Handout #11

Offshore Financial Markets
The Eurocurrency Market

Slides to highlight: 1-29, 37-74, 90-91

Course web page:
Reading Assignments for this Week

<table>
<thead>
<tr>
<th>Text</th>
<th>Scan</th>
<th>Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levich</td>
<td>Chap 9</td>
<td>Pages</td>
</tr>
<tr>
<td>The Eurocurrency Market</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luenberger</td>
<td>Chap</td>
<td>Pages</td>
</tr>
<tr>
<td>Solnik</td>
<td>Chap 1</td>
<td>Pages 22-24</td>
</tr>
<tr>
<td>Foreign Exchange</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blanchard</td>
<td>Chap</td>
<td>Pages</td>
</tr>
<tr>
<td>Wooldridge</td>
<td>Chap</td>
<td>Pages</td>
</tr>
</tbody>
</table>
Midterm Exam: Friday Aug 1, 2008

Coverage: Chapters 3, 4, 5, 6, 7, 8, 9, 10 +
Ben Bernanke’s semi-annual testimony

It’s a closed-book exam. However,
a two-sided formula sheet (11 x 8.5) is required;
calculator/dictionary is okay;
notebook is NOT okay.

75 minutes, 7 questions, 100 points total;
five questions require calculation and
two questions require (short) essay writing.

Remote SCPD participants will also take the exam on Friday,
August 1, 2008

Please Submit Exam Proctor’s Name, Contact info as SCPD
requires, also c.c. to veetienfu@yahoo.com a week before the exam.
Final Exam MS&E 247S
Fri Aug 15 2008 12:15PM-3:15PM Gates B01
Or Saturday Aug 16 2008 12:15PM-3:15PM Gates B01
Remote SCPD participants will also take the exam on Friday, 8/15
Please Submit Exam Proctor’s Name, Contact info as SCPD requires, also
c.c. to yeetienfu@yahoo.com a week before the exam.
Local SCPD students please come to Stanford to take the exam. Light
refreshments will be served.
Offshore Financial Markets
The Eurocurrency Market

MS&E 247S International Investments
Yee-Tien Fu
The Eurocurrency market owes its existence to differences in national financial regulation combined with declining barriers to international capital movements.

The Eurocurrency market and its offspring - the Eurobond, Eurocommercial paper, and Euroequity markets - comprise some of the most important financial innovations of the last 40 years.
Introduction

These innovations are examples of unbundling, in this case, separating the exchange risk of one currency (the US $, for example) from its indigenous regulatory environment, and combining it with the regulatory climate and political risk of another financial center (such as London).

The Eurocurrency and Eurobond markets, virtually nonexistent until the late 1950s, have grown to become major centers of activity and in many instances the preferred market for raising or investing funds.
OFFSHORE FINANCIAL MARKETS

The Eurocurrency Market
The market for deposits placed under a regulatory regime different than the regulations applied to deposits used to execute domestic transactions.

The Eurobond Market
A Eurobond was once defined as a debt instrument (1) underwritten by an international syndicate, & (2) offered for sale simultaneously in a number of countries.
Introduction

In most cases, eurocurrency corresponds to US$ deposits outside the United States, UK£ deposits outside the United Kingdom, and so forth. However, several countries have set up special regulations to permit “Eurocurrency deposits” on domestic turf. For example, in the US, dollar deposits at so-called International Banking Facilities (IBFs) are subject to a lower regulatory burden.

IBF deposits are tantamount to Eurodeposits but they are available only to nonresidents, and IBF accounts may not be used to conduct transactions within the US.
Introduction

Since the Eurocurrency market has expanded to financial centers outside of Europe, the term *offshore* is more appropriate to describe its location. And we use the term *onshore* to mean the traditional, domestic marketplace.

