The Market for Loans

When we consider the market for loans, it turns out that there is a supply curve for loans, and a demand curve for loans. And, as fate has it, the supply and demand curves satisfy the 1st Law of Supply and 1st Law of Demand as well. That is, the supply curve for loans is upward sloping; the demand curve for loans is downward sloping.

Flashback

Recollect when we first learned how to calculate GDP, we could classify goods into 4 categories.

Y = C + I + G + NX
- C = consumption - strawberry shakes, massages, Play Stations
- I = investment - spending to create new capital – forklifts, assembly lines
- G = government purchases
- NX = net exports – exports less imports

For today, we'll ignore the existence of government (hence G = 0), and assume that we have a closed economy, that is that we have no international trade (NX = 0). Thus, simplifying the above expression

Y = C + I

Recollect when we calculated GDP back in the day, we could think of GDP two ways.

We could think of it as output, or we could think of it as income. We could count up all the goods produced, or we could count up all the income created at each stage of production.

If we look at goods, we'll see either we can produce goods for consumption (pop tarts), or investment goods (cranes and hammers).

Y = C + I

It want to create more investment goods today, we'll have to give up consumption. More hammers means less pop tarts. But in the future we'll have more capital to produce goods, which will mean we'll be able to produce more pop tarts in the future. Investment is foregone current consumption in exchange for higher future consumption.

Or we can look at GDP as the economy's income. What can we do with our income? We can either spend it on consumption goods or we can save it. We'll denote S as the total amount of saving done by the economy.

Y = C + S

We can either spend our money today on consumption, or we can save some for later.

But of course, since output = income (these methods have to add up to the same answer), we can deduce that C + I = C + S

And thus, I = S

What does this mean? It means that somehow, in equilibrium, the amount of saving (S) in the economy will equal the amount of investment (I). Our next endeavor is to figure out how, and why this is important.

Demand for loans

Who demands loans? The biggest demander of loans will be firms. Firms (companies) such as Microsoft, IBM, and Ford borrow large quantities of money to invest in capital. While we won't be concerned with it too much in this class, they issue corporate bonds (essentially IOUs) that are bought and sold on a daily basis in the secondary market.

On many occasions when the government is running a budget deficit (always?), the government will demand a good deal of loans. We'll ignore this possibility for the time being. A small fraction of the demand for loans comes form households for cars, houses, etc.

Be that as it may, for now, we will think of loans being demanded by firms only for investment (purchasing capital).

Suppose there are three investment projects. Each considers purchasing a machine (capital) that costs $1000. To purchase the machine, the firm must borrow $1000. The machine will increase profits in the next year by a certain amount (shown below) and will fall apart at the end of the year, leaving no resale value. The firms must decide whether or not they should borrow the $1000 to purchase the capital. That is, the firm must decide how much money to invest.

Project A - $1000 investment (today)	$1100 increase in profits in next period
Project B - $1000 investment (today)	$1200 increase in profits in next period
Project C - $1000 investment (today)	$1300 increase in profits in next period.

We can figure out at what interest rate that a firm would be indifferent between investing in project C and not investing in project C, using our interest rate formulas.

$r = (A / P) - 1$
$r = \$1300 / \$1000 – 1 = 1.3 – 1 = 0.3 = 30\%$

Thus, if $r < 30\%$, the firm will make the investment.

For instance, if $r = 25\%$, the present value of the increased profits from purchasing the machine

$P = A / (1 + r) = \$1300 / 1.25 = \$1040$

It only costs $1000 for the machine, thus it is profitable to make the investment.

If $r > 30\%$, the firm will not make the investment

For instance, if $r = 35\%$, the present value of the increased profits from purchasing the machine

$P = A / (1 + r) = \$1300 / 1.35 = \$963$

The machine cost more than the increased profits, thus it is not profitable.

If $r = 30\%$ the firm will be indifferent between investing and not investing. We'll say that the firm will invest just to ease the exposition.

