in turn, are influenced primarily by four factors. These factors have come to be known as the **Hicks-Marshall laws** of derived demand. These laws state that the elasticity of demand for labor will be greater (more elastic):

1. the greater the elasticity of demand for output,
2. the easier it is to substitute other factors of production for labor,
3. the more elastic is the supply of other factors, and
4. the greater is labor’s share in the total costs of the firm.

To understand the Hicks-Marshall laws, consider a situation where the wage increases, holding all else constant. What kinds of things would tend to *diminish* the substitution and scale effects, and hence result in a very unresponsive (inelastic) labor demand curve?

![Figure 4-1](image)

Considering the substitution effect first, the substitution effect will be small if circumstances exist that make it difficult to substitute capital for labor. For example, in a production process where labor and capital are used in fixed proportions, there can be no substitution effect. Alternatively, union rules may limit firms from undertaking certain tasks with less than some minimum number of workers. Supposing that the firm can and does try to substitute capital for labor, are there any factors that could limit this substitution? Usually we think of the firm being able to buy as much or as little capital as it wants at the going price. This would be the case if the supply of capital is perfectly elastic (horizontal). But suppose instead that the supply of capital is actually upward sloping and relatively inelastic. As the firm tries to substitute capital for labor, the demand for capital will be shifting outward along a relatively inelastic supply curve. This bids up the price of capital significantly and limits the firm’s incentive to continue substituting additional units of capital for labor. So substitution can be limited or perhaps even unfeasible due to either technical or economic factors.
What would lead to a small scale effect? The best way to answer this is to think of the linkages through which the scale effect occurs. When the wage increases, the marginal cost of production ($MC$) rises, and a rise in the MC destroys the equality between marginal revenue ($MR$) and $MC$. That forces the firm to adjust its output downward to restore the $MR = MC$ condition for profit maximization. As the optimal output ($Q^*$) is adjusted downward, the firm’s use of labor ($L$) and capital inputs ($K$) are reduced. This chain of reasoning is summarized schematically below.

$$W \uparrow \Rightarrow MC \uparrow \Rightarrow Q^* \downarrow \Rightarrow K^* \downarrow \text{ and } L^* \downarrow.$$

The important thing to realize is that if the first two links in the chain are weak, the last cannot help but be weak. But what would cause the $MC$ of production not to rise much as the wage increases? The answer is if the cost of employing labor is a small share of total cost. As an extreme example of this, suppose a firm did not use any labor to begin with (so that labor’s share of total cost was 0%). In such a case, an increase in the wage would have no effect on the $MC$. (See the discussion accompanying footnote 5 in the text for a situation where a category of labor could still be highly elastic even when it accounts for a very small share of total costs.) What about the second link? What would make the level of output not fall very much for a given increase in $MC$? The answer here is an inelastic demand for the final product the firm sells. The more unresponsive quantity demanded is to changes in price, the more the $MC$ increase can be passed along in the form of higher prices, and the less output has to adjust downward.

If the focus is how responsive the quantity demand of labor input $i$ is to a change in the price of another input $j$, the elasticity is called the cross-price elasticity of demand (cross-wage elasticity of demand when the other input is a different category of labor) and is defined as

$$\eta_{ij} = \frac{\% \Delta E_i}{\% \Delta W_j} = \frac{\Delta E_i}{\Delta W_j} \cdot \frac{W_j}{E_i}.$$

Similarly, one could define a cross-price elasticity $\eta_{ji}$ (though readers should note that the two elasticities will not have the same value). Unlike the own-wage elasticity where the sign is typically ignored, both the sign and magnitude of the cross-price elasticities are important. If the sign is positive, the employment of input $i$ moves together with the price of input $j$ (and hence presumably opposite to that of the quantity of input $j$) indicating that $i$ and $j$ are gross substitutes. If the sign is negative, inputs $i$ and $j$ are gross complements.

