

# BasicMicro. Economics: An Outline

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## Part II Chapter fourteen

### IX. Markets for Inputs and Distribution of Income

The factor markets allocate the factors of production among the various producers/sellers. In a market economy, the inputs [land (R), labour (L), capital (K) and entrepreneurial ability] are owned by individual agents who make decisions about the amount of each input they want to supply. The decisions of the producers determine the demand for the inputs. Remember that the decisions of the producers reflects the preferences and ability

In the goods markets, each individual consumer will maximize their utility when;

$$\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y} = \dots = \frac{MU_N}{P_N}, \text{ subject to: } P_X Q_X + P_Y Q_Y + \dots + P_N Q_N \leq \text{BUDGET}$$

This is an equilibrium condition. The consumer cannot alter their expenditure and improve their welfare or increase their utility. Income (budget), preferences ( $MU_N$ ) and the relative prices determine the outcomes. The market demand reflects these conditions to the market. The demand function is a schedule of the maximum price (reservation price) that buyers are willing and able to pay for a schedule of quantities of a good in a given period of time ( $ut$ ), *ceteris paribus*. The supply function in the market reflects the opportunity cost or producing each unit of output. It can be defined as the minimum price (reservation price) that the seller will accept for each unit of output. Market equilibrium is determined by the interaction of the buyers and sellers.

The equilibrium of the buyers and market equilibrium depends on the income of the buyers. The way in which income is distributed in a system determines the allocation decisions. The judgment about the criteria used to distribute income has both an ethical and efficiency dimension. In most social groups, it is considered desirable that income be distributed in proportion to the contributions to the achievement of objectives. Clearly, most societies make exceptions; most societies refuse to let individuals who are incapable of making contributions do without resources and goods to support life. In industrial societies there is a range of judgments regarding what things should be provided. At one extreme few resources are provided. At the other extreme a higher level of comfort is considered appropriate.

From an efficiency perspective, each factor should receive a share of income in proportion to the factor's contribution to the value of the output. John Bates Clark (1847-1938) was one of the architects of the "marginal productivity theory of income distribution." In concept the idea is simple, in practice it is difficult to

measure the contributions of each factor to the production process.

The production process was described by a production function. In its simplistic form it is:  $Q = f(\text{labour, kaptial, land, technology, . . .})$  The marginal product of each factor describes the contribution of each factor to the production of the output. The marginal product of a factor can be described as:

$$MP_F \equiv \frac{\Delta Q}{\Delta F}, \text{ the change in output (Q) "caused" by a change in F (the factor)}$$

With the use of calculus the marginal products of a set of inputs can be described as partial derivatives. Given a production function:

$Q = AL^\alpha K^\beta$ , the marginal products of the factors is:

$$MP_L = \frac{\partial Q}{\partial L} = A\alpha L^{\alpha-1} K^\beta$$

$$MP_K = \frac{\partial Q}{\partial K} = AL^\alpha K^{\beta-1}$$

If the marginal products are known and the relative prices of goods in the markets reflect the values of the outputs, the value of each factors contribution can be calculated as the product of  $MP_F$  and the price of the output. The marginal productivity theory of income distribution suggests that the income share each factor of production should receive is determined by the marginal product of the input and the price of the output. The change in the value of the output associated with a change in an input is called the **value of marginal product (VMP)** or the **marginal revenue product (MRP)**. Originally the VMP was used to describe the demand for an input into production process for a purely competitive firm and the MRP was used to describe the demand for an input used to produce a product where market power (a negatively sloped product demand) existed. Most texts currently use MRP as a generic term that covers both VMP and MRP.

## A. The Demand for Inputs

The demand for a factor of production is a **derived demand**. You do not have a direct demand for an auto mechanic; rather you have a demand for an automobile that functions properly. The demand for the mechanic is a derived demand. You probably do not have a demand for 2X4's (they really aren't 2" by 4"), you have a demand for a house that is constructed with the lumber. The demand for an input is determined by the relative value of the good produced and the productivity of the input.

The demand for an input can be derived by using the production function (the MP for an input) and the price of the good. The marginal revenue product is shown in Table IX.1.

Table IX.1 shows a short run production function. Capital is fixed at 4 units. As labour is added, the output (Q or TP) increases at an increasing rate. In this example the marginal product of labour ( $MP_L$ ) declines from the first unit. This makes the  $MRP_L$  or demand for labour less messy.

The constant price at all levels of output ( $P_x = \$11$  at all output levels) is the result of the firm being in a purely competitive market; the demand faced by the firm is perfectly elastic.

