Lecture 9:  A Theory of Investment Demand,  
An Expanded Loanable Funds Model

We start by thinking about an individual company. We calculate the internal rates of return (IRR) of each potential project that the company is contemplating. Recall that the net present value (NPV) calculates the current value of a project’s expected future cash flows for a given discount rate. The IRR calculates the discount rate that results in a value of “ZERO” for the project’s NPV. Ergo, if the company’s cost of capital—their borrowing rate—is below the project’s IRR, the company will begin work on the project.

Engineering Economics at its finest

In theory, we can collect IRR for all projects in the economy. The chart, depicted above, a marginal efficiency of capital curve, provides us with an idealized version of the IRRs for the overall economy. It provides a measure of aggregate investment for the overall economy, a function of changing levels for the cost of capital. We can specify a cost of Capital r₀, and we have determined investment.
What is the problem with thinking in *engineering* terms? The cash flow projections for any project are *expected* cash flows. They are not engineering calculations because they depend upon how the future unfolds. If business disappoints, cash flows may well come up short. And that means, in turn, that expectations about cash flows and IRRs for investment opportunities are hostage, in part, to overall expectations. In a bullish phase for the economy, high expectations will justify aggressive investment for a given interest rate. A fall for overall expectations, in turn will elicit substantially less investment, given the same interest rate in place.

Hostage to expectations

\[ r_0 \rightarrow I_0 \text{ Amid recessionary expectations} \]
\[ r_0 \rightarrow I_1 \text{ Amid Boom expectations} \]

When we draw as IS Curve, from standard macro theory it is not an MEC Curve. It is not an engineering calculation. It is a set of investment and output levels for a given interest
rate that depends upon expectations. Thus it reflects the opinions of entrepreneurs, investors, bankers, and speculators.

**Macro Notion #1: A Downward Sloping IS Curve.**

Expectations, we insist are of paramount importance. Nonetheless, a downward sloping IS curve is a powerful macroeconomic notion. Fed policymakers and macro forecasters depend upon it, most of the time.

<table>
<thead>
<tr>
<th>Junk</th>
<th>Bond</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>For a given economic regime</td>
<td>drive real rates higher, activity will slow.</td>
</tr>
</tbody>
</table>

Essentially, economic practitioners operate under the assumption that a decision by the central bank to change the economy’s key interest rates, will affect the economy’s level of investment and its overall growth rate. The chart above makes this explicit for business fixed investment. We can interpret the chart as follows. For a given expectational regime the level of business fixed investment will move up and down with the borrowing rate that businesses confront. Alan Blinder, in the article in your readings, reminds us that econometric results find rate changes more likely to explain housing and car purchases than business investment. But the overall result—a big move for rates will elicit a change in overall investment and real GDP growth is a central tenet for central banks and forecasters.

How might we think about U.S. housing investment in the just past cycle? More specifically, what is the appropriate way to calculate the real interest rate that drives potential buyers of homes? Fred Mishkin while he was at the FRB in Washington suggested we consider the user cost of capital (UCC) for a potential home buyer. Here is a simplified version of his equation:

\[
UCC = IR - HpeR
\]

UCC is real user cost of capital, IR is the inflation adjusted mortgage interest rate, HpeR are real house price expectations.

The home buyer borrows money at a given real interest rate (mortgage rate minus expected inflation rate). She wants to adjust that real cost of money by comparing it to the real change in the value of the house over the borrowing period (expected change in house prices minus expected inflation rate over the period).

Suppose the mortgage rate is 6%/yr the buyer expects house prices to rise by 4%/yr and expected inflation is 2%/yr. The buyer views their user cost of capital as 0%.

Let’s now assume that inflation expectations remain constant at 2%. Then changes in the UCC are a function of changes in the mortgage rate and changes in house price expectations. Mortgage interest rates, of course are easy to identify. But what about house prices? These are expectations, after all, not historical developments.

The point Mishkin makes is that house price expectations are very much influenced by historical house price performances. In the boom of 2002-2006 strong house price increases, following twenty years of good gains, led people to raise their expectations about house prices. But the swoon for housing today is pushing house prices and long term house price expectations lower. Consider the following table:

<table>
<thead>
<tr>
<th>Year</th>
<th>Real U.C.C.</th>
<th>Real Rate</th>
<th>Real House Price Expectation</th>
<th>Housing Starts (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>1.8</td>
</tr>
<tr>
<td>2005</td>
<td>-2</td>
<td>4</td>
<td>6</td>
<td>2.1</td>
</tr>
<tr>
<td>2007</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>1.3</td>
</tr>
<tr>
<td>2009</td>
<td>6</td>
<td>3</td>
<td>-3</td>
<td>0.5</td>
</tr>
<tr>
<td>2010</td>
<td>5.6</td>
<td>2.6</td>
<td>-3</td>
<td>0.6</td>
</tr>
<tr>
<td>2013:Q1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0.9</td>
</tr>
</tbody>
</table>
What we present in the table above is a stylized look at U.S. housing using the Mishkin insights. The graph below converts the numbers in the table to an approximation of an investment schedule for U.S. housing. What we see is that the boom in housing owed much to the growing conviction about rising house prices and the consequent decline in the UCC. Conversely, falling confidence in house price appreciation raises the UCC. Indeed, if people actually begin to believe that housing prices will fall for the foreseeable future, then no change in mortgage rates will be able to restore a low UCC. Thus Mishkin was telling us that the 2008 housing crisis was a race between the Fed’s ability to drive rates lower and the public’s stepwise lowering of house price expectations. The Fed lost the race.

Consider the table below. The first column displays the year-on-year change in house prices, using the Case-Shiller 20-City house price index. We have emphasized in this class that ‘yesterday profoundly influences opinions about tomorrow’. We can create a 4-year weighted average of house price performance, the second column, subtract inflation expectations, and we have an adaptive expectations view of house prices. We then sprinkle in a bit of rationality and we can justify the real house price expectations embedded in the UCC table.

<table>
<thead>
<tr>
<th>Year</th>
<th>Case Shiller</th>
<th>4-year weighted average</th>
<th>Federal Reserve Breakeven Inflation</th>
<th>real house price expectations (F-G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>8</td>
<td>2.7</td>
<td>2.7</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>12</td>
<td>2.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>11</td>
<td>3.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>16</td>
<td>12</td>
<td>2.9</td>
<td>9</td>
</tr>
<tr>
<td>2005</td>
<td>16</td>
<td>14</td>
<td>2.4</td>
<td>11</td>
</tr>
<tr>
<td>2006</td>
<td>0</td>
<td>11</td>
<td>2.5</td>
<td>8</td>
</tr>
<tr>
<td>2007</td>
<td>-9</td>
<td>6</td>
<td>2.7</td>
<td>3</td>
</tr>
<tr>
<td>2008</td>
<td>-19</td>
<td>-3</td>
<td>2.1</td>
<td>-5</td>
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<tr>
<td>2009</td>
<td>-3</td>
<td>-8</td>
<td>3.2</td>
<td>-11</td>
</tr>
<tr>
<td>2010</td>
<td>-2</td>
<td>-8</td>
<td>3</td>
<td>-11</td>
</tr>
<tr>
<td>2011</td>
<td>-4</td>
<td>-7</td>
<td>2.4</td>
<td>-9</td>
</tr>
<tr>
<td>2012</td>
<td>7</td>
<td>-1</td>
<td>2.8</td>
<td>-3</td>
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<tr>
<td>2013</td>
<td>13</td>
<td>4</td>
<td>2.7</td>
<td>1</td>
</tr>
<tr>
<td>2014</td>
<td>6</td>
<td>6</td>
<td>2.5</td>
<td>3</td>
</tr>
</tbody>
</table>
An example of the power that changing expectations can have on investment attitudes.

Make sure to read: **Housing and the Monetary Transmission Mechanism, Frederic S. Mishkin*—Member Board of Governors of the Federal Reserve System, August 2007**

**HOUSING INVESTMENT AS A SHARE OF GDP:**

![Graph showing housing investment as a share of GDP](http://www.federalreserve.gov)
The Basic Loanable funds Model and Wicksell's Natural Rate

Imagine a world without a central bank. We would expect that interest rates in this universe would be driven by the sources and uses of credit. A loanable funds model looks at the supply of credit and the demand for credit, across term and risk structures.

![Graph showing Supply of Credit and Demand of Credit](image)

We can posit that there is a "natural rate of interest" that will just match the economy's marginal product of capital (MPC= the extra yield that one collects for an additional dollar of capital invested). When the economy's interest rate is at the natural rate, investment and overall growth and economy will avoid any inflationary or deflation price pressures. Knut Wicksell, at the turn of the 20th century, built a model of monetary policy based upon just such a "natural rate" concept. The Federal Reserve Bank of St. Louis described his model as follows:

"Wicksell based his theory on a comparison of the marginal product of capital with the cost of borrowing money. If the money rate of interest was below the natural rate of return on capital, entrepreneurs would borrow at the money rate to purchase capital (equipment and buildings), thereby increasing demand for all types of resources and their prices; the converse would be true if the money rate was greater than the natural rate of return on capital. (Wicksell did not distinguish real from nominal interest rates"
because, under the gold standard of the time, sustained inflation was unlikely. Here, all interest rates and rates of return should be interpreted as real rates.) So long as the money rate of interest persisted below the natural rate of return on capital, upward price pressures would continue. In Wicksell's theory price pressure could arise even if new credit were extended only against increases in production, that is, against "real bills". "Price stability would result only when the money rate of interest and the natural rate of return on capital-the marginal product of capital-were equal."

