Using financial futures to hedge exposure to interest rate risk is useful but there are two main problems:

1. There may not be a futures contract that corresponds precisely to spot activity that is being hedged. This increases basis risk.

   Example: Small credit union’s assets (loans) do not have the same risk characteristics as Treasury securities.

2. Futures contracts are only traded out to about 2.5 years. So a manager cannot hedge against interest rate risk at long maturities.

**ANSWER:** INTEREST RATE SWAPS
Basic interest rate swap: Two parties issue debt and make each other’s payments. Typically, one rate is fixed and the other is variable, i.e. floating.

This idea has been extended to currency swaps: two parties issue debt denominated in different currencies and then they swap payments.

(Often, a financial intermediary plays a role as a swap facilitator.)

Interest Rate Swaps – First interest rate swap was between the World Bank and IBM in 1981. Since then the growth in the market has been staggering: roughly 50% per year!!
The Bank for International Settlements reports that interest rate swaps are the largest component of the global OTC derivative market. The notional amount outstanding as of December 2006 in OTC interest rate swaps was $229.8 trillion, up $60.7 trillion (35.9%) from December 2005. These contracts account for 55.4% of the entire $415 trillion OTC derivative market. However, interest rate swaps are not standardized enough to allow them to be traded through a futures exchange like an option or a futures contract.
A Plain Vanilla (the only kind we are interested in!!) Interest Rate Swap

IBM and the World Bank have each issued debt for $1,000,000. IBM’s debt is a 5 year note that has a floating rate tied to the London Interbank offered rate – LIBOR. The rate is 3% + LIBOR. The World Bank’s debt is a fixed rate of 12% (also with maturity of 5 years.). Both parties agree to pay each other’s annual interest payments. (Since the value of these payments is $1M but this is not exchanged, this is referred to as the notional principal. Also, actual payment is the implied difference: if LIBOR = 10%, then WB pays IBM $10,000.)
It is clear from this example why interest rate swaps would be attractive to depository institutions:

By engaging in a swap, a bank or savings and loan can transform its floating rate liabilities into fixed rate liabilities.

Consequently, both FGAP and DGAP can be managed via interest rate swaps.

But another motivation: Comparative Advantage!
Nobel laureate Paul Samuelson was once challenged by the mathematician Stanislaw Ulam to “name me one proposition in all of the social sciences which is both true and non-trivial.” It took Samuelson several years to find the answer —

**Comparative Advantage!!**

“That it is logically true need not be argued before a mathematician; that it is not trivial is attested by the thousands of important and intelligent men who have never been able to grasp the doctrine for themselves or to believe it after it was explained to them.”
Comparative Advantage: It’s opportunity costs that matter!
Take the following example:
In one day, Jed can produce either 1 book or 1 You Tube video.

In the same time, Fiona can produce 2 books and 4 You Tube videos.

Fiona has absolute advantage…but that is not relevant for trade! What is the relative price for each good?

For Fiona, she gives up 4 videos to produce 2 books so the relative price of a book is

\[ P_{b,F} = \frac{2v}{1b} \]

For Jed, it is clear that his relative price is simply

\[ P_{b,J} = \frac{1v}{1b} \]
So Jed has a comparative advantage in book production and Fiona has a comparative advantage in video production. (What is the relative price of videos?)

Any trading price for books between 1 and 2 videos will make both Jed and Fiona better off. Suppose the price is 1.5v/b.

Jed specializes in book production...then he can now obtain a maximum of 1.5 videos through trade rather than 1.

Fiona specializes in videos, she can now obtain a maximum of 8/3 books through trade rather than 2.

Both are happy. Same idea with regard to borrowing.
Now consider two firms: both can borrow at either a fixed or floating rate. One will have a comparative advantage at fixed rate borrowing and one will have a comparative advantage at floating rate borrowing. Specialize in appropriate debt and then swap the payments!

<table>
<thead>
<tr>
<th></th>
<th>Acme Corp: Good Credit (prefers floating)</th>
<th>Widget LLC.: Poor Credit (prefers fixed)</th>
<th>Difference in Costs (basis points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-year fixed rate debt</td>
<td>11%</td>
<td>12.5%</td>
<td>150</td>
</tr>
<tr>
<td>Floating rate debt</td>
<td>LIBOR + 25 bp</td>
<td>LIBOR + 50 bp</td>
<td>25 bp</td>
</tr>
</tbody>
</table>

Acme has a comparative advantage in fixed rate debt.
1. Acme issues fixed rate but pays floating rate of LIBOR to Widget.

