

4.0 FACTOR MARKET (v.81)

(Note the version number, these notes should be considered a draft. Consider consulting a text for more detailed reading and graph work if any concept is not clear.)

Up to this point in the course the emphasis has been on the product market. And much of what has been studied in that market can be applied to the factor market(aka input). Just as in other markets there is a demand and a supply component. The factor market is a derived market. Demand for labor in the automobile industry is derived from demand for automobiles. Aggregate demand for a factor such as labor is the sum of demand by firms in all industries. This is the horizontal sum of all firm's demand for labor. This argument also applies to other factors.

Labor vs. Capital

The two primary factors or inputs are labor and capital. In the short run, these can be viewed as variable (labor) inputs and fixed (capital) inputs. In the long run, all inputs are variable. When we say variable we mean that the quantity hired can vary.

There is a close relationship between labor and output. Hiring more labor generates more output. However, if demand weakens, labor can be laid off. Capital cannot be decreased, it is fixed.

One important characteristic of factors is their substitutability for one another. For example, in some processes, labor and capital are equally interchangeable. That means if labor becomes cheaper, hire more labor and less capital. The ability to do this will depend on the nature of capital, can it be reduced.

Besides this substitution effect there is also an output effect. With cheaper factor costs, MC declines which makes it more profitable for firms to produce more.

Competitive vs. Monopolistic Product Market Effects on the Factor Market

Factor markets can be competitive or monopolistic. Combined with competitive and imperfectly competitive (monopolistic or oligopolistic) product markets, different results are achieved in quantity of input and price paid per unit of input.

In a competitive product market the firm faces a flat demand curve so $MR = P$. Consequently, a competitive firm strives to maximize profit by producing where its $MC = MR = P$. However, a monopolistic firm has $MR < P$ so it will produce less than that of a competitive firm. This means that a monopolistic firm needs less labor since it has less output.

Factor Market Structures

There are two factor market structures: a competitive factor market and a monopolistic factor market.

A competitive factor market means there are many buyers of labor and suppliers of labor. When talking about a monopolistic factor market the discussion becomes more complicated. There can be one buyer of labor (called a monopsony), one seller of labor or both.

General Optimization Rule: $MRP = MFC$

Just as in the product market, the general optimization (or profit maximization) rule is to buy inputs until their marginal revenue equals their marginal cost. We call the marginal revenue earned by hiring one more unit of a factor, in this case, labor, Marginal Revenue Product (MRP). The cost of hiring an additional unit of a factor, in this case, labor is the Marginal Factor Cost (MFC).

You may ask if we already have a $MR = MC$ rule why do we need this one, especially if they produce the same result. I will tell you, it is due to the fact that there can be multiple inputs. More importantly this section establishes pricing behavior in the input markets. It determines the income workers receive in order to buy the products.

How Product Market Structure Impacts MRP

This returns to a point made earlier, in a competitive product market, $P = MR$ but in a monopolistic market $P > MR$. Therefore, a competitive firm's MRP will be greater than a monopolistic firm's MRP.

How Factor Market Structure Impacts MFC

If a single buyer faces a competitive factor market, they can buy as much of the factor at the factor's price. The factor supply curve is perceived as a straight line.

The marginal factor costs, the cost of hiring an additional hour of labor is the wage rate, $MFC = w$.

If that buyer is the only buyer of that input, then she faces the factor market supply curve. The supply curve will be upward sloping. In order to hire more labor, the firm must pay a higher wage. However, it must pay all of its workers a higher wage.

Consequently, the marginal factor cost includes additional wages paid to existing workers. Hence, $MFC > w$.

General Assumptions of a Competitive Factor Market

Similar to a competitive product market, with many buyers and sellers of a factor, all are price takers. Therefore, any firm perceives the supply curve as being flat. It can buy as much as that factor as it wishes at the market price without affecting the market price.

General Assumptions of a Monopolistic Factor Market

Again, there exist some similarities to the product market case. Here the firm is the sole buyer of an input. Consequently, it faces the market supply curve, which is upward sloping. As stated before, the MFC is now greater.

The Labor Market

General Assumptions of the Labor Market

Labor is considered fungible and mobile. Basically, any labor can be used for any task (fungible), and used anywhere (mobile). Even if some labor does not have this flexibility, a large enough percentage of the workforce is flexible enough to ensure a competitive market.

Labor Demand

The Labor Market: Demand for a Single Variable Input

While determining demand for a single variable input such as labor we hold the other inputs, such as capital, constant. Assuming all markets are competitive $MR = P$, (note P here refers to product price not input price). Demand is determined by that factor's contribution to the firm's revenue. Firm's only hire labor to produce a profit. As long as the wage or cost of labor is less than the labor's contribution to revenue then the firm will hire more labor until cost equals revenue contribution.

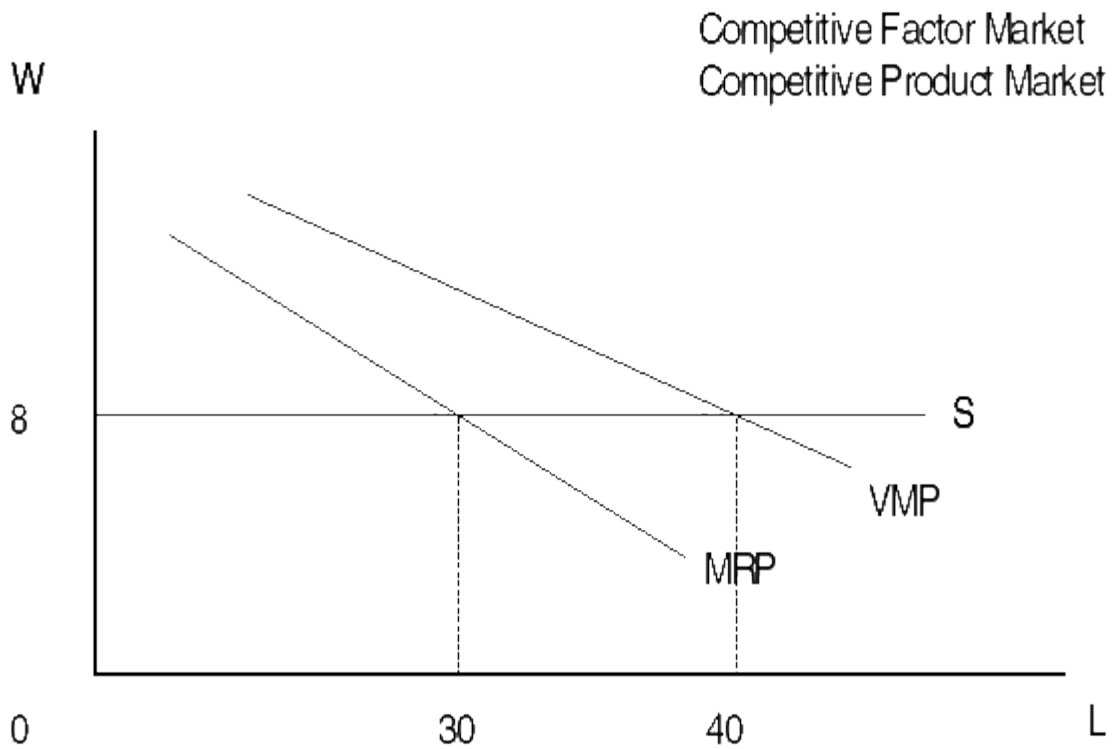
To determine labor's contribution to the firm's revenue we must multiply the marginal product of a unit of labor times the product price. This is called the Value of the Marginal Product (VMP). For example, if a worker can produce 20 burgers per hour and each burger brings in a net price of \$1.00 (let's say \$1.50 minus the other input costs: meat, bread, equipment, etc. of \$.50) then the firm can afford to pay this worker \$20.00 per hour.