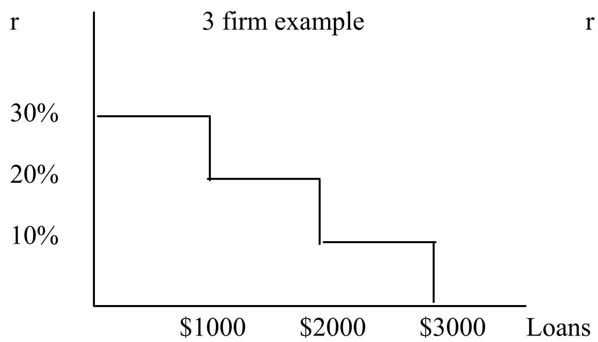
Repeating the same logic for firm project B, we find that if $r <20\%$, the firm will make the investment. Again, repeating the calculation for project A, we find that if $r<10\%$, the firm will make the investment.

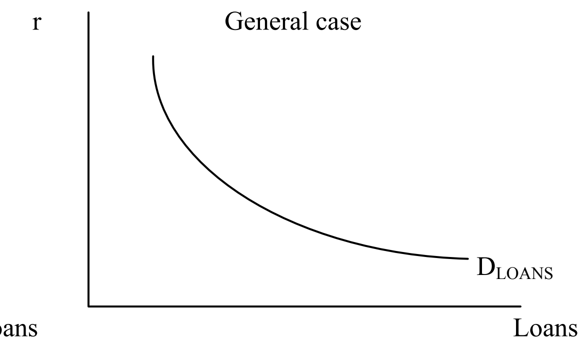
If $r = 30\%$, only project C is profitable, and $1000 worth of loans are demanded.
If $r = 20\%$, both project B and C are profitable, and $2000 worth of loans are demanded.
If $r = 10\%$, all three projects are profitable, and $3000 worth of loans are demanded.

Or looked at a bit differently,

At any interest rate larger than 30%, no firm finds it profitable to invest.
At any interest rate between 20% and 30%, just project C will be completed, thus I = $1000.
At any interest rate between 10% and 20%, project B and C will be completed, thus I = $2000
At any interest rate less than 10%, all three projects are completed, and I = $3000.

We can plot this relationship graphically, which is down below. While the graph has steps, it is a clearly a downward sloping relationship. It turns out if we allow many firms (instead of just three) and different sized investment opportunities, we will end up with a smooth downward sloping curve.





Essentially, the higher the interest rate, the fewer investment opportunities will be profitable, and hence the lower the quantity demanded of loans.

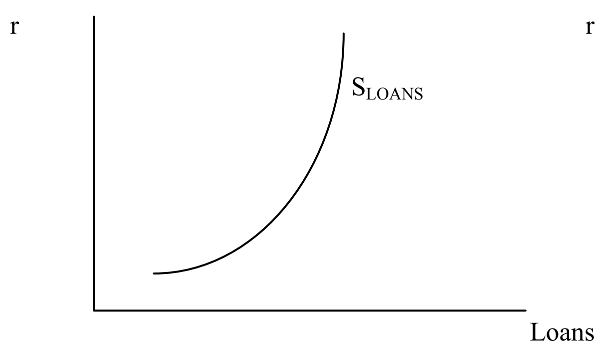
Likewise, the lower the interest rate, more investment opportunities will be profitable, the higher the quantity demanded of loans.

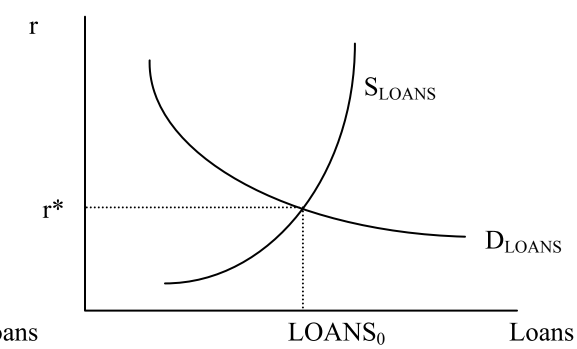
When you think of the demand for loans, think about it as the amount of investment that businesses would like at each real interest rate.

<u>Supply of Loans</u>

While it true both businesses and households each save, it will be easiest to think of the supply of savings as coming from households. In actuality, very few of us buy corporate bonds, but we do take our savings to banks. Though you probably don't realize this, banks take your savings and loan them to businesses. A bank is a financial intermediary (middleman) that takes my savings and your savings, packages them up, and loans them out to businesses. We will discuss financial intermediaries (maybe?) later in the semester. So if we ignore the middleman we can view savings as coming from households.