The key distinction between offshore and onshore markets is the regulatory environment, not location.
## Sectors of the International Money Markets

### Currency Dimension

<table>
<thead>
<tr>
<th></th>
<th>US$</th>
<th>DM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Onshore</strong></td>
<td>U.S. bank deposit</td>
<td>German bank deposit</td>
</tr>
<tr>
<td></td>
<td>U.S. Treasury bills and bonds</td>
<td>German government bonds</td>
</tr>
<tr>
<td></td>
<td>U.S. corporate bonds</td>
<td>German corporate bonds</td>
</tr>
<tr>
<td><strong>Offshore</strong></td>
<td>Euro-$ deposit</td>
<td>Euro-DM deposit</td>
</tr>
<tr>
<td></td>
<td>Euro-$ bond</td>
<td>Euro-DM bond</td>
</tr>
<tr>
<td></td>
<td>(corporate and sovereign issuers)</td>
<td>(corporate and sovereign issuers)</td>
</tr>
</tbody>
</table>

### Regulatory Dimension

- **Onshore**
- **Offshore**
Introduction

The offshore market is like a parallel market that offers bank instruments and securities that compete with similar financial products in the traditional, onshore market.

In Chapter 3, we showed how forward exchange contracts could be used to transform a DM security in one market to a similar synthetic US$ security.

Thus, synthetic dollar-denominated securities “compete with” conventional dollar-denominated securities.
Spot v.s. Forward

Jan 1

US$

B

borrow US$ at $i$

lend US$ at $i$

sell DM spot at $S$

buy DM forward at $F$

Jul 1

A

DM

C

borrow DM at $i_{DM}$

lend DM at $i_{DM}$

sell DM forward at $F$

buy DM spot at $S$

Levich Figure 3.2 Pg. 78
Introduction

A second dimension of competition exists in international financial markets. Securities in the onshore market bear certain regulatory costs and political risks. If these costs or risks become large, agents have an incentive to cross into the offshore markets and devise new securities and institutional structure.

Any market can be characterized by its supply and demand components, which is a useful way to think about the origins of the Eurocurrency market.
Supply of Funds to the Eurodollar Market

International commodities were often priced in terms of US dollars. So, Europeans held balances in US dollars to execute transactions, to act as a hedge against foreign exchange changes, and to serve as a store of value.

Russian depositors once were reluctant to hold their US $ in accounts in the US, since Russian-owned $ balances had been impounded by the Alien Property Custodian during World War II. Instead they deposited their $ in London and Paris with affiliates of state-owned Russian banks.
Another boost to the market came in 1958 with a general relaxation of exchange controls throughout Europe and a return to external convertibility for the £. Private individuals could now hold their US $ earned through international trade rather than being required to sell them to the central bank.
Demand for Funds in the Eurodollar Market

Borrowers will always prefer to borrow cheaper funds because there is no risk to them in doing so.

The sterling crisis of 1957: the Bank of England restricted the use of Sterling for financing foreign trade and external loans. British merchant banks responded with a pragmatic solution: Use the US $ which was not regulated by the Bank of England to conduct these transactions from accounts based in London - the advantage was evident and European banks began to actively solicit $ deposits.
Onshore Banking Regulations Boost the Offshore Market: US Examples (1970s)

Banking regulations in the US helped to serve up a fresh, continuing supply of funds to the Eurodollar market.

Regulation Q by Federal Reserve: No interest was allowed on demand deposits, < 1% interest to time deposit < 90 days.

Interest Equalization Tax (IET): excise tax on US purchases of new or outstanding foreign currencies

=> raising the price of long-term borrowing in US outlets: Euro$, Eurobond market
Foreign Credit Restraint Program: set specific limits on the volume of bank lending that US banks could conduct with foreigners (including foreign subsidiaries of US multinational firms)

=> a large group of borrowers were given strong incentive to investigate the Eurocurrency markets.
Onshore Banking Regulations Boost the Offshore Market: Germany & Swiss Examples (1970s)

German capital controls: the Bundesbank required foreigners with onshore DM accounts to place a fraction of their funds in noninterest-bearing accounts.