Value of Marginal Product (VMP) = Marginal Product (MP) * P

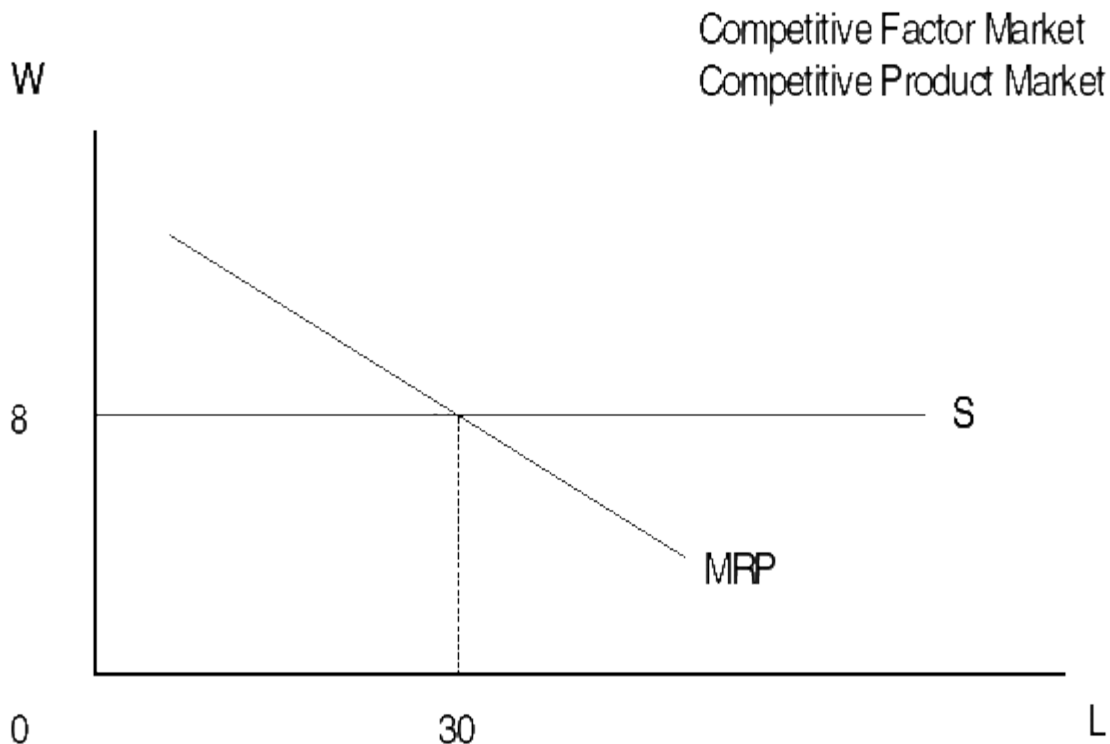
In the competitive product market $MR = P$ but in a monopolistic market $MR < P$. Therefore, a firm will hire based on MR not P. Labor's contribution to the firm's revenue is measured by the Marginal Revenue Product (MRP) which is the marginal product of a unit labor times the product price.

Marginal Revenue Product (MRP) = Marginal Product (MP) * MR

Therefore in a competitive market $VMP = MRP$ but in a monopolistic product market, $VMP > MRP$. In a competitive product market the VMP equals the demand for labor. In a monopolistic product market the MRP equals the demand for labor. Consequently a competitive product market will hire more input (labor in this case) than a monopolistic market. This makes sense as a monopoly produces less than a competitive firm.



In the graph above, the difference between MRP and VMP is illustrated. MRP hires 30 units of labor while VMP hires 40 units of labor. The MRP is steeper than the VMP curve because $MR < P$. Both are downward sloping for another reason, MP falls as more units of labor are hired.



In the graph above, where $MRP = S$, 30 units of labor are hired. In this type of competitive factor market, the firm can hire as many units of labor as possible at the same wage. The firm's hiring demands are so small compared to quantity of labor in the market that it has no effect on wage. The firm will not hire more than 30 as the cost of hiring, the wage w , is more than the revenue gained, MRP . Any quantity of labor to the left will not maximize the firm's profits as $w < MRP$ meaning the firm can earn more profit by hiring more labor.

There are some generic variables that affect the price elasticity of demand for a factor. One, substitutability of other factors, two, price elasticity of demand for the product the factor is being used to produce, three, time, and four, the proportion of production costs that the factor represents.

Determinants of Factor Demand

Determinants of factor demand include shifts in the product demand curve, changes in marginal product, and changes in substitute factor's prices.

Changes in product demand

What happens if a firm experiences a decrease in demand? It generally lays off workers. Some economic theories would predict that workers would take pay cuts to maintain full employment as in the competitive labor market model. Why does the firm lay off workers instead of offering a pay cut to keep them? Cutting pay lowers morale, lower morale lowers productivity which in the end lowers profitability. At least with a layoff, the disgruntled workers are removed from the environment. Now having said this, there is another side to the argument. Empirical evidence is accumulating that downsizing companies only produces increased profits in the short run. Within three to five years

nearly all of the downsized companies experienced lower profits compared to the period prior to downsizing.

Changes in marginal product; productivity

Productivity is a function of time spent on the job (other factors such as training, education, etc. are also important). As employees gain more experience, productivity rises. Given a higher wage, there is more incentive for employees to show up for work consistently, on time, and take an interest in the firm's success. Remember however, that productivity is not measured directly in the monthly P&L. The manager often manages productivity imperfectly and indirectly by minimizing labor expense.

One of the biggest influences on labor productivity, which traditionally does not receive much attention from economists, is management. In simplistic terms, if your boss is having a bad day, then you are going to have a bad day. The world's best workers are not going to overcome a boss who is an idiot.

To improve the situation, various management movements have arisen. These include re-engineering, total quality management (TQM), six sigma, employee empowerment, and etc. A good course in operations management covers these topics.

Very often tasks are accomplished through teams. Consequently, it is very difficult to identify an individual's contribution to the effort. The team is rewarded for its successes rather than an individual. This raises the problem of free riders, individuals who enjoy the team's rewards but fail to contribute any effort to the team to achieve those successes. Does this remind you of anyone you know in class?

Changes in substitute factor's prices

Very often in many processes, capital can be substituted for labor, and vice versa. To the extent that can happen, when the price of capital falls, then capital is purchased to replace labor. For example, there are machines that can mass produce hamburgers. Burger King uses a chain drive open flame oven. It can produce massive amounts of burgers very quickly. In contrast, McDonald's until recently relied on a flat grill with a cook flipping and monitoring the cooking process. To increase production, McDonald's had to add additional cooks. As long as labor is cheap, McDonald's strategy pays off but since labor has become more expensive, the capital intensive process of Burger King has a lower cost. It should be no surprise that Burger King has been able to offer their prized sandwich, the Whopper, for about \$1, while McDonald's Big Mac, frequently hits \$3.