Source: Monetary Trends, 3/05, FRB St. Louis, "Wicksell's Natural Rate".

The loanable funds model, expanded to three interest rates:

We now embrace the idea of a downward sloping IS curve. We assume that risky long term interest rates are the rates that intersect with IS curves, and thereby influence the pace of investment and in turn the overall growth rate for the economy. We now need to think about how interest rates are determined. In our simplified Carlin/Soskice model the central bank exogenously determines the interest rate. This renders the monetary authorities immense power. Life, however, is not nearly so neat. We now will work with an expanded loanable funds model, one that marries Fed policy moves to supply/demand and expectational considerations in bill and bond markets.

We create a model with three interest rates:

\[ r_c \text{ the real long term borrowing rate for corporations} \]
\[ r_g \text{ the real long-term borrowing rate for the government} \]

Fed monetary policy is tied to a third interest rate:
\[ r_f \text{ the real short term interest rate: the real fed funds rate.} \]

Fed policy targets the real fed funds rate \( r_f \). The real fed funds rate influences the real long term government rate \( r_g \). The Fed policy rate and government long rate influence the borrowing rate for corporations: \( r_c \)
**Four Actors**: Households, Government, Federal Reserve, Corporations.

**Three Interest Rates**: $r_f$, $r_g$, $r_c$

The Expanded Loanable Funds Model:

**The Actions of Key Actors**

- Federal Reserve sales or purchases of treasury bills, shifts net government demand for household funds in the treasury bill market:

  $\text{FR}_{tb}^t \equiv \text{Federal Reserve t-bill transactions, add/subtract to net demand for household funds}$

  $\text{FR}_{tb}^p \equiv \text{Federal Reserve purchases t-bills, reducing the net government demand for household funds}$

  $\text{FR}_{tb}^s \equiv \text{Federal Reserve sells t-bills, adding to the net government demand for household loanable funds}$

  $\text{FR}_{tb}^t \equiv \text{FR}_{tb}^p \text{ OR } \text{FR}_{tb}^s$
• Corporations demand funds in the corporate bond market:
  \[ D_c \equiv \text{demand of Corporations’ for funds in the corporate bond market} \]

• Government demand for funds: TOTAL vs. PRIVATE
  Federal Reserve Buys and Sells Government Debt
  Government’s Private Demand for funds:
  Net of Federal Reserve Transactions.

\[ D_g \equiv \text{government demand for loanable funds} \]
\[ D_h \equiv \text{government demand for household funds} \]
\[ FR_{tb} \equiv \text{Federal Reserve net provision of funds} \]

\[ D = D_g + FR_{tb} \]
\[ D = D_g - FR_{tb} \]

The Fed buys t-bills and establishes a 1% real fed funds rate.
The Fed sets the short rate. It influences other rates. It attempts to influence output and inflation, by changing interest rates that households and businesses confront.
Monetary Policy in a Three Asset Market Framework:

Suppose the Federal government runs a $400 billion deficit. Suppose further, that they finance this deficit half in t-bills and half in t-bonds. The Government borrows $200 billion in the t-bill market ($D_{tb} = $200).

We find that households are willing to supply $200 billion in loanable funds ($S_{tb} = $200) They receive 4% interest. Why 4%? \[ \pi = 2\% i = 4\% r = 2\% \]

Now we imagine that the monetary authorities want to ease policy.
How does an easing of the fed funds rate lower the risk rate?
We need to remember what happens to the price of substitute, when the price rises
for the item in question:

WE TRAVEL ALONG THE HOUSEHOLD SUPPLY CURVE FOR T-BILLS
THE EQUILIBRIUM T-BILL RATE FALLS (T-bill prices rise)
THIS SHIFTS THE HOUSEHOLD SUPPLY CURVE FOR T-BONDS
LOWER RISK-FREE RATES SHIFTS THE HOUSEHOLD SUPPLY CURVE FOR RISKY
BONDS
THE CORPORATE (RISKY) REAL BORROWING RATE, \( r_c \) DECLINES
Think of an individual investor. She has an opinion about how much risk to take:

- 2% risk-free bills, she commits 20% of her funds
- 3% risk-free bonds, she commits 30% of her funds
- 5% risky bonds, she commits 50% of her funds

Now the rate on t-bills has been pushed down to 1%, via Fed open market operations.