Objective: limit nonresident demand for DM.
Result: agents deposited DM offshore.
The German capital controls expired in 1974.

Swiss interest rate penalties: impose heavy interest rates penalties on nonresidents with onshore Swiss franc accounts. The Swiss interest rate penalties were abolished in Dec. 1979.
Creating Eurodollars

Adam Smith (an American) holds a $100 deposit with a New York Bank.

Smith decides to open an account in London. He does so by writing a check on his New York bank, carrying it to London, and depositing it (2).

The London bank accepts the check, open an account for Smith (3), and sends the check for collection to its New York correspondent.

The New York bank deducts $100 from Smith’s account and credits that amount to the London Bank’s *nostro* (its own) account (4).
**Eurodollar Creation: Round 1**

<table>
<thead>
<tr>
<th>Adam Smith</th>
<th>N.Y. Bank</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) NY Bank $100</td>
<td>A. Smith (1) $100</td>
</tr>
<tr>
<td>(2) NY Bank -$100</td>
<td>A. Smith (4) -$100</td>
</tr>
<tr>
<td>(2) London B $100</td>
<td>London B (4) $100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>London Bank</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3) NY Bank $100</td>
</tr>
</tbody>
</table>
After Smith’s transaction, there are 100 Euro$ measured by the liabilities of the London bank. Note also that US $ are cleared and settled in New York.

The London bank may wish to increase its earnings on the $100 above the interest paid on its *nOSTRo* account and it can do so by making a loan.

Suppose that in Round 2 David Hume (a Swiss) comes to the London bank for a $100 loan, shown in Round 2 as the London bank’s asset and a liability for Hume (5).
Creating Eurodollars

The London bank issues a check to Hume, which he takes to a Zurich bank for deposit (6).

The Zurich bank accepts the check and sends it to New York for collection (7).

The New York bank debits the London bank’s *nostro* account and credits the Zurich bank’s *nostro* account (8).
## Eurodollar Creation: Round 2

<table>
<thead>
<tr>
<th>London Bank</th>
<th>Zurich Bank</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(5) D. Hume</strong></td>
<td><strong>(7) NY Bank</strong></td>
</tr>
<tr>
<td>$100</td>
<td>$100</td>
</tr>
<tr>
<td>(6) NY Bank</td>
<td>D. Hume (7)</td>
</tr>
<tr>
<td>-$100</td>
<td>$100</td>
</tr>
<tr>
<td>David Hume</td>
<td>N.Y. Bank</td>
</tr>
<tr>
<td>(6) Zurich B</td>
<td>London B (4)</td>
</tr>
<tr>
<td>$100</td>
<td>$100</td>
</tr>
<tr>
<td>London B (5)</td>
<td>London Bank (8)</td>
</tr>
<tr>
<td>$100</td>
<td>-$100</td>
</tr>
<tr>
<td></td>
<td>Zurich B (8)</td>
</tr>
<tr>
<td></td>
<td>$100</td>
</tr>
</tbody>
</table>
Creating Eurodollars

After Hume’s transaction, there are 200 Eurodollars - the $100 liability of the London bank to Smith and the $100 liability of the Zurich bank to Hume. The liabilities of the New York bank remain at $100. The process of lending and redepositing could continue until Euromarket deposits reached:

\[ D = \frac{R}{r} \]

\( R = \) initial injection of funds into the Euromarket,  
\( r = \) fraction of reserves held against deposits,  
\( \frac{1}{r} = \) deposit-reserve multiplier
Creating Eurodollars

How much Eurocurrency deposit is eventually created if funds are deposited, lent, redeposited, relent? Let’s add them up:

<table>
<thead>
<tr>
<th>Operation</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original deposit</td>
<td>$ R</td>
</tr>
<tr>
<td>First lending</td>
<td>$(1 - r) X $ R</td>
</tr>
<tr>
<td>Second lending</td>
<td>$(1 - r)^2 X $ R</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Total Euro$ supply</td>
<td>$ R/r</td>
</tr>
</tbody>
</table>

Creating Eurodollars
Creating Eurodollars

If r=0, then in theory, deposit creation within the Euromarket could go on indefinitely, creating a huge inverted pyramid of deposits backed by only $100 of base reserves in the New York bank. This certainly presents the image of a market at risk if Messrs, Smith, Hume, and their friends were to arrive at their respective banks at the same time to withdraw their funds.