This example also brings out another point, product design has a major influence on costs. The Big Mac has two layers of meat, three layers of bread, and one layer of condiments. In contrast, the Whopper, has one (big) layer of meat, two layers of bread, and one layer of condiments. By eliminating a layer of meat and bread, it takes much less labor and time to put together a Whopper.

Labor Supply

There are some basic definitions that need to be covered. One, marginal factor cost (MFC), average factor cost (AFC), and total factor cost (TFC).

- Marginal Factor Cost = $\text{chg in TFC} / \text{chg in input quantity}$
- Average Factor Cost = $\text{TFC} / \text{input quantity}$
- Total Factor Cost = $\text{input price} * \text{input quantity} = \text{wage rate (W)} * \text{number of workers (L)}$

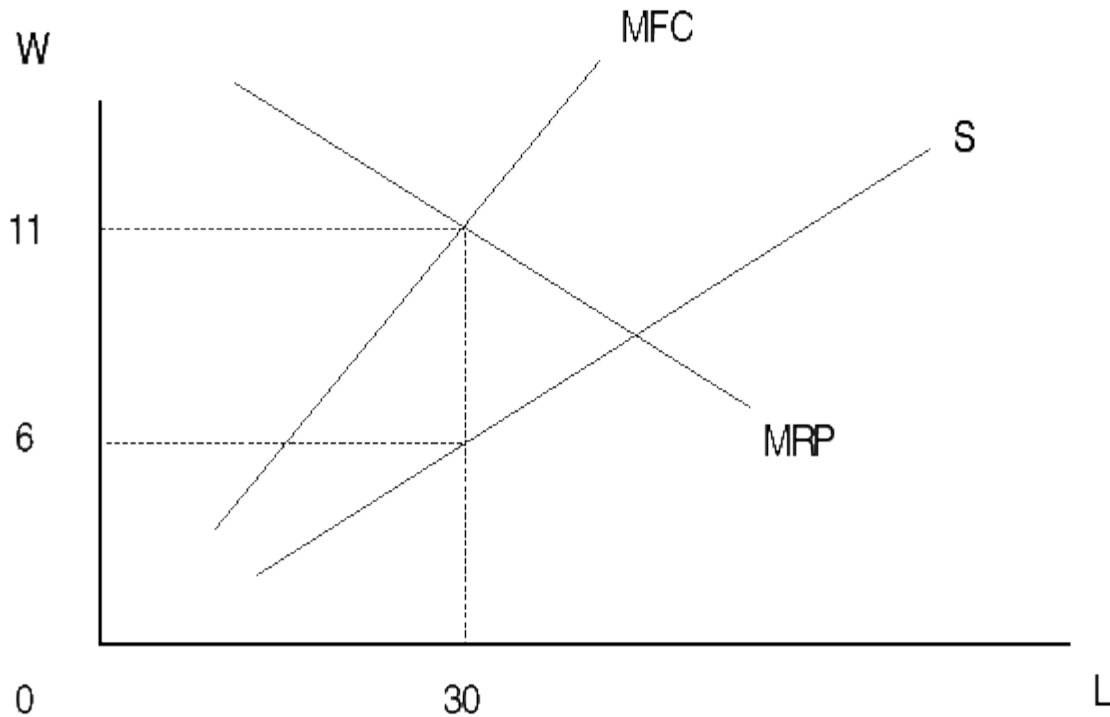
In a competitive market, $\text{MFC} = \text{input price}$. For labor that means $\text{MFC} = \text{W}$, where W is the wage rate.

Basic Labor Market Assumptions

One of the basic assumptions behind the classical labor market analysis, as seen here, is that labor is mobile. That means anyone can do anything, anywhere. Labor is easily substitutable for itself. That is a bold assumption that is not entirely true, yet for our purposes of analysis, it is true enough to have real value. To some extent, people can be retrained for other jobs. While not everyone can be retrained for any job, there are usually enough that can that labor supply is seen as adequate. Notice that I said usually. It takes time for labor supply adjustment. It takes time for people to learn or acquire new skills. For a period of time, those with information technology skills earned a premium wage in the market. But higher wages drew more people into information technology, an oversupply situation began to develop, and wages fell.

Another issues with job mobility, is geographical mobility. Many people are unwilling or even unable to move to a different locale to seek employment. This creates local markets that may experience excess demand or supply for extended periods of time.

Another hidden assumption is information. In other simple markets, we assumed that workers know what jobs are available and the wage rates that are available. With the rise of the internet, more information about jobs is available to people.



In the graph above, the buyer of labor faces the labor supply curve. In other words, it is an imperfectly competitive factor market. To hire additional workers the firm must offer a higher wage. Unfortunately, the firm must pay all of its workers the higher wage or risk losing them. Consequently, the firm's costs per unit of labor are rising faster than the increase in the wage because of the additional payments to existing workers. In this example, the cost of hiring an additional worker is \$11 per hour even while the wage rate is \$6.

Labor supply curves have positive slopes. However, firms facing a competitive labor market may perceive the labor supply curve as flat. Labor supply curves have a backward-bending component due to work-leisure tradeoffs. Shifts in labor supply curves occur due to changes in labor force participation rates, migration, and population growth.

Work-Leisure Decision

Let's talk about the decision a worker makes in supplying labor. An increase in income, with leisure as an inferior good. Given an increase in proportional income taxes, what will be the effect on the labor supply?

Effect of a wage change on the work-leisure decision

People work to earn an income, which they spend. The work decision is related to income. To earn a desired income, one must work. Earning a higher income necessitates working more hours. People support a lifestyle with income. The ability to generate an income is a function of the wage rate times hours worked. Work hours have a disutility. They reduce leisure hours. When a higher wage is paid, a higher income can be earned. However, to maintain a given income fewer hours need to be worked.

This points out that there is a cost to each hour of leisure. It is the wage rate. The income generated by working one hour. We say this is the opportunity cost of leisure.

Each time there is an increase in the wage rate, a dilemma exists: work more hours because they earn so much more, or enjoy the extra hours of leisure working fewer hours that a higher wage can allow. Often the decision is a combination of both.

The Substitution Effect

Let's examine the first idea in a little more detail. As the wage rate increases, the opportunity cost of leisure increases. It becomes more expensive. A substitution effect, wherein a cheaper good, takes place. Therefore, as the wage rate increases the substitution effect suggests less leisure will be taken as work hours will be substituted in their place.

The Income Effect

There is another effect, the income effect. As income increases, we buy more of an income normal good and leisure is an income normal good.

People generally want to enjoy life. That means having leisure time and the income to support it. The question now becomes, for a wage change which effect dominates: substitution or income? The answer depends on the rate of substitution between income and leisure on the indifference curve. If leisure is relatively preferred, the income effect will dominate. That means that for an increase in the wage rate leisure time increases, work time decreases. We say that income > substitution.