She will likely supply less in the t-bill market, given this lower rate of return. We see this as a movement along households' supply curve for t-bills. Now money previously invested in t-bills shifts, and is invested in the t-bond and corporate bond market. Thus we have an outward shift for the bond market supply curves.

**Monetary Policy Amid the Zero Bound**

How can the Fed get long term real rates lower, if it can't lower fed funds?

<table>
<thead>
<tr>
<th></th>
<th>Nominal</th>
<th>π</th>
<th>real</th>
</tr>
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<tbody>
<tr>
<td>Fed funds:</td>
<td>0%</td>
<td>2%</td>
<td>-2%</td>
</tr>
<tr>
<td>10-year t-bond:</td>
<td>2%</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Baa bond:</td>
<td>5%</td>
<td>2%</td>
<td>3%</td>
</tr>
</tbody>
</table>

Quantitative easing is one way to continue to ease amid zero fed funds. The Fed can directly provide funds. The Fed usually buys t-bills to peg the fed funds rate. It can buy t-bonds, to try to directly lower bond rates. It can do this in one of two ways. It can announce a quantity target:

> The Fed bought $85 billion per month, in 2013 and 2014

Alternatively, it could announce a target interest rate for a long bond:

> We will buy the 10-year till its yield equals 1%
Appendix: A Housing Bust For The Ages!

The 2005-2009 bust in the housing market suffered from the same dynamics. The key, simpler observation in housing was the outright break between the earnings generating capability of owning a house and the price of the house.

Let’s look at some simplified examples:
We begin in the year 2000. We imagine ourselves to be investors who buy homes to rent. We consider a typical home. It sports a $110,000 purchase price. We chose to put $10,000 down, and finance $100,000 at 7%.

Mortgage payments are $8,000 per year plus $2,000 per year in net taxes. Rents are $12,000 per year. We therefore earn $2,000 per year on our investment.

Over the next three years, however, mortgage interest rates plunged. Home buyers, in normal times, are fascinated with “the monthly nut” the monthly mortgage payment. By 2002, the fall for interest rates had driven the mortgage payment for the median home down to only 17% of median household income. Simply put, housing affordability had soared. An avalanche of new buyers, as a consequence, entered the market. In turn, home prices rose sharply in 2003 and 2004. Affordability, reflecting the rise for home prices that exceeded income gains, suffered. But the fantastic gains for home prices caught everyone’s attention. Buying homes, moving to bigger homes, buying second homes, these were deemed to be a path to riches. Guaranteed, it seemed, by the reality of 5 years of soaring prices laid alongside the factoid that “home prices in the U.S., in aggregate, have never fallen, over the past 50 years”.

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>house price</td>
<td>110,000</td>
<td>220,000</td>
</tr>
<tr>
<td>annual mortgage payment</td>
<td>8,000</td>
<td>15,200</td>
</tr>
<tr>
<td>mortgage plus net taxes</td>
<td>10,000</td>
<td>18,200</td>
</tr>
<tr>
<td>rent</td>
<td>12,000</td>
<td>12,000</td>
</tr>
</tbody>
</table>

In asset price terms, we now had left the land of the asset price as the discounted present value of its potential cash flows (in this case, rents). Instead, house prices were going up rapidly, because of the broad sweeping demand to buy homes…and the demand was broad sweeping because house prices were going up rapidly!

Enter the FRB, in 2004 through mid-2006. The fed funds rate is raised 17 times to 5.25% from 1%. Long term rates also move up modestly. Higher interest rates, superimposed upon climbing home prices, extend the deterioration in housing affordability.

The charts on the following page provide a road map for this dynamic. An extended period of low interest rates kept housing affordable. The recession in 2001-2002, quite unusually, did not involve a sustained rise for interest rates, and as such it did little to
housing affordability and to enthusiasm for home purchase. The sharp fall for interest rates, 2001-2003, invited strong further commitment to housing investment. Surging home prices, in 2003 through 2006, overwhelmed calculations focused upon the income generating capabilities of homes. A bubble mentality had taken hold. With the jump for rates 2005-2006, superimposed on climbing prices, affordability plunged. The violent housing retrenchment meant that a large dose of falling mortgage rates and falling home prices were necessary to rescue the housing market.