This risk is highly unlikely since nearly all Eurodeposits are term deposits which can be withdrawn only at maturity, rather than demand deposits which can be withdrawn at any time on short notice.
Describe the multiplier effect in the case of the creation of Eurodollars. Take a basic example.

The multiplier effect in the Eurodollar market comes from the practice of fractional reserve banking. For every $100 deposit, if a bank holds 10% in reserve, it can lend out $90 of the initial deposit. This $90 deposit in turn generates a $9 reserve in the next bank and an $81 loan. This generates another $81 deposit, an $8.10 reserve in the next bank and a $72.90 loan. The sum of $100 + $90 + $81 + $72.90 + … eventually reaches $1,000, or $100 divided by the percentage reserve.
Growth of the Eurocurrency Market

The market has grown from essentially zero in 1960 to roughly $7.8 trillion on a gross basis and $4.8 trillion on a net basis (netting out all interbank deposits) in 1995 - larger than the US money supply as measured by M2. The market’s annual rate of growth exceeded 20 percent for many years, but it tapered off in recent years.

1 trillion = 1000 billion = $10^6$ million = $10^{12}$
Pricing of Eurocurrency Deposits and Loans

To approach the question of how Eurocurrency interest rates are determined, we propose conducting the analysis using a loanable funds framework. It is convenient to imagine a world with n currencies and n countries or financial centers.
# Kinds of Interest Rates

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Explanation</th>
<th>Key Factors</th>
<th>Typical Level (%) (as of 9/96)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount rate</td>
<td>Rate Fed charges banks for loans</td>
<td>Federal Reserve policy</td>
<td>5 - 6</td>
</tr>
<tr>
<td>Fed funds</td>
<td>Overnight loans between banks</td>
<td>Federal Reserve policy</td>
<td>5 - 6</td>
</tr>
<tr>
<td>T-bill</td>
<td>Short-term Treasury security</td>
<td>Federal Reserve policy</td>
<td>5</td>
</tr>
<tr>
<td>10-year T-note</td>
<td>10-year Treasury security</td>
<td>Federal Reserve policy, inflation</td>
<td>6</td>
</tr>
<tr>
<td>“The long bond” or</td>
<td>30-year Treasury security, the longest readily</td>
<td>Inflation, Federal Reserve policy, strength of</td>
<td>6 - 7</td>
</tr>
<tr>
<td>“The bond”</td>
<td>tradable bond</td>
<td>the economy</td>
<td></td>
</tr>
</tbody>
</table>

Federal Reserve policy, inflation, strength of the economy
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Explanation</th>
<th>Key Factors</th>
<th>Typical Level (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime rate</td>
<td>Rate banks charge good corporate customers</td>
<td>Bank’s cost of borrowing, Federal Reserve actions</td>
<td>8</td>
</tr>
<tr>
<td>Adjustable</td>
<td>A home mortgage whose rate adjusts every year or so</td>
<td>Mortgage market conditions, Treasury note rates</td>
<td>7 - 9</td>
</tr>
<tr>
<td>mortgage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed-rate</td>
<td>A home mortgage whose rate is fixed for the loan life, usually 15 or 30 yrs</td>
<td>Mortgage market conditions, Treasury note rates</td>
<td>7 - 9</td>
</tr>
<tr>
<td>mortgage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corporate bond</td>
<td>A loan to a creditworthy corporation, most often for 10 years</td>
<td>Treasury rates, economic conditions, inflation</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Kinds of Interest Rates

