

I. What is Capital?

In the previous lecture we've looked at the labor and land markets and determined that firms will demand both labor and capital to the point where the marginal revenue product is equal to the price of the input. Now we turn to the capital market and examine what are the factors that lead to firm demand for capital. To start we need to define capital.

Capital are goods produced that are used as inputs to produce other goods in the future. Unlike some other inputs, capital exists both in the present and in the future. They are usually not used up in the production process. Although it is challenging to measure output directly we do have an indirect measure called **capital stock**. Capital stock is the current market value of all the firms' plants, equipment, inventories and intangible assets.

A. Types of Capital

Capital can be broken into three broad categories.

1. **Tangible Capital**-Tangible capital are the physical units that are employed by the firm.
 - a. **Non-Residential Structures (office buildings; factories)**
 - b. **Residential Structures (apartment buildings; houses; condos)**
 - c. **Durable Equipment**-Equipment that will last a long time (such as trucks, machines)
 - d. **Inventories of inputs and output**
2. **Social Capital (Infrastructure)**-Social capital is tangible capital that is owned not by private firms, but by the public and are used to provide services to the public. Examples of social capital include highways, bridges, police cars, fire trucks, etc)
3. **Intangible Capital**. Intangible capital are non-material things that contribute to the output of future goods. **Human capital** is one of the most important forms of intangible capital. It is the skills and knowledge that workers acquire through education or training. Make workers more productive in the future.

B. Investment and Depreciation

The amount of capital for a firm is constantly changing. It depends on investment and depreciation. **Investment** is new addition to a firm's capital stock and it increases the stock of capital. **Depreciation** is the decline of capital stock over time. Depreciation occurs due to the normal wear and tear of using capital or can occur if the capital becomes obsolete. A good analogy of investment and depreciation and its relationship to the stock of a capital is a bathtub full of water. The water already in the bathtub is the stock of capital, while the new water that comes from the faucet can be thought of as investment. "Depreciation" occurs when water goes down the drain. The point is that the amount of capital a firm has is never static, as new capital comes in while old capital wears out.

C. The Capital Market

We now turn to the question of where does capital come from. In the input markets it is households that supply the factors of production. Thus capital comes from households. Households do not sell firms the actual trucks, factories or other tangible capital, but they do provide funds by which firms can purchase their capital stock. Households can supply the funds to firms **directly** or **indirectly**. We'll look at both methods.

1. **Direct Financing.** For both direct and indirect financing we'll assume that households can do two things with their income. Households can either use their income for consumption or save it. If households have left over funds after their consumption they save it by lending it directly to firms. Suppose a household has \$1000 left over for savings. They will loan that \$1000 to the firms by way of purchasing a **bond**. A bond is simply an IOU issued by the firm. In exchange for the \$1000 from the household, the firm will issue a promise of repayment at some point in the future. Bonds almost always pay an interest. The firm will use the \$1000 to purchase its capital. Since the funds are supplied from the household to the firm with no middleman, it is called direct finance.
2. **Indirect Finance.** Most of the time, however, the household supplies funds to firms through a third party such as a bank. These third parties are called **financial intermediaries**. Typically households supply funds to these financial intermediaries who in turn lend the same funds out to firms who then uses it to purchase its capital. Suppose that a household has \$1000 in savings. One option is that they could deposit the savings into a bank account. They would then receive interest for their deposit from the bank. The bank would be silly just to hold on to the money in their bank vault. Since they are paying interest on the deposits, they need to loan it out at a higher interest rate to make money. What a bank will do is to loan that same \$1000 to a firm. The firm will pay interest to the bank for the loan. With its \$1000 the firm can now purchase their capital. This indirect method of funds going from households to firms is called the **financial capital market**.

D. Capital Income

Households are willing to supply capital to firms or banks because they earn **capital income**. Capital income is the income earned by household savings in the financial capital market. This income comes in two forms: Interest and Profit.

1. **Interest.** Interest is the payment made for the use of money. Another way to think of interest is the cost of borrowing. The **interest rate** is the annual interest payment as a percentage of the loan.

Example: Suppose that a household has savings of \$1000 that pays them an annual interest payment of \$100. The interest rate will be $\$100/\$1000 = 10\%$

Interest rates can vary across individuals and firms. A prime determinant of the rate of interest is the riskiness of the borrower. If there is a strong chance that a firm would go bankrupt, a higher interest rate will be required for the firm to get a loan. Likewise, an

individual with a bad credit score will find that they will have to pay a high interest rate on any loan they get.

- 2. Profits.** We saw how households that provide direct financing received a bond from a firm. There is another method, whereby households in exchange for funds receive a part-ownership of a company. Households receive **stock** in a company that is an ownership claim on a firm which entitles the stockholder to a share of the profit.

For example, company XYZ needed some funds for an investment capital project. You gave XYZ \$10,000 and in exchange XYZ gave you 1000 shares. Suppose that there are 100,000 shares outstanding in company XYZ. You are now a 1% owner of the company and are entitled to 1% of its profits. Profits of companies that are paid to its shareholders are called **dividends**.

It's important to remember when we speak of profits we are talking about **economic profits**. Households are not earning an economic profit unless it covers at least the opportunity cost of an alternative project.

For example, suppose you invested \$100,000 in company ABC and received a dividend of \$3000. Your profit is not necessarily \$3000. Suppose with that same \$100,000 you could have purchased government bonds which paid a 5% return. Instead of earning that \$5000 return you only earned \$3000 so you actually earned a negative profit by investing in company ABC.