The marginal revenue product is a measure of the value of the output that is attributable to each unit of the input. The first unit of labour "produces" 8 units of output ( $MP_L = 8$ ). These 8 units of output can be sold for \$88 ( $P_x = \$11$ ,  $MP_{L1} = 8$ ; so  $P_x * MP_L = 8 * 11 = 88$ ). The maximum that an employer would be willing to pay the first unit of labour would be \$88. The MRP of the second worker is \$77. The second worker produces 7 units of output valued at \$11

each.

Table XI.1					
Short Run Demand for Labor in Pure Competition					
Kaptial (fixed)	Labour (L)	Q, TP	MP <sub>L</sub>	Product price, P <sub>x</sub>	(MP <sub>L</sub> )P <sub>x</sub> MRP <sub>L</sub>
4	0	0		\$11	
4	1	8	8	\$11	\$88
4	2	15	7	\$11	\$77
4	3	21	6	\$11	\$66
4	4	26	5	\$11	\$55
4	5	30	4	\$11	\$44
4	6	33	3	\$11	\$33
4	7	35	2	\$11	\$22
4	8	36	1	\$11	\$11
4	9	36	0	\$11	\$0

The MRP of each unit of input is the maximum an employer would be willing to pay each unit of input and can be interpreted as a demand function. Notice that if 35 units could be sold, 7 units of labour would be hired. The MRP<sub>L7</sub> is \$22. The maximum the employer would be willing to pay the 7<sup>th</sup> unit of labour is \$22. Wage/price discrimination is technically illegal, all workers are paid \$22. The employer gains \$66 on the first unit of labour (\$88-\$22), \$55 on the second, \$44 on the third, \$33 on the fourth, \$22 on the fifth, \$11 on the sixth and nothing on the seventh. This is shown graphically in Figure IX.1

The MRP is the maximum the employer will pay each unit of labour in a given period of time given the productivity (MP) and the price of the output (P<sub>x</sub>). At a wage of W<sub>R</sub>, the firm will hire N workers. All N workers are paid the same wage rate; i.e. there is no price discrimination.

The wage bill or expense is shown as area ONRW<sub>R</sub>, measure by NW<sub>R</sub>. the producer surplus is area W<sub>R</sub>RA. The producer surplus is not the same as profit. The payment to the fixed factor must be subtracted from the producer surplus to calculate profit.

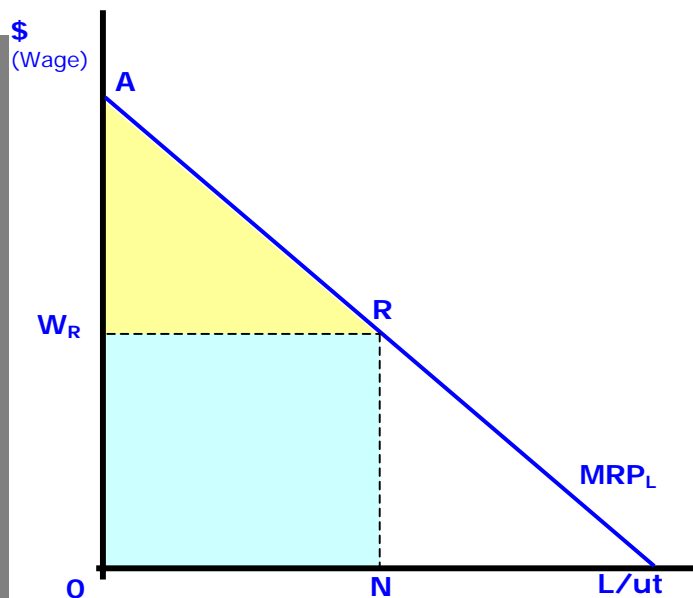


Figure IX.1

The MRP of an input used by a firm with market power (a negatively sloped demand for its output) is shown in Table IX.2.

Table XI.2					
Short Run Demand for Labor For Firm in Imperfect Competition or Monopoly					
Kaptial (fixed)	Labour (L)	Q, TP	MP <sub>L</sub>	Product price, P <sub>x</sub>	(MP <sub>L</sub> )P <sub>x</sub> MRP <sub>L</sub>
4	0	0		\$13	
4	1	8	8	\$11	\$91
4	2	15	7	\$10	\$70
4	3	21	6	\$9	\$53
4	4	26	5	\$8	\$39
4	5	30	4	\$7	\$28
4	6	33	3	\$6	\$19
4	7	35	2	\$6	\$12
4	8	36	1	\$6	\$6
4	9	36	0	\$6	\$0

Note that the only difference in Table IX.1 and IX.2 is that the price of the output must be decreased if more units are to be sold. This makes the demand for the input relatively more inelastic.