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Explanation</th>
<th>Key Factors</th>
<th>Typical Level (%) (as of 9/96)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junk bond</td>
<td>A loan to a less creditworthy corporation</td>
<td>Corporation’s financial stability, Treasury rates</td>
<td>8 - 11</td>
</tr>
<tr>
<td>Muni bond</td>
<td>A bond issued by a state or local govt or agency where the interest is tax free</td>
<td>Treasury rates, tax exemption</td>
<td>4 - 6</td>
</tr>
<tr>
<td>Credit card loan</td>
<td>Interest consumers pay when they borrow on their credit cards</td>
<td>Rarely changes</td>
<td>12 - 18</td>
</tr>
<tr>
<td>Real interest rates</td>
<td>The expected return after inflation is removed</td>
<td>Cannot be measured directly</td>
<td>? about 3</td>
</tr>
</tbody>
</table>

### Notes
- Real interest rates cannot be measured directly.
**Benchmark Rates, August 1996**

<table>
<thead>
<tr>
<th>Benchmark Instrument</th>
<th>Maturity</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treasury bills</td>
<td>3 months</td>
<td>5.07%</td>
</tr>
<tr>
<td>Treasury bills</td>
<td>6 months</td>
<td>5.16</td>
</tr>
<tr>
<td>Fed funds rate</td>
<td>1 day</td>
<td>5.24</td>
</tr>
<tr>
<td>AA commercial paper</td>
<td>3 months</td>
<td>5.39</td>
</tr>
<tr>
<td>AA commercial paper</td>
<td>6 months</td>
<td>5.42</td>
</tr>
<tr>
<td>LIBOR</td>
<td>3 months</td>
<td>5.53</td>
</tr>
<tr>
<td>LIBOR</td>
<td>6 months</td>
<td>5.72</td>
</tr>
<tr>
<td>Constant-maturity Treasury note</td>
<td>10 years</td>
<td>6.74</td>
</tr>
<tr>
<td>AAA corporate bond rate</td>
<td>Long term</td>
<td>7.62</td>
</tr>
<tr>
<td>Bank prime rate</td>
<td>Short-term floating</td>
<td>8.25</td>
</tr>
</tbody>
</table>
For the latest on money market rates, visit http://www.federalreserve.gov/releases/ and http://www.money-rates.com
**U.S. PRIME RATES**
(historical data)

<table>
<thead>
<tr>
<th>Year</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1929</td>
<td>5.50-6.00%</td>
</tr>
<tr>
<td>1935</td>
<td>1.50%</td>
</tr>
<tr>
<td>1948 Aug</td>
<td>2.00%</td>
</tr>
<tr>
<td>1959 Sep 01</td>
<td>5.00%</td>
</tr>
<tr>
<td>1969 June 09</td>
<td>8.50%</td>
</tr>
<tr>
<td>1979 Dec 07</td>
<td>15.25%</td>
</tr>
<tr>
<td>1980 April 02</td>
<td>20.00%</td>
</tr>
<tr>
<td>1989 July 31</td>
<td>10.50%</td>
</tr>
<tr>
<td>1999 Nov 17</td>
<td>8.50%</td>
</tr>
<tr>
<td>2001 June 28</td>
<td>6.75%</td>
</tr>
<tr>
<td>2001 Nov 7</td>
<td>5.00%</td>
</tr>
<tr>
<td>2003 Jun 27</td>
<td>4.00%</td>
</tr>
<tr>
<td>2005 Dec 13</td>
<td>7.25%</td>
</tr>
<tr>
<td>2006 Jan 31</td>
<td>7.50%</td>
</tr>
<tr>
<td>2006 June 29</td>
<td>8.25%</td>
</tr>
</tbody>
</table>

http://research.stlouisfed.org/fred2/series/prime
## Latest Observations:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>7.25</td>
<td>6.50</td>
<td>6.00</td>
<td>5.25</td>
<td>5.00</td>
</tr>
</tbody>
</table>
Pricing in the Case of One Currency & Two Financial Centers

To begin, consider the case of one currency (the US $) and two financial centers (New York and London).