Effect of Capital on Labor Demand

Capital can be used as a substitute for labor and as a complement. In fact, it can have elements of both where in the short run it complements labor but in the long run it can function as a substitute. In this case we will focus on capital as a substitute. As a substitute, as the price of labor increases then more capital will be used. Conversely, as the price of capital increases more labor will be used. How much will change, will depend on the relative product market price demand sensitivities.

Other Issues in the Labor Market

Measuring Performance

Other issues in determining pay: measuring performance, does effort = results. Divergence of interests, agents (workers) may increase their utility on the job by shirking, that is not exerting effort. Then there are the costs of monitoring effort or output. Various contractual solutions are available, each with their advantages and disadvantages. Subjects for a course on Labor Economics.

Skill Differences

From this theory one can make some observations how wages are established in general. Wages respond to changes in supply and demand. Wage differentials reflect productivity differentials. Wage differentials also reflect differences in factor scarcity and in product demand. Work flexibility in terms

of which hours are worked will also have an impact on wages.

Some professions may be demanding in terms of knowledge and skill, but are so desirable that wage rates are driven down by excess supply. Yet, some jobs are so undesirable that they earn high wages even as the skill requirements are minimal, such as trash collection.

Monopolistic Labor Markets

What happens when we have the case of one sole buyer of a particular input, which is called, monopsony? The monopsonist faces the market supply curve, which was illustrated earlier. The marginal factor cost = marginal revenue product. The marginal factor cost is greater than the input cost because in order to increase the quantity supplied, a higher price must be paid and to all previously hired workers. As a consequence monopsonists hire fewer workers and pay lower wages. The profit maximization rule is to hire the input until $MRP = MFC$.

In the case of a monopolized product market and a competitive factor market, $MR < P$ the addition to revenue from an input will be less than the value of marginal product. This change in total revenue for a one-unit change in a variable input is the MRP. The rule to optimize input is to equalize the ratio of MP to input prices for all inputs. In this situation the demand curve for multiple inputs cuts across the different input's MRP curves.

A monopolized labor market is exemplified by a union. Labor unions are subject to government protection and regulation. There are two generic types of unions (with many hybrids) craft unions, whose workers possess the same skill or practice the same craft or trade, and industrial unions, whose workers are in the same industry regardless of skill or trade. The goals of a labor union are to secure or maintain jobs for its members, maximize the total wage payment, and/or maximize the wage rate of a subset of its members. They tend to differ on how they operate. Craft unions attempt to restrict supply, industrial unions reshape supply. Craft unions restrict who may learn the trade and who may join the union. Industrial unions refuse to work at a wage less than the current contract rate. Workers with overtime hours are paid at an overtime rate that usually is one and a half times the regular rate.

Despite the deep controversy, unions probably have raised the wages and living conditions of their member as well as nonunion members.

In the case where a union faces a monopsonist we have a bilateral monopoly. Classical economic theory does not offer an equilibrium solution but game theory offers conditions necessary for solutions. We are in the realm of game theory, where the prisoner's dilemma applies.

Pay Secrecy

In an effort to combat the effects of MFC, many firms upon hiring individuals enforce a code of pay secrecy. In other words, you may be earning more than your experienced co-workers but you are not to tell them. Management does not want to be forced in a position to increase their salaries. Of course, information does eventually leak out. Some employee will guess that the fact you are driving a new Porsche while they are driving Volkswagens, is a clue you are being paid more. More likely, some of them are in the job market and have gotten a good idea of what market wage rates are being offered. Some will directly ask you. Knowing that you are probably on a six month probation, you do not want to risk losing your job by telling them. But on the other hand, if you are very cold to your fellow employers, chances are quite good you will be a failure at your job. Everyone needs cooperation. So you drop clues and leave it at that. There is nothing ethical about pay secrecy. It is a device used by firms to control costs.

Minimum Wage Laws

In a sidebar discussion, let's discuss the impact of minimum wage laws. Traditionally it was thought that increasing the minimum wage increased unemployment. That assumes a competitive labor market. If the labor market is imperfect then an increase in the minimum wage may even increase employment. One of the interesting effects that has been discovered, is that turnover decreases with increases in the minimum wage. This lowers labor costs for firms. Now you may ask if this wonderful result occurred, why wasn't it done earlier? Good question! But there is an answer. What we measure is what we manage. The blame here falls on our system of financial accounting. According to generally accepted accounting principles (GAAP) labor costs are an expense in the current period. What is paid (or accrued) is your expense.

Labor Turnover

There is not any line item in the monthly profit and loss called turnover expense. It isn't measured. The manager is going to do everything to minimize expenses on a monthly basis to maximize profit and her bonus. The big expense is labor.

What are the costs of turnover? Interviewing costs, training costs, loss of productivity, increased error/defect rates, lost sales, etc. Let's say the manager works 50 hours per week. If 20 hours are spent interviewing and training new employees then that is 20 hours less that could be spent on other management tasks. Those tasks may have allowed the firm to increase customer satisfaction, quality control, and to ultimately earn more revenue. It even may be necessary to hire more managers to make up for lost time. But note interviewing and training time do not necessarily increase expense as there is not an explicit cash outlay. Indirectly these time wasters reduce sales. However, there is no line item for lost sales, it is difficult to measure. More often than not, managers are forced to overhire as they can never be sure if they will have enough workers on a shift. Only through an elaborate statistical analysis can these effects be isolated and estimated.

A Comprehensive Example

Let's put all of these concepts together to calculate the firm's demand for inputs, and point of output for maximum profit. Our first example will consider a market where the firm is monopolistically competitive yet operates in a perfectly competitive labor market. The second example will consider the case where labor is imperfectly competitive. We are not going to consider the case of multiple inputs.

Figure 1.0

L	W	Q	MP	P	MR	MRP
0	9.00	0	0	8	0.0	0.0
1	9.00	8	8	7	9.0	72.0
2	9.00	15	7	6	6.9	48.3
3	9.00	21	6	5	4.5	27.0
4	9.00	26	5	6	1.8	9.0
5	9.00	30	4	7	-1.5	-6.0

Fixed costs are \$10. MFC in this example equals W, when it is held constant. Marginal product at where $Q = 21$, is computed by $\text{chg } Q / \text{chg } L$, $(21-15)/(3-2)$ or 6. The Marginal Revenue Product at $Q=21$ is $MR * MP$ or $4.5 * 6$ which equals 27. The firm will hire at where $MFC = MRP$ thus hiring 4 units of labor. At the profit maximization point, profit will equal \$116, where $TR = P * Q$, $6 * 26 = \$156$ and $TC = FC + VC$, $\$10 + 4 * \$9.0 = \$46$.

Figure 2.0

L	W	TFC	Q	MFC	MP	P	MR	MRP
0	7.00	0	0	0	0	2	2	0
1	8.00	8	8	8	8	2	2	16
2	9.00	18	15	10	7	2	2	14
3	10.00	30	21	12	6	2	2	12
4	11.00	44	26	14	5	2	2	10
5	12.00	60	30	16	4	2	2	8

Again let's assume that fixed costs are \$10. MFC is calculated as $\text{chg TFC} / \text{chg L}$, at $L = 3$ $(30-18)/(3-2) = 12$. Marginal product at where $Q = 21$, is computed by $\text{chg Q} / \text{chg L}$, $(21-15)/(3-2)$ or 6. Note that in this example, the firm is operating in a competitive product market. Marginal revenue equals price. The Marginal Revenue Product at $Q=21$ is $MR * MP$ or $2 * 6$ which equals 12. The firm will hire at where $MFC = MRP$ thus hiring 3 units of labor. At the profit maximization point, profit will equal \$2.