What factors lead two inputs to be gross substitutes or gross complements? When focusing on the long-run demand for labor, the size of the substitution and scale effects are again the determining factors in whether demand will be relatively elastic or inelastic, and whether any two inputs will be gross substitutes or gross complements. (In the short run only the scale effect is relevant to the choice between capital and labor since there can be no substitution effect. However, if the focus is on two types of labor, there often can be substitution between the two types even in the short run.)

Focusing on these four factors (the ease of substitutability between labor and other inputs, the supply elasticity of the other inputs, the share of total costs that are labor costs, and the product demand elasticity) provides a good place to start in assessing the likely consequences for employment of different changes that may take place in the labor market. By assembling evidence on each of these factors, one would be in a strong position to gauge the magnitude of the employment change due to a change in the wage. Also these four factors can provide focus when assessing the employment effects of changes in the price of other inputs. In the problems and applications that follow, these four factors will be employed in a number of different contexts to assess and explain a variety of labor market phenomena. Proper use of the Hicks-Marshall laws is one of the most important and versatile tools for anyone interested in being a serious thinker about labor market issues.
The next section of the chapter uses the concept of elasticity to consider the effects of **minimum wage** legislation. The basic model of labor demand under competitive labor market conditions predicts that the minimum wage will produce both winners and losers. The winners are those who retain their jobs at the higher wage. The losers include those covered by the law who lose their jobs, and those not covered by the law who experience lower wages because of the rightward supply shift that accompanies the migration of these unemployed workers to the uncovered sector. The key issue is the degree of the employment loss among low-wage workers and the resulting impact on poverty levels, and ultimately this is a question of labor demand elasticity. Factors that can complicate the empirical estimation of the employment effects of the minimum wage are reviewed and an overview of recent empirical results is presented. Empirical findings have been sensitive to the design of the study, and overall it is difficult to reach a definite conclusion as to the effects of the minimum wage on employment, although certainly there are many reasons to doubt its effectiveness as a tool to fight poverty.

The chapter also applies the labor demand framework to the issue of how **technological change** affects employment. Technological change can affect the demand for labor in two ways. Technological change involving the introduction of new or improved products causes demand shifts in the product markets—an outward shift for the newly created product, an inward shift for the product that is superseded—which in turn translates into shifts in labor demand. Labor demand will increase in the sectors producing the new product, and decrease in the sectors producing the outdated product. New and improved products also tend to increase competition in the product markets as consumers have more substitution possibilities. Increased competition means each firm faces a more elastic product demand. A more elastic product demand, according to the Hicks-Marshall laws, results in a more elastic labor demand curve for the firm. An elastic labor demand greatly diminishes the ability of unions to bargain for wage increases since employment losses are greater for a given wage increase when labor demand is elastic.

Technological change can also affect employment by reducing the price of capital directly, or making available a new type of capital that can serve as a substitute for labor. The latter occurrence can be treated as a reduction in the price of capital since when something is unavailable it essentially has an infinite price. When the capital does become available through technological change, it is as if its price has fallen to a point where at least some firms can afford to buy it. Direct or indirect price changes like these induce the firm to substitute capital for labor, but also create a scale effect that causes the firm to use more capital and more labor. By examining the factors listed in the Hicks-Marshall laws, the likely size of the substitution and scale effects can be determined, thereby providing a solid foundation for assessing the likely employment effects of the technological change on particular industries. Even when employment falls in a particular industry, however, it is important to keep in mind that these labor resources are now free to flow to those industries that will be expanding because of the technological change.

However, while it is fairly simple to demonstrate that technological change involves a net benefit to society (since more goods and services can be obtained from limited resources), it is more difficult to prove whether technological change results in benefits to society as a whole. The answer to this question depends largely on how the gains (and losses) from change are distributed, and whether any losers are compensated. This in turn suggests that for society as a whole to gain from these changes requires attention to minimizing the costs to the losers, perhaps through unemployment insurance, job banks, and retraining programs that facilitate the move from declining to expanding sectors.