Capital income is important because it provides the proper incentive to households to supply funds which firms can use to purchase capital. Interest is the reward for households for delaying their consumption, while the prospect of profits is the reward to households for taking risks and investing in companies.

E. Raising Capital

The firm has several ways they can raise the funds for their demand of capital several of which we have already examined. A firm can

- 1. Borrow.** Firms can borrow from banks in the form of business loans
- 2. Venture Capital.** There are a type of financial intermediaries called venture capitalists that specialize in investing in high risk projects. Firms receive money from venture capitalists in exchange for a share of the profits.
- 3. Retained earnings.** When firms earn a profit, they don't always distribute the profit back to shareholders. Sometimes firms will use some of the profit and use it to fund capital investment.
- 4. The Stock Market.** As we saw, firms can issue new shares of stock and sell them to investors. Firms receive the funds from the sale, while the holders of the newly issued shares are now entitled to a portion of the firm's profit.

II. Deriving the Demand for Capital

The investment decision made by firms involves a two step process. First firms must evaluate the cost of the capital project. Typically the cost must be incurred today. The second step is that firms must then form some expectation about the future. If the firm invests in a machine today how much extra revenue will that investment provide the firm in the future. If the future expected revenue from the investment project exceeds the cost today of undertaking the investment, the firm should invest in capital. If on the other hand, the future expected revenue from the project is less than the cost of the investment, the firm should not invest in the capital project. An added complication to this simple calculation is that the cost of the project is paid in today's dollars, while the revenue is paid in future dollars. We must first develop a tool that will allow us to compare today's cost with tomorrow's benefit.

A. Present Value

Present value is the maximum amount you are willing to pay today for some amount in the future. The basic idea is that money received today is worth more than money received in the future. To illustrate this suppose that you were given a choice between receiving \$100 today versus receiving \$100 next year. Clearly you would want to take the \$100 today. The reason why is that you could take the \$100 put it in the bank and earn some interest. As a result you would have more than \$100 next year.

How do we calculate present value?

Let i = interest rate offered by the bank for deposits

Suppose that you received \$100 as a birthday gift and you want to put it in the bank which is paying a 5% interest. How much will you have next year?

Future Amount Next Year = \$100 + \$100*i*
(principal) (interest payment)

Next year you'll get back your \$100 (the principal) plus the interest payment. In this case since $i=5\%$ you'll get \$5 in interest thus the future amount next year will be \$105.

We could also have re-written the formula as

Future Amount Next Year = \$100(1+ i)

Next year you'll get back your \$100 (the principal or present value) plus the interest payment. In this case since $i=5\%$ you'll get \$5 in interest thus the future amount next year will be \$105. Other way of thinking of this is that you would be indifferent between choosing \$100 today or \$105 next year. In general if we let PV stand for present value and FV=future value we can derive the formula for finding the present value of a future amount 1 year from now.

$$PV = \frac{FV}{(1+i)}$$

Let us go back to our banking example. Suppose you have \$100 today, with interest rate of 10%. How much will you have 2 years from now?

We know that $FV_1 = PV (1+i)$

It must be the case that $FV_2 = FV_1(1+i)$ we can substitute for FV_1 to get

$$FV_2 = PV (1+i)^2 \quad \text{or} \quad PV = \frac{FV_2}{(1+i)^2}$$

In general to find what the present value is of some future amount n years in the future the formula is:

$$PV = \frac{FV_n}{(1+i)^n}$$

Example: Suppose you wished to purchase a \$20,000 car next year, and the current bank interest rate is 5%. How much do you have to save today in order to purchase the car next year?

Answer = $PV = (\$20,000)/1.05 = \19047.61

Note from the Present value formula the relationship between present value and interest rates. When interest rates increase, the present value falls. This should make sense, at high interest rates you will be willing to pay less today for some future amount in the future. Similarly when interest rates decrease, the present value will rise.

B. Interest Rates and Investment

The key determinant of the amount of investment is the interest rate. The higher the interest rate, the fewer investment projects that are going to be profitable, and thus fewer investments will be made. The investment function is a downward sloping curve.

$$I = I(r)$$

To help illustrate this important relationship we will use our present value theory.

Suppose you are a CEO of a firm that has several investment projects in which you could invest in. All of these projects will cost \$100, but they have different 1-year returns.

| Project # | Cost | Payoff in 1 Year | Present Value of Project if (r=2%) | Present Value of Project if (r=8%) |
|-----------|-------|------------------|------------------------------------|------------------------------------|
| A | \$100 | \$101 | \$99.02 | \$93.52 |
| B | \$100 | \$103 | \$100.98 | \$95.37 |
| C | \$100 | \$105 | \$102.94 | \$97.22 |
| D | \$100 | \$107 | \$104.90 | \$99.07 |
| E | \$100 | \$109 | \$106.86 | \$100.93 |

As you can see from the chart if the interest rate was initially at 2%, all of the investments would be profitable except for Project A. For example, according to present value formula a firm would be willing to pay \$102.94 for the future returns of Project C. Since the cost of the project is only \$100, the firm will gladly undertake this project. In fact the firm will undertake 4 of the investment projects when interest rates are at 2%

Suppose now that the interest rate is higher at 8%. From the chart, we see that only Project E is profitable. At a higher interest rate of 8%, the firm will only undertake 1 of the investment projects.

This simple example illustrates the point that the investment curve and interest rate are **negatively related**.

Figure 1 illustrates the investment demand diagram.

Figure 1