The supply curve of loans slopes upwards. As the interest rate increases, people gain more from lending. You earn more at a high interest rate than at a low interest rate, and thus you will be willing to loan higher quantities of money at higher interest rates.





Equilibrium in Loan Market

Equilibrium is shown on the graph above, on the right. The equilibrium interest rate is r*, and the equilibrium amount of loans is labeled $LOANS_0$. Don't confuse the amount of loans with the amount of labor.

We will assume that $\mathbf{D_{LOANS}}$ is comprised of only demand (by firms) for **investment**. Think of the demand curve for loans as telling us how much investment firms want to do at each interest rate.

By the same token we'll assume that $\mathbf{S_{LOANS}}$ is comprised of only **savings** from households. Think of the supply curve for loans as telling us how much savings households want to do at each interest rate.

At the **equilibrium interest rate**, the amount of **investment** desired by firms is equal to the amount of **savings** done by households. Putting this together in notional, at equilibrium, LOANS = S = I.

Why are we using r, the real interest rate, instead of R the nominal interest rate, when we are looking at the market for loans?

In this last example I was intentionally a bit vague about what interest rate we were talking about when we draw the supply and demand curves for loans. When a firm considers whether or not an investment is profitable, it will turn out that the expected inflation will not concern the firm. Thus the firm will be concerned with only the real interest rate. Why?

Consider an example, that is reproduced (without permission) from another macro book.

Sammy's Sports Store in considering borrowing $15,000 for a new machine that will produce 6,000 ball caps each year for the next three years then explode. The store can sell the caps for $1.00 each.

Suppose that r = 3% (the real interest rate = 3%).

First assume that there is no expected inflation. Thus, the nominal interest rate is the same as the real interest rate (R = r = 3%). In this case, the present value of the profits is

$$P = \$6000 / (1+r) + \$6000 / (1+r)^2 + \$6000 / (1+r^3$$
$$P = \$6000 / (1.03) + \$6000 / (1.03)^2 + \$6000 / (1.03)^3$$
$$P = \$6000 / (1.03) + \$6000 / (1.0609) + \$6000 / (1.0927)^3 = \$16,972$$

The increase in profits $16,792 exceeds the cost of the machine ($15,000): the machine is profitable.

If you pulled out your big calculator, you could after doing a fair amount of work, find out that if r = .097 (9.7%), the firm will be just indifferent between making the investment or not. At any real interest rate < 9.7%, the firm will make the investment.

Now, suppose that <u>expected</u> inflation rises to 5% per year. Does this change the profitability of the investment?

Now, the price they can sell the ball caps will increase 5% per year. The first year, the price of the cap will rise to $1.05. The second year to $1.1025. The third year to $1.158.

Thus, the first year, the machine generates 6000 * $1.05 = $6300
The second year, the machine generates 6000 * $1.1025 = $6615

The third year, the machine generates 6000 * 1.158 = $6946

Since expected inflation has risen to 5%, the Fisher equation tells us the nominal interest rate must go up. In fact, it tells us that $R = r + \pi^e = 3\% + 5\% = 8\%$. However, the Fisher equation is a slight approximation. It turns out that if expected inflation is 5% and the real interest rate is 3%, the nominal interest rate will actually be 8.15% (interested people can see below – if I don't make this adjustment, things get messy in the calculations below). You don't have to worry about this approximation. Thus, the present value of the project is now

$P = \$6300 / (1 + R) + \$6615 / (1 + R)^2 + \$6946 / (1+R)^3$
$P = \$6300 / (1.0815) + \$6615 / (1.0815)^2 + \$6946 / (1.0815)^3$
$P = \$6000 / (1.0815) + \$6000 / (1.1696) + \$6000 / (1.2650)^3 = \$16,972$

This is the same figure we came up with no expected inflation.
The investment is still profitable if $r < 9.7\%$.

While expected inflation causes the nominal interest rate to go up, it also causes the future revenue associated with the project to increase, because the price of caps will go up. The increase in the price of caps (revenue) caused by the inflation will be exactly offset by the increase in the interest rate, and on net, expected inflation will not matter.