2. Widget issues floating rate at LIBOR + 50bp but pays Swap Rate (fixed) to Acme.
Managing Interest Rate Risk – Interest Rate Swaps

What determines the Swap Rate? Must lower costs to both parties. Acme wants floating rate. All-in-costs (AIC) are:

<table>
<thead>
<tr>
<th>Fixed Rate Debt issue</th>
<th>11%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floating rate paid in swap</td>
<td>L</td>
</tr>
<tr>
<td>Fixed rate received</td>
<td>SR</td>
</tr>
<tr>
<td>AIC</td>
<td>$11 + L - SR$</td>
</tr>
</tbody>
</table>

For the swap to be acceptable to Acme:

\[
AIC < L + 0.25
\]

\[
11 + L - SR < L + 0.25
\]

\[
10.75 < SR
\]
Managing Interest Rate Risk – Interest Rate Swaps

What determines the Swap Rate? Must lower costs to both parties. Widget wants fixed rate. All-in-costs (AIC) are:

<table>
<thead>
<tr>
<th>Floating Rate Debt issue</th>
<th>L + 0.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed rate paid in swap</td>
<td>SR</td>
</tr>
<tr>
<td>Floating rate received</td>
<td>L</td>
</tr>
<tr>
<td>AIC</td>
<td>SR + 0.50</td>
</tr>
</tbody>
</table>

For the swap to be acceptable to Acme:

\[ AIC < 12.5 \]
\[ SR + 0.50 < 12.5 \]
\[ SR < 12 \]
Acme’s condition: \( SR < 10.75 \)

Widget’s condition: \( SR < 12 \)

So any rate in the range \( 10.75 < SR < 12 \) is acceptable to both parties.

You have a deal!!
Hedging with Interest Rate Swaps:
You are a manager of a small bank (First Bank of Winters) that has the following data:

Assets = $100 million
Net Worth = $5 million
DGAP = 1.72 years.

One way to eliminate the DGAP is to lengthen the maturity of your liabilities: Swap your floating rate liabilities for fixed rate liabilities.

Acme Bank offers to pay you 1% over the 1 year T-Bill rate over the next 10 years in exchange for First Bank paying a 7% fixed payment.

The Question: What should be the value of the swap (the notional principal) to hedge net worth from interest rate changes?
First recall what the DGAP tells us:

\[ DGAP = \bar{D}_A - \frac{L}{A} \bar{D}_L \]

And remember what this tells us. Since \( \Delta NW = \Delta A - \Delta L \) this implies:

\[ \frac{\Delta NW}{A} = \frac{\Delta A}{A} - \frac{L}{A} \frac{\Delta L}{L} = \%\Delta A - \frac{L}{A} \%\Delta L = -DGAP \frac{\Delta i}{1+i} \]

Hence, the \textbf{absolute} change in net worth will be determined by the factor:

\[ \Delta NW = A \times DGAP \]

So you need to engage in a swap that will change by the same absolute amount.
Managing Interest Rate Risk – Interest Rate Swaps

So the first step is to figure out the implied duration of the swap deal.

The duration of the floating rate component is easy: since the T-Bill is a pure discount bond, its maturity is equal to the duration. So duration = 1 year.

The duration of the fixed rate payment is determined by your finance division to be 8.1 years. (We skip the details.)

So duration of the swap is \( D_{swap} = 1 - 8.1 = -7.1 \)

Just as in the earlier discussion of DGAP, the absolute change in the value of the swap will be determined by the factor:

\[
V_{swap} \times D_{swap}
\]
Recall we had the following information:
Assets = $100 million
Net Worth = $5 million
DGAP = 1.72 years.

And we know $D_s = -7.1$

If interest rates rise, bank NW falls but the value of the swap increases. We want the absolute change to be the same which requires

$$V_{swap} \times D_{swap} = -A \times DGAP$$

Which implies:

$$V_s = \frac{-A \times DGAP}{D_s}$$

For the numbers given we have: $V_s = \frac{-100m \times 1.72}{-7.1} = 24.2m$
Before we sign the deal, we want to make sure. Suppose interest rates rise to 0.08.

Then \[ \frac{\Delta NW}{A} = -DGAP \frac{\Delta i}{1+i} \Rightarrow -1.72 \times \frac{0.01}{1.07} = -1.6\% \]

Given that assets = $100 million, this implies a fall in net worth of $1.6 million.

The percentage change in value of the swap is:

\[ \% \Delta V_s = -D_s \frac{\Delta i}{1+i} = -(-7.1) \frac{0.01}{1.07} = 6.6\% \]

Given that the value of the swap is $24.2 million we have

\[ \Delta V_s = 0.066 \times 24.2m = 1.6m \]

You keep your high paying job as manager!!!!
That wraps up our discussion of interest rate risk and hedging using interest rate futures and interest rate swaps.

The final topic related to interest rate risk is securitization — another idea in finance that developed out of the high inflation and high interest rates environment of the 1970s and early 80s. We next discuss that in the context of the mortgage market.