**Accelerating House Price Increases, 2003-2006, Reflected Decades Of Generally Falling Mortgage Rates.**

Home Mortgage Interest Rate, Blended vs. Median Home Prices


NAR: Mortgage Payments As A Share Of Household Disposable Income
A Housing Recovery in 2012-2013.

As the chart on the bottom of the previous page reveals, housing affordability spectacularly improved from 2006 through 2011. It is true that household disposable income took a big hit in the 2008-2009 recession. But the fall for incomes was dwarfed by both the plunge for house prices and the swoon for mortgage interest rates:

<table>
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</thead>
<tbody>
<tr>
<td>Disposable Income(HH)</td>
<td>$74,800</td>
<td>$72,700</td>
<td>$75,200</td>
</tr>
<tr>
<td>Median House Price</td>
<td>$220,000</td>
<td>$160,000</td>
<td>$173,000</td>
</tr>
<tr>
<td>Fixed Rate Mortgage</td>
<td>6.5%</td>
<td>4%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Monthly payment</td>
<td>$16,700</td>
<td>$9,200</td>
<td>$9,400</td>
</tr>
<tr>
<td>Housing Affordability</td>
<td>22.3%</td>
<td>12.6%</td>
<td>12.5%</td>
</tr>
</tbody>
</table>

Notwithstanding the sharp gain for housing affordability, home buying throughout 2010 and 2011 was looked at as a dangerous proposition. Home ownership as a percent of household formations fell sharply, as many families decided it was safer to rent than to buy. This dynamic kept downward pressure on home price and simultaneously put impressive upward pressure on rents rates as the demand for homes fell and the demand for rental properties rose.

As we entered 2012, we had completely reversed the snapshot in place in late 2006. Recall in the winter of 2006 we posited that homes priced at $220,000, financed with a 6.5% mortgage required mortgage payments of $16,700 per year, well above the $13,200/year that the home would generate in rents.

We can use a rent buy calculator to investigate this proposition. ([http://www.nytimes.com/interactive/business/buy-rent-calculator.html](http://www.nytimes.com/interactive/business/buy-rent-calculator.html))

We plug in the home price, $220,000; the monthly rent, $1,100; the fixed rate mortgage, 6.5%. We assume rents will rise with inflation, at 2% per year. Now if we embrace the ADAPTIVE EXPECTATIONS notion of a real 6% appreciation for home prices, over the foreseeable future, our calculator concludes that buying is better than renting after only 2 years in the home.

But what if we impose some rationality on home price expectations? If real home prices rise by 6% per year and real incomes rise by 2% per year, new entrants to the housing market will be increasingly unable to buy. So let’s substitute an expectation of home prices steady with inflation. In that circumstance, you will need to own the home for 20 years before it made sense to buy rather than rent. Moreover, stable nominal home prices and renting is the right way to go over the entire 30 year loan period.

What about after the bust?
Again, if we assume people adapt their expectations based solely upon recent priced action, we find homeowners worrying about 5% real house price depreciation. We lower the price of the home to $165,000 from $220,000. We assume rents rise with inflation, at 2%, we input a much lower mortgage rate, 4%. We discover that it only pays to buy if you are in the house for over 13 years. That kind of Armageddon thinking, no doubt played a role in keeping housing under great duress in 2010 and 2011.

But is it reasonable to assume additional declines for home prices, on the heels of a 25% decline, with housing affordability at record levels? As defaults played themselves out, house prices began to stabilize. And the 2012-2013 rebound for housing, no doubt owes much to the calculation one could make if anxiety about falling house prices gave way to a feeling that house prices and rents would likely be stable, in real terms, as they both climbed slowly with inflation.

Simply change your home price expectation, and assume prices are stable in real terms, rising at a 2% rate—the same pace as the increases for rents. In such circumstances, buying makes more sense than renting if you expect to be in the home for only 3 years.

What if many homebuyers remain mesmerized by recent house price weakness and continue to judge that renting makes more sense than buying? What should this elicit? Because demand for homes is weak, we have registered a sharp fall for prices. Conversely rents have risen as the demand for rental properties has jumped. The higher rents and lower prices allow investors to buy homes and rent them with healthy profit margins—thanks to the high rental income, the low purchase price and the very low financing costs.

This, in turn, should stabilize house prices. In other words, we now are betting that RATIONAL ECONOMIC ACTORS will see value in homes, buy them AND CONVERT THEM INTO RENTAL PROPERTIES, and end the falling home price dynamic, a dynamic that at this late date is being driven by backward looking IRRATIONAL ADAPTIVE EXPECTATIONS PLAYERS.

This happened in a big way in 2012. Funds were created to invest in residential real estate, to benefit from this opportunity.