### A. Supply of Inputs

The individual agent who owns the input will decide how much of a factor they want to offer for sale at each price offered for the input. A worker must decide how many units of labour (hours, days, weeks, years, etc) they will offer for sale at each possible wage rate. The supply of labour is a function of the wage rate, the value of leisure, alternatives available, taxes and other circumstances. Generally it is believed that more labour will be offered for sale at higher wage rates, up to a point. Owners of other factors of production (land, capital, entrepreneurial ability) make decisions that determine the supply functions of those factors. Figure IX.2 illustrates several possible supply functions. The segment HGB is one possibility, it represents a supply where the worker is willing to offer more labour at higher wage rates. The maximum labour that will be offered for sale is at point B. At a wage rates higher than  $W_H$ , the supplier substitutes leisure for income and offers less labour for sale as the wage increases. Another possibility is a supply of labour that is represented by segment  $W_RGB$ . A

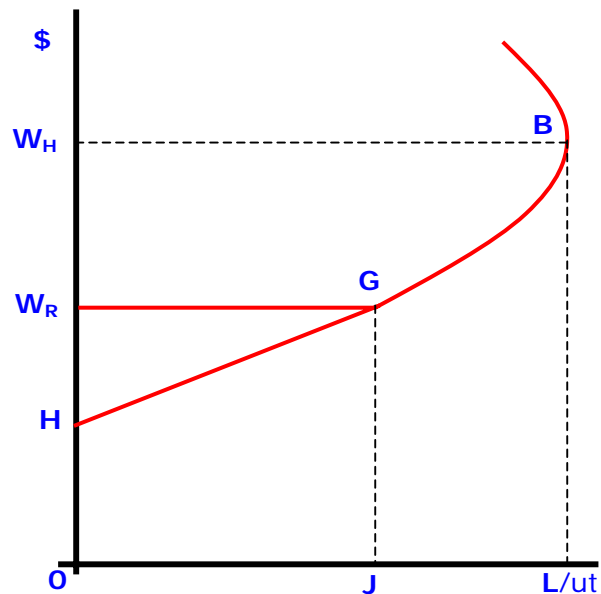


Figure IX.2

horizontal segment at the prevailing wage rate is caused by a worker or workers who refuse to work at any wage that is less than the prevailing wage,  $W_R$ .

## B. Market for Inputs

The market for an input includes all potential buyers and sellers of an input. The demand reflects the decisions of the buyers of the inputs and is based on the MRP for the factor. The supply function represents the decisions of the factor owners to supply the input at various prices. Figure IX.3 represents a market for labour. MRP represents the demand and S is the supply of L. The market equilibrium occurs at point G where the quantity of labour offered for sale is equal to the quantity of labour that is demanded at a the wage rate  $W_R$ . J units of labour are hired.

An increase in the productivity of labour or the price of the good produced ( $P_x$ ) will increase the demand (MRP). A decrease in productivity or  $P_x$  will shift the MRP to the left ( $MRP_1$ ). If worker are unwilling to work for less than the market wage,  $W_R$ , the supply is represented by line  $W^RGB$ . The level of employment would fall to F units of labour. If  $HGB$  were the relevant supply, unemployment would fall to T units and the wage would fall to  $W_L$ .

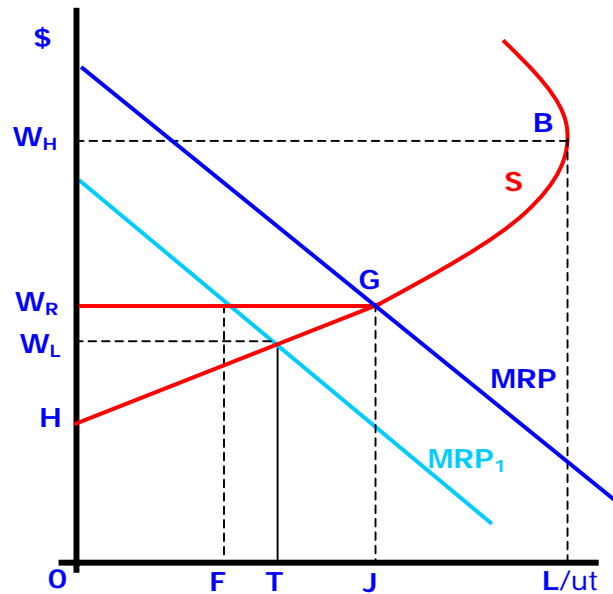


Figure IX.3

If the MRP increased so the wage rate exceeded  $W_H$ , workers would supply a smaller quantity of labour in a given period of time.