Thus, the firm's investment and household's savings decisions concern the real interest rate. When we draw the demand and supply of loans, we should put the real interest rate on the vertical axis.

<u>Summary</u>

- The demand for loans is downward sloping; the supply for loans is upward sloping. The market for loans determines the real interest rate in the economy. At the equilibrium interest rate, the amount of money that firms want to invest is equal to the amount of money that households want to save. In short, at the equilibrium real interest rate, I = S.

- The real interest rate is the interest rate that matters for investment and savings decisions.

<u>What should I read</u>

Chapter 13 - particularly 274 – 281

<u>Stuff for mathematically inclined people is below – don't worry unless you want to</u>

Aside on the Fisher Equation approximation – that approximation

The Fisher equation **really** tells us that

$(1 + R) = (1 + r) * (1 + \pi^e)$
$1 + R = 1 + r + \pi^e + r * \pi^e$ Then, subtracting 1 from each side
$R = r + \pi^e + (r * \pi^e)$

The last term, $r * \pi^e$ is usually very small, so it is usually ignored, leaving us the familiar $R = r + \pi^e$

In our example, r = .03 (3%) and π^e = .05 (5%), thus $r * \pi^e = 0.03 * 0.05 = 0.0015$ (0.15%)

R = 3% + 5% + .15% = 8.15%

<u>If you are really a glutton for punishment and want to see expected inflation disappear</u>

Recollect that the amount of increased revenue associated with the new machine is the 6000 ball caps multiplied by the expected price. The expected price is just the original price, $1, adjusted for expected inflation.

Thus, for year one, expected revenue = $\$6000 * (1 + \pi^e)$
For year two, expected revenue = $\$6000 * (1 + \pi^e)^2$
For year three, expected revenue = $\$6000 * (1 + \pi^e)^3$

And $(1 + R) = (1 + r) * (1 + \pi^e)$

$$P = \frac{\text{revenue in year 1}}{(1 + R)} + \frac{\text{revenue in year 2}}{(1 + R)^2} + \frac{\text{revenue in year 3}}{(1 + R)^3}$$

$$P = \frac{\$6000 * (1 + \pi^e)}{(1 + r) * (1 + \pi^e)} + \frac{\$6000 * (1 + \pi^e)^2}{[(1 + r) * (1 + \pi^e)]^2} + \frac{\$6000 * (1 + \pi^e)^3}{[(1 + r) * (1 + \pi^e)]^3}$$

The $(1 + \pi^e)$ terms all cancel out, leaving you the original expression that only depends on the real interest rate.

$$P = \frac{\$6000}{(1 + r)} + \frac{\$6000}{(1 + r)^2} + \frac{\$6000}{(1 + r)^3}$$ the same expression we had with no inflation

<u>Someone asked me this question after class</u>

As an alternative to investing in the project, Sammy's Sports Store could just stick $15,000 in the bank at the going interest rate? Clearly if they have more money at the end of the three years with this plan, they would never build the machine? I agree.

But this is really what present value calculations do. Essentially, when we do the present value calculations, we are comparing the $15,000 today (already in terms of today's dollars – no work to do here) to the current dollar equivalent of the investment project (which we calculate with the formulas). Since we know we can turn $1 today into $1.0815 next year, this is why we divide the future dollars by (1+R).

What the question that was asked is really getting at is – could we also compare the alternatives by looking at how much they are worth in terms of future values? The answer is yes, and you'll get the same answer.

Stick $15,000 in the bank for three years, and you'll have

$$A = P * (1 + R)^3 = \$15{,}000 * (1.0815)^3 = \$18{,}975$$

Alternatively, you'd have
$6300 you'll get in a year, which you can stick in the bank for two years and
$6615 you'll get in two years, which you can stick in the bank for one year and
$6946 you get in three years

Thus, at the end of three years you'll have

$$\$6300 * (1.0815)^2 + \$6615 * 1.0815 + \$6946 = \$7369 + \$7154 + \$6946 = \$21{,}469$$

So again, you choose the investment project.

Now, after all that, which was easier? I like the present value way, put you can do what you want.