The Capital Market

General Assumptions of the Capital Market

We make the simple assumption that capital is fungible and mobile. Similar to labor. Advanced courses will relax these assumptions.

Capital Demand

(Demand for a Fixed Factor)

Some of the same terminology used for the labor market can be applied to the capital market. Again, as in the labor market, demand for capital or more specifically, capital assets is a derived demand. Businesses acquire capital assets such as buildings, plant, and equipment to service future sales. Unlike labor which is paid directly via wages, capital must earn a return to be paid to its owners. Owners in this sense could apply to debt holders which could be a bank that has extended credit to the firm. That return, for simplicity, can be called interest.

Effect of Income on Capital Demand

As in the labor market, there is a marginal product (the marginal product of capital, MPK), the output attributable to one unit of capital. That output is priced (more specifically, price minus the costs paid to the other factors of production). Consequently, the product of $MPK * P$ is the return on one unit of capital. It is the rate of return directly comparable to an interest rate.

The idea is very simple, acquire capital assets only when the rate of return exceeds the cost of capital. However, if a firm is operating below the capacity of its capital assets, it will not seek to acquire more capital.

The cost of capital is the return or interest rate paid to the owners of capital (debt or equity) whether they are creditors, banks, or stockholders.

As in the labor market, productivity affects demand for capital assets. Higher productivity diminishes demand, but if capital is substitutable for other factors, such as labor, then demand may actually increase in the short term.

Technology typically has a great impact on capital spending. Capital assets embodying the new technology are in great demand. However, it must be understood, firms replace existing assets with new assets only if there is an expected increase in profitability.

Effect of Interest Rates on Capital Demand

The cost of capital is stated as an interest rate. Sometimes it is called the price of credit. There is a structure of interest rates. Interest rates are a function of risk, term, inflation, and liquidity. These are somewhat interrelated. Many of these relationships are revealed in the Fisher condition. It says that the nominal interest rate = real rate + inflation + risk premium. The real rate is a riskless rate without inflation, typically it is close to 3%. Interest rates vary according to supply and demand conditions in the capital markets. This is covered in more detail in macroeconomics courses.

Effect of Risk on Capital Demand

Most people are risk averse. That means people want to avoid risk. If you want them to assume risk, they will want more money, ie. return. Consequently, we say investor's demand higher return for taking more risk.

There are many definitions of risk but the best one for our purposes is simply, variability of return. The larger the ups and downs of return, the riskier it is. Return that is constant, let's say 3% per year, has little risk. You know you will get 3%.

When buying a capital asset, we are buying a series of cash flows, one cash flow for each period or year. A series of even cash flows is called an annuity. The cash flow can occur at the end of the period, such as in paying a loan, which is called an ordinary annuity. Cash flows occurring at the beginning of the period are called an annuity due, such as paying the rent at the first of each month.

Unfortunately, capital assets rarely generate a nice even constant cash flow. Some projects have a greater variability of cash flow than others, hence, they are considered riskier.

Other projects have an uncertain cash flow. That is, cash flows cannot be accurately forecasted. Uncertainly, can be considered risk. In capital budgeting, risk demands a higher return, that is, a higher interest rate.

Capital Supply

Capital is often used in two senses of the word. One, refers to the funds used to buy the assets, the other to the assets themselves.

From the viewpoint of funds, the supply of capital depends on savings, more to the point, retained earnings, which is business savings.

From the viewpoint of assets, capital is fixed. Once it is there, it is there a long time. Whereas for labor when demand varies, the amount of labor hired varies, for capital, the amount of capital employed does NOT change.

Effect of Income

Increases in National Income increases savings, it is savings that provides the funds for capital.

Increasing a firm's income gives the firm more funds to invest, business savings. This lessens the need to obtain outside financing such as from banks, bonds and stocks.

Effect of Interest Rates

Typically, interest rates have little impact on national savings. In the capital markets, they are the price of capital that allocates capital. To the firm however, interest rates attract capital. Firms compete for capital against other firms. Offering a higher interest rate attracts more capital funds.

Effect of Risk

Investors demand more return when there is more risk. In other words, a higher interest rate is needed to attract funds.

The Nature of Capital Markets

Capital markets in the United States are generally very competitive and well organized. European capital markets are not far behind but this discussion will focus on American markets. Access to capital may depend somewhat on firm size. Small firms are able to consider several banks for small business loans. Additionally, depending on the tides of politics, the Small Business Administration may make credit available. New firms with good growth possibilities may be able to secure financing from venture capitalists. Large firms have more choices as they can access capital markets directly by issuing bonds and/or stock.

Very rarely will a firm face a monopolistic supply of capital. However, in foreign countries, the situation is very different. It is quite common in many countries not to have access to a developed capital market. Furthermore, the banking system may be monopolized by the state or owned by one of the ruler's family. If one of your competitors is owned by one of the ruler's relatives, you are not going to get access to bank credit.

As the trend toward globalization continues, expect better development of and access to global capital markets.

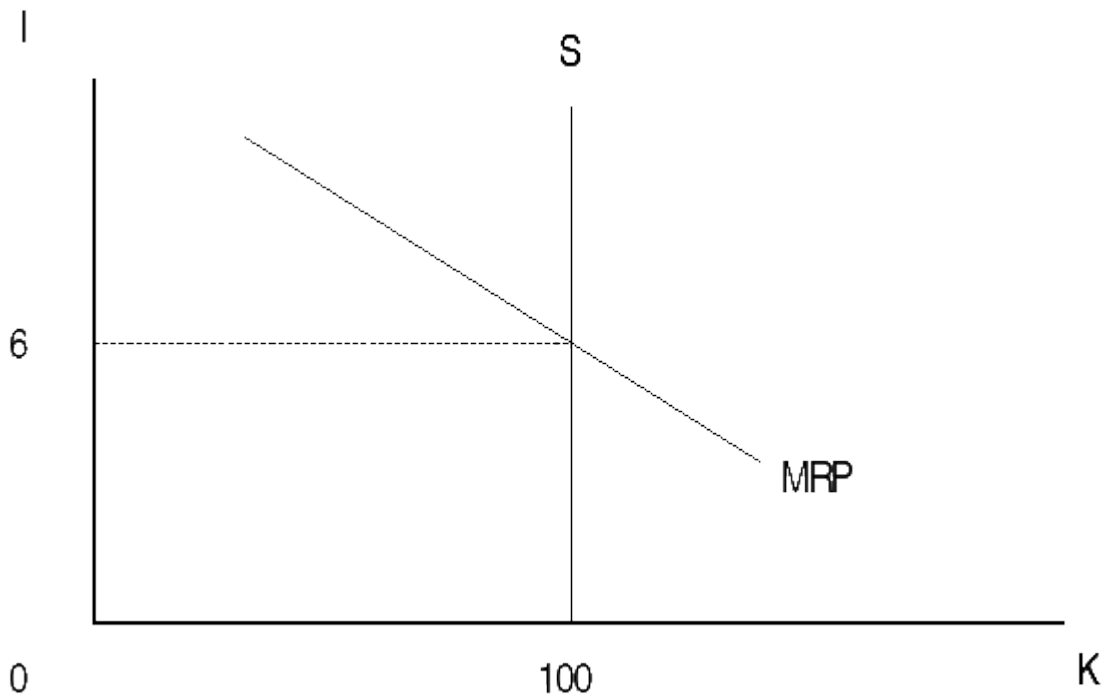
Economic Rent

Economic rent is sum of wages (or price of any input) in excess of that needed to hire workers (that input). It is the area between the supply line and the equilibrium level of wage, in other words, it is the producer surplus.