## C. Income Distribution

Income distribution can be described as a functional or personal distribution. The functional distribution of income describes the allocation of income among the factors of production. The distribution of income among the members of society, individuals and families, is called the personal distribution of income.

Adam Smith, David Ricardo, Karl Marx and other early economists were primarily concerned about the distribution of income among social classes that were partially based on economic criteria. During the feudal era labour (serfs) and land owners (aristocracy and church) were the important factors of production. Generally, the social classes were the serfs, aristocracy and clergy. Economic behavior was coordinated by a complex set of social institutions that were based on deontological ethics (duty). Reciprocity and command were the primary organizing mechanisms. Markets existed and were used in many cases. Market towns and fairs were used to allocate some goods while labour, land and many goods were allocated through obligations specified by tradition and command.

The personal distribution of income describes the allocation of income among economic agents. In most modern, industrial societies, markets are the primary organizing institution of economic processes. Markets determine the allocation of income as well as the allocation of scarce resources. Other social

institutions such as welfare and philanthropy play a minor role in the personal distribution of income.

Irvin Tucker (*microECONOMICS for Today*, South-Western 2000, p 283) shows the distribution of income based on the head of household. His data is based on the Census data and is shown in Table IX.3.

<b>Table IX.3</b>	
<b>Income Distribution Based on Head of Household - 1997</b>	
Irvin Tucker, <i>microECONOMICS for Today</i> , South-Western 2000, p 283	
Characteristic By Head of Household	Median Income
All Families	\$44,568
Male	\$32,960
Female	\$21,023
Age 25-34	\$39,979
Age 65+	\$30,660
Head non High School Grad	\$25,465
Head High School Grad	\$40,040
Head with Bachelor's degree	\$67,230

The information in Table IX.3 poses several issues. When considering income distribution by age of household, there is a "life cycle" of a person's earnings and needs that should be considered. It should be noted that the distribution of wealth and income are two related but different problems. Another issue is the role of education and training. Disease and the industrial revolution significantly altered the social classes and the distribution of income. Technological change is a fundamental feature of modern industrial societies and will change the nature and role of education and training in the distribution of income.

A "Lorenz Curve" can also describe the personal distribution of income. A Lorenz curve can be used to show either the distribution of income or wealth and can be applied to the world, a country or a sub category of individuals (the military, lawyers, or . . . ). A Lorenz curve plots the cumulative proportion of income units and cumulative proportion of income received when income units are arrayed from lowest to highest.

The data for a Lorenz curve is shown in Table IX.4. (Irvin Tucker, *microECONOMICS for Today*, South-Western 2000, p 282) The income distribution is arrayed from lowest to highest. The data in Table IX.4 suggest that the income distribution became more equal from 1929 to 1970 and less equal from 1970 to 1997. The trends in income distribution are subject to controversy. There are many forces that influence income distribution. It is highly unlikely that the MRP is the single determinate of the income share received by a factor or individual who owns the factor. Political forces, technological change, tradition, law and a variety of other forces influence the distribution of income. Discrimination by gender or race are hotly debated issues.

Table IX.4 Income Distribution Among Families 1929-1997						
% Families	1929		1970		1997	
Lowest 20%	3.5%	3.5%	5.5%	5.5%	4.2%	4.2%
Second Lowest 20%	9.0%	12.5%	12.2%	17.7%	9.9%	14.1%
Middle 20%	13.8%	26.3%	17.6%	35.3%	15.7%	29.8%
Second highest 20%	19.3%	45.6%	23.8%	59.1%	23.0%	52.8%
Highest 20%	54.4%	100%	40.9%	100%	47.2%	100%
Highest 5%	30%	Cumulative	15.6%	Cumulative	20.7%	Cumulative

A Lorenz curve is usually shown as plots of the cumulative proportion of income units and cumulative proportion of income received when income units are arrayed from lowest to highest. In Figure IX.4 data from 1929, 1970 and 1997 are compared to an equal income distribution. An equal income distribution is shown as a diagonal line AB. The further the Lorenz curve deviates from the diagonal, the more unequal the distribution of income.