Suppose that in the onshore market, the demand (D) for funds depends on the required rate of return on available projects, while the supply (S) of funds depends on individuals’ rates of time preference.

The curve take on the expected slopes as illustrated in Figure 9.5. In the absence of transactions costs, equilibrium is at point A.
Pricing in the Case of One Currency & Two Financial Centers

In the onshore market ...

The demand ($D$) for funds depends on the required rate of return on available projects, while the supply ($S$) of funds depends on individuals’ rates of time preference.

When banks incur costs $X$, equilibrium deposit rate $= R_D$, lending rate $= R_L$, market size $= Q$.

In the absence of transaction costs, the equilibrium is at $A$. 

Figure 9.5
However, banks incur costs in collecting deposits and in servicing loans. The major categories of costs are:

1. noninterest-bearing reserves at the Federal reserve,
2. Federal Deposit Insurance Corp. (FDIC) insurance,
3. credit review,
4. asset-liability risk management,
5. taxes, and
6. administrative overhead.

If these costs are summarized by amount \( X \), then the onshore market will reach an equilibrium with deposit rate \( R_D \), lending rate \( R_L \), and market size \( Q \), as shown in Figure 9.5.
Pricing in the Case of One Currency & Two Financial Centers

Where can a Euro$ market fit into this picture? Assume that a new market in US$-denominated funds opens in London.

Americans will supply dollars to the offshore market only if they are compensated for bearing the extra costs and risks associated with London.

Since Americans can earn $R_D$ with minimum inconvenience and no political risks in the onshore market, the supply curve to the offshore market ($S^*$) will begin at $R_D$. 
Pricing in the Case of One Currency & Two Financial Centers

Similarly, in the absence of capital controls, no borrower would travel to London to pay a higher price for funds. Therefore, the demand curve for offshore funds \( (D^*) \) must begin at \( R_L \), reflecting the unfunded projects along segment \( yz \) of the onshore demand curve \( D \).
Pricing in the Case of One Currency & Two Financial Centers

**In the offshore market ...**

Eurobanks incur cost $X^* < X$, resulting in offshore deposit rate $R_D^*$, lending rate $R_L^*$, market size $Q^*$.

Since $R_D$ can be earned in the onshore market, the supply curve to the offshore market ($S^*$) will begin at $R_D$.

Similarly, the demand curve for offshore funds ($D^*$) must begin at $R_L$.

**Figure 9.5**

<table>
<thead>
<tr>
<th>Interest Rates</th>
<th>Quantity of Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_L$</td>
<td>$Q^*$</td>
</tr>
<tr>
<td>$R_L^*$</td>
<td></td>
</tr>
<tr>
<td>$R_D^*$</td>
<td></td>
</tr>
<tr>
<td>$R_D$</td>
<td></td>
</tr>
</tbody>
</table>

$x < x^*$
Pricing of Eurocurrency Deposits and Loans

• The relationships among onshore and offshore interest rates are:
  \[ R_L > R_L^* > R_D^* > R_D \]

• In other words, for US$:
  New York lending rate (“Prime”) > London Interbank Offered Rate (LIBOR) > London Interbank Bid Rate (LIBID) > New York deposit rate
Pricing in the Case of One Currency & Two Financial Centers

The offshore $ market exists only if it is able to collect deposits and service loans at a profit. We can see that if this cost remains at \( X \), the Eurodollar market will not exist.