The idea is that land will be provided regardless of the price. This ignores the desirability (or undesirability) of land due to erosion, pollution, soil characteristics, and of course, location. Land frequently has alternative uses such as residential, commercial, or industrial.

When supply is fixed (supply is inelastic), as in the case of land, the market price is determined by the intersection of the demand curve. In this case the entire value of the land is economic rent.

One outcome of the economic rent discussion was a proposal to finance all government operations via a single tax on land. Normally, taxes have a distortionary effect on prices and output. A tax on land was thought to avoid some of these problems since land would be provided regardless of the prices, or tax.



Multiple Inputs

The situation becomes more complicated in the case of multiple inputs. No longer can one VMP (or one MRP in the case of monopolistic product markets) curve give the optimum result. Interdependency of the inputs requires calculus for a solution. When more capital is used the MP of labor is increased. The productivity of each factor is dependent on the quantity used of the other factors. This can cause an increase or decrease in the quantity of factors used.

For example, let's consider the effects on labor due to an increase in the price of labor relative to capital (causes VMP curve to shift). There are two types of effects, a substitution effect and an output effect. The combination of the two is called the net effect or profit maximizing effect. If the substitution effect

is negative, relative use of an input such as labor will decline as its price increases. Capital will be used in its place. With a positive output effect, production increases as cost of an input such as labor decreases. When the cost of labor increases, as in our example, we have a negative output effect, that is, output drops as less inputs are used. In our example, both the substitution and output effects caused the quantity of labor employed to drop.

In short, due to the profit maximizing effect, a firm does not necessarily keep its expenditures constant when input prices change. Adjustments are made in the quantity of factors employed which will probably change the output level. In order to maximize profit, both output and inputs are changed.

There is a simple rule that can be used to find the least cost combination given an output. Equalize the ratios of marginal product to factor prices. Considering that many firms are adjusting to an average output, they have little market power, this rule produces good results.

Capital Budgeting

Capital budgeting is a systematic approach to allocating funds to their best and highest use. Capital budgeting techniques are used by business to determine the most profitable use of capital. Used to rank projects, to evaluate each project's profitability, can be used for sensitivity analysis, how much is profitability affected by changes in the interest rate.

To determine how much capital is going to be demanded and supplied by firms, one needs to understand the principles of present value.

Present value of a lump sum = Cash Flow / $(1 + r)^n$

For example, if \$1,000 is to be received in two years, given a current interest rate of 10%, what is its present value?

$$\$1,000 / 1.10^2 = \$826.45$$

Why is the current worth of future receipts less than their face value (aside from the mathematical rationale)? People prefer current consumption to future consumption. Funds not spent today can be lent to earn interest. PV can be applied both to the earnings and payments stream.

For a cash flow that is constant and extends into infinity, the formula is simply:

$$PV = CF / r$$

This is called a perpetuity. If the cash flow (CF) is \$5,000 with a rate (often called a discount rate) of 20% then the PV equals \$25,000. Another way of visualizing this is think about a savings account with a \$25,000 balance earning 20% per year. That would generate \$5,000 interest income each year.

If the rate increases to 25%, then the value of the cash flow stream drops to \$20,000. You can verify this by taking \$20,000 times 25% to earn \$5,000 per year.

If the rate decreases to 10%, then the value of the cash flow stream increases to \$50,000. In all PV problems the pattern is the same, increases in the discount rate decrease the PV, decreases in the discount rate increase the PV. The present value is really the asset value, which is dependent on the income stream generated by that asset.

Demand for capital varies inversely with the interest rate. As interest rates increase, the cost of the project increases. This is reflected in the decreasing present value. An example of this arises in bond pricing. Bond pricing really is an application of present value.

How do you value a cash flow that increases at a constant rate? This is called the Gordon Growth model. Here the asset value = $CF_0 / (r - g)$. For example, if your favorite firm is growing at 5% per year and the discount rate is 10% then with an initial cash flow of \$1,000 (CF_0 means initial cash flow in the current period), the value would be $\$1,000 / (10\% - 5\%) = \$20,000$. Increase the growth rate to 8% and the value increases to \$50,000.

This model is not valid if the growth rate is greater than the discount rate. It does show that small increases in the growth rate cause large increases in the asset value. Be careful of the assumptions used in this model! Firms cannot grow faster than the nominal growth rate of the economy in the long run. In cases where firms are experiencing a temporary higher than normal growth rate that will drop in the

future, a different more sophisticated model is needed. That is beyond the scope of this discussion but can be handled with an extended PV model.

Stock prices, in the long run, can be expected to be influenced by firm earnings and the discount rate. Some of the price volatility (but not most of it) can be explained by variations in earnings and interest rates.

Net Present Value (NPV)

Firms or projects with irregular cash flows can be handled by discounting each individual cash flow back to the present.

Figure 3.0 Capital Budgeting Comprehensive Example

Yr	Cash Flow	Discount Rate	Discount Factor	Present Value	IRR 23.38%	Present Value
0	-2,000	5.0%	1.0	-2,000	1.00	0
1	1,000	5.0%	.952	952	.811	811
2	1,000	5.0%	.907	907	.657	657
3	1,000	5.0%	.864	864	.532	532
NPV				\$723		\$0

From the table above, reading from left to right, is the period, cash flow, discount rate, and then the discount factor is multiplied by the cash flow to calculate the present value of each period's cash flow. For example, in year 2, using a 5% discount rate, generates a discount factor of .907, which is $1/(1.05)^2$. Net Present Value equals the sum of the present values minus the original cost (2,000), which here is \$723. Profit maximization rules suggest acquiring assets only when their net present value is positive ($NPV = PV - Cost$). PV can vary greatly depending on the interest rate (discount factor) chosen and timing of cash flow.

Assumptions of NPV

There are a couple of key assumptions behind NPV. One, that cash flows will be reinvested at the discount rate. Modified NPV, another technique, modifies the reinvestment rate to a more realistic number. This is often called the reinvestment assumption.

Two, a problem arises in comparing projects of different sizes. NPV is affected greatly by scale. It assumes implicitly that all projects are alike in scale.

Internal Rate of Return (IRR)

Another perspective is obtained by calculating the Internal Rate of Return (IRR). This is the rate necessary for $NPV = 0$. The advantage of this calculation is that it allows managers to compare different size projects and opportunity costs of investment (firms could invest spare funds in the capital markets) in a convenient, easy to define interest rate.

Assumptions of IRR

IRR makes an important assumption about the reinvestment of cash flows, they are reinvested earning the same rate as the project. In this particular case, it is doubtful that the firm can find other investments generating a 23% return. Modified IRR, another technique, modifies the reinvestment rate to a more realistic number.

Importance of the Interest Rate and Cost of Capital

Selection of the interest rate used in capital budgeting is important. While this is covered in detail in a finance course, a few essentials will be discussed here. Companies must cover their costs of capital. Capital used to finance firms usually is a combination of debt and equity. Consequently a weighted average cost of capital or a marginal cost of capital (preferred by economic theory) is utilized. Any project that has a return higher than this "hurdle rate" is accepted. This hurdle rate is used as the discount rate in NPV or as a comparison against IRR that projects have to beat to be considered. Additional adjustments may be made depending on the risk characteristics of the project or expected future economic environment.

STUDY GUIDE

Fill in the Blank

Labor

1. Income of the household is determined by _____.
2. The demand for factors is a _____ demand.
3. Marginal Revenue Product = _____ * _____.
4. Marginal Factor Cost = _____.
5. Value of the Marginal Product = _____ * _____.
6. _____ = _____ for a competitive product and factor market.
7. Employment is set at the point where _____ = _____.
8. $MFC = SL$ for a _____ factor market.
9. The revenue associated with hiring an additional worker is called _____.
10. The cost with hiring an additional worker is called _____.
11. Competitive product and factor market profit maximization rule is _____ = _____.
12. In a competitive labor market, at the market _____, firms are able to hire as many staff as they need.
13. In a monopolistic labor market, firms must increase _____ to hire more labor. Consequently, _____ < _____.
14. MFC rises faster than the wage necessary to attract additional workers, as _____ workers must also be paid the higher wage.
15. Increases in labor productivity tend to reduce _____.

Capital

16. _____ is the current worth of future funds.
17. _____ and _____ are the most commonly used capital budgeting techniques.
18. The nominal interest rate includes as components _____.
19. Profit maximization rule using NPV: acquire asset when _____ > 0.
20. $NPV = \text{_____} - \text{_____}$.
21. Demand for capital varies _____ with the interest rate.
22. _____ is the rate at which PV of revenues = the PV of costs.
23. Rates of return on capital projects falling below the hurdle rate are _____.
24. As the project's riskiness increases, the required _____ increases.
25. In a competitive capital market, at the market _____, firms are able to obtain funds, given a normal risk.
26. The quantity $MPK * K$ is roughly equivalent to _____.
27. Both IRR and NPV rely on a(n) _____ assumption.
28. $MPK * P$ measures the _____ per unit of capital.
29. The profit maximization rule using IRR: acquire asset when $IRR > \text{_____}$.
30. _____ is a systematic approach to allocating funds for capital projects.

General

31. Least cost combination rule: equalize ratios of _____ to _____.
32. Graphical method: optimal production at point where _____ is tangent to _____.
33. _____ curve is a line at which output is constant while proportions of inputs change.
34. _____ curve is a line at which cost of output is held constant while costs of inputs vary.
35. In the case of multiple variable inputs, marginal product of factors are _____ as changes in the price of one factor affect its usage and therefore the _____ of the other factors.
36. Determinants of factor demand include: _____.
37. _____ affect the price elasticity of demand for a factor.
38. _____ is the definition of a sole buyer of a particular input.
39. _____ is payment beyond that necessary to employ the factor.
40. _____ is payment to a factor whose supply is fixed.
41. Quasi rent is payment to a factor whose supply is fixed in the _____ run.
42. With a substitution effect, an increase in the price of capital will cause _____ to be substituted for _____.
43. With an output effect, an increase in the price of capital will cause _____ to be substituted for _____.
44. A decrease in the price of labor which causes more capital to be used can be attributed to a(n) _____ effect.

FIB Solutions

Labor

1. factor prices, factor quantity
2. derived
3. Marginal Product, Marginal Revenue
4. wage rate
5. Marginal Product, Price
6. $VMP = MRP$
7. $MRP = MFC$
8. competitive
9. MRP [marginal revenue product]
10. MFC [marginal factor cost]
11. VMP, W
12. wage
13. wages, W, MFC
14. current
15. labor demand

Capital

16. Present value
17. Net Present Value, Internal Rate of Return
18. real interest rate, inflation, default risk
19. NPV
20. present value, cost
21. inversely
22. IRR
23. rejected
24. return
25. interest rate
26. IRR
27. reinvestment rate
28. return
29. hurdle rate
30. Capital budgeting

General

31. marginal product, factor costs [prices]
32. isoquant, isocost
33. Isoquant
34. Isocost
35. interdependent, marginal productivity
36. demand curve shifts, substitute factor prices, and marginal productivity changes
37. factor substitutability, product price elasticity, time, proportion of production costs that the factor represents
38. monopsony
39. Economic rent
40. Rent
41. short run
42. labor, capital
43. labor, capital
44. output

True/False

Labor

1. A monopolistic firm will hire inputs until their $MRP = MFC$.
2. In a competitive factor market the firm's $MFC = W$.
3. In a competitive factor market, the market $S = MFC$.
4. In a monopsonistic factor market, S and MFC are two distinct curves.
5. The quantity of labor hired in a monopolistic product market compared to a competitive product market will be higher.
6. The wage paid in a monopolistic product market compared to a competitive product market will be higher.
7. MRP is affected by available supply of labor.
8. Declining markets can put downward pressure on industry employment and wages.
9. Increasing productivity shifts the MRP to the left thereby decreasing employment for that industry with a competitive factor market.
10. Increasing product price shifts the MRP to the right thereby increasing demand for labor.
11. Productivity of labor affects supply of labor.

Capital

12. Funds not spent today cannot be lent to earn interest.
13. Bond prices will be less than par value when market rates exceed coupon rates.
14. The Net Present Value of a project will decline as the discount rate is decreased.
15. Demand for capital will increase due to interest rate increases.
16. Net Present Value assumes reinvestment of funds at the discount rate.
17. Internal Rate of Return assumes reinvestment of funds at the IRR.

General

18. People generally prefer current consumption to future consumption.
19. Product demand variables affect MRP through price attached to output.

True/False Solutions

Labor

1. True
2. True
3. True
4. True
5. False
6. False, this why there are unions.
7. False, MRP represents demand.
8. True, MRP shifts to left, fewer labor is hired and wages are less.
9. True
10. True
11. False, only affects demand.

Capital

12. False
13. True
14. False
15. False, it decreases.
16. True
17. True

General

18. True
19. True, price is a function of demand.

Problems & Exercises

1. Fill in the missing numbers in the table below.

L	W	Q	MFC	MP	P	MR	MRP
0	6	0	6	0	3	3	0
1	6	10	6	10	(d)	3	30
2	6	18	6	(c)	3	3	24
3	6	2	6	6	3	3	18
4	(a)	28	6	4	3	(e)	12
5	6	30	(b)	2	3	3	(f)
6	6	30	6	0	3	3	0

There are fixed costs of 20.

2. Using data from problem 1:

a. What is the output at the point of profit maximization?

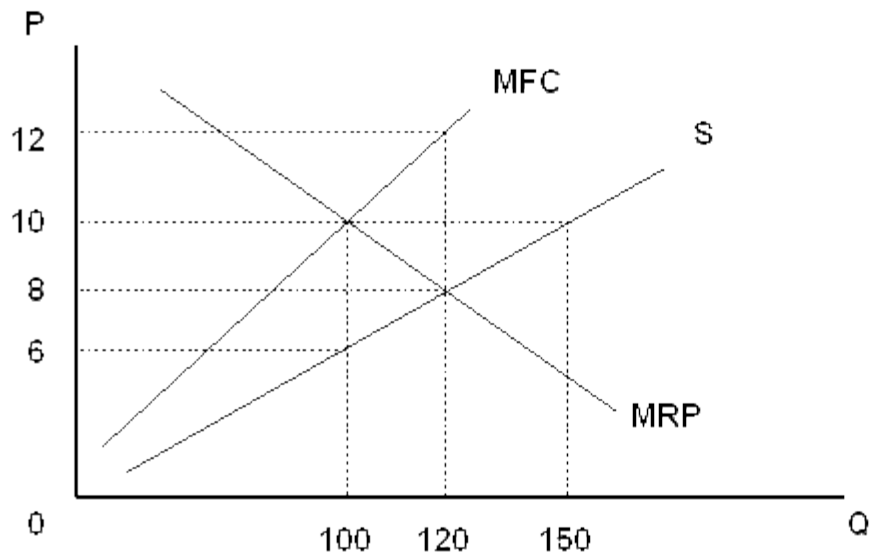
3. What is profit earned at the point of profit maximization?
4. What is the amount of labor employed and its cost?
5. If fixed costs increased \$10, what would be the point of profit maximization?
6. What is the type of factor market in which the firm operates?
7. What is the type of product market in which the firm operates?

8. Time Value of Money (TVM)

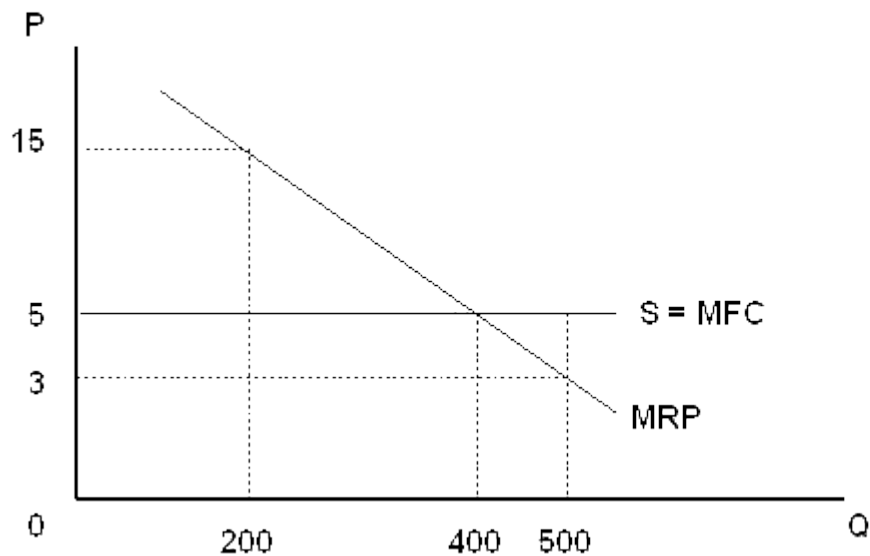
a. What is the present value of \$1,000 received in 5 years at an interest rate of 6%?

9. What is the future value of \$1,000 at an interest rate of 7% in 4 years?
10. What is the present value of a project that generates cash flows of \$10,000 for five years using a discount rate of 8%?
11. What would be the net present value of the project above if its investment costs is \$20,000?
12. What would be the internal rate of return for a project that cost \$50,000 and had cash flows of \$6,000 for 20 years?
13. From the table below, rank the projects in order of acceptance using NPV the IRR criteria.

Project	NPV	IRR
A	200,000	10%
B	50,000	12%
C	60,000	14%
D	150,000	9%



14. Use the above graph to answer the following questions.
- What is the equilibrium quantity of labor employed?
15. What is the MFC when $L = 120$?
16. What is the wage rate when $L = 120$?
17. What is the equilibrium wage rate?
18. What type of market is this?



19. Use the above graph to answer the following questions.
- What is the profit maximizing level of employment?
20. What is the equilibrium wage rate?
21. What is the MRP when $L = 200$?
22. How much profit or loss per unit of labor will be incurred at $L = 500$?
23. Given a constant product price of \$2, what is the MPL at $L = 15$?

Answers & Solutions

1. Fill in the missing numbers in the table below.
 - a. 6: the wage is constant in a competitive labor market.
2. 6: $MFC = w$ in a competitive labor market.
3. 8: $MP = \text{chg } Q / \text{chg } L = (10-18)/(1-2)$
4. 3: the price is constant in a competitive product market.
5. 3: $MR = P$ in a competitive product market.
6. 6: $MRP = MPR * MR$; $2 * 3$
7. Using data from problem 1
 - a. 30
8. $90 - 3 - 20 = 40$
9. 5 units, \$30
- 10.No change from previous answer, 5 units
- 11.Competitive
- 12.Competitive
- 13.TVM
 - a. \$747.26
- 14.\$1,310.80
- 15.\$39,927.10
- 16.\$19,927.10
- 17.10.32%
- 18.NPV: A,D,C,B; IRR: C,B,A,D
- 19.Factor Market graph
 - a. 100
- 20.\$12
- 21.8
- 22.6
- 23.monopolistic factor market
- 24.Factor Market graph
 - a. 400
- 25.\$5
- 26.15
- 27.62, loss
- 28.13, 15-2

Activities and Discussion

1. What is the average salary per employee for General Motors?
2. What is the average sales per employee for General Motors?

Selected Definitions

Capital Budgeting

The procedure used to determine how much capital will be used and how it is to be used.

Cost of Capital

The rate necessary to compensate providers of funds such as banks, bondholders, and stockholders.

Discount Rate

The interest rate used to discount future cash flows.

Discounted Value (DV)

Found by applying the discount factor, $1/(1+r)^n$, times the cash flow.

Economic Rent

Excess payment beyond that necessary to employ input. It is the producer surplus.

Future Value (FV)

Cash flow received at some point in the future.

Hurdle Rate

The rate of return necessary to achieve return objectives.

Internal Rate of Return (IRR)

The discount rate necessary to equate the value of the discounted cash flow to the cost. NPV would be zero.

Marginal Factor Cost (MFC)

The additional cost of hiring one additional unit of a factor such as labor.

Marginal Revenue Product (MRP)

It is similar to VMP but the value of the output is determined by marginal revenue as opposed to price as selling additional output in a monopolistic product market requires lowering price.

Net Present Value (NPV)

The value of future discounted cash flows minus the cost.

Present Value (PV)

Same as discounted value.

Reinvestment Rate

The rate of return earned by funds from cash flows generated in a project or investment and reinvested.

Risk

The variability of return or cash flow.

Value of the Marginal Product (VMP)

The value of the output generated by employing one more unit of a factor such as labor, price * marginal product.

Selected Formulas

$$MFC = TFC / L$$

$$MRP = MPL * MR$$