However, if the cost of collecting deposits and servicing loans in the offshore market (\( X^* \)) is less than in the onshore market, we can determine the offshore deposit rate \( R_D^* \), lending rate \( R_L^* \), and market size \( Q^* \).
Pricing in the Case of One Currency & Two Financial Centers

Because Eurobanks

(1) earn interest on their voluntary level of reserves,
(2) do not pay FDIC-like insurance,
(3) deal primarily with known, high-quality credits,
(4) use floating interest rate arrangements and maturity matching to minimize interest rate risks,
(5) often operate in tax havens or under other special tax incentives, and
(6) operate a wholesale business with lower overheads than onshore operations,

we fully expect to find $X^* << X$. 
Determination of Onshore and Offshore Interest Rates

Figure 9.5
With $X^* \ll X$, Figure 9.5 shows the normal relationship between onshore and offshore interest rates. That is:

$$ R_L > R_{L^*} > R_{D^*} > R_D \quad (9.1) $$

In more familiar terms, this inequality states that for US$, the New York lending rate ("Prime") $R_L$ exceeds the London Interbank Offered rate (LIBOR) $R_{L^*}$, which exceeds the London Interbank Bid Rate (LIBID) $R_{D^*}$, which in turn exceeds the marginal cost of funds $R_D$ (either a certificate of deposit rate or the Federal Funds rate) of a New York bank.
Pricing in the Case of One Currency & Two Financial Centers

Prime rate: Rate banks charge good corporate customers

London Interbank Offered Rate (LIBOR)
offered means asked

London Interbank Bid Rate (LIBID)

Fed Funds rate: Overnight loans between banks
\[(1 + x)^m = 1 + mx + \frac{m(m-1)}{2!} x^2 + \cdots\]

\[0.99^{70} = (1 - 0.01)^{70}\]

\[= 1 + 70 \cdot (-0.01) + \frac{70 \cdot 69}{2} (-0.01)^2 + \cdots\]

\[\approx 1 - 0.7 + 0.2415 = 0.5415\]
Pricing in the Case of One Currency & Two Financial Centers

\( R_L \): Prime Commercial Bank Lending Rate  
\( R_L^* \): Offshore Borrowing Rate: LIBOR  
\( R_D^* \): Offshore Deposit Rate: LIBID  
\( R_D \): Onshore Deposit Rate  
*: Offshore

Table 9.1 lists the deposit rates and borrowing rates (onshore and offshore) for France, Germany, Japan, Switzerland, United Kingdom, and the United States.

In Table 9.1, we see that \( R_L > R_L^* > R_D^* > R_D \) for all the five countries. Thus, the data correspond with the broad prediction of equation (9.1).
Deposit Rates and Borrowing Rates: Onshore and Offshore
Percentage Per Annum as of January 5, 1996

<table>
<thead>
<tr>
<th>Country</th>
<th>Prime Lending Rate ($R_L$)</th>
<th>Offshore Borrowing Rate: LIBOR ($R^*_L$)</th>
<th>Offshore Deposit Rate: LIBID ($R^*_D$)</th>
<th>Onshore Deposit Rate ($R_D$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>7.50</td>
<td>5.00</td>
<td>4.875</td>
<td>4.50</td>
</tr>
<tr>
<td>Germany</td>
<td>6.25</td>
<td>3.75</td>
<td>3.625</td>
<td>3.22</td>
</tr>
<tr>
<td>Japan</td>
<td>1.625</td>
<td>0.625</td>
<td>0.50</td>
<td>0.44</td>
</tr>
<tr>
<td>Switzerland</td>
<td>3.875</td>
<td>1.8125</td>
<td>1.6875</td>
<td>1.13</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>7.50</td>
<td>6.5625</td>
<td>6.4375</td>
<td>6.41</td>
</tr>
<tr>
<td>United States</td>
<td>8.5</td>
<td>5.625</td>
<td>5.375</td>
<td>5.01</td>
</tr>
</tbody>
</table>

Note: Prime lending rates may not be comparable as lending practices may vary across countries. LIBID, LIBOR, and deposit rates are for three-month maturities.

Table 9.1 of Levich 1E
### Deposit Rates and Borrowing Rates: Onshore and Offshore

Percentage Per Annum as of June 20, 2000

<table>
<thead>
<tr>
<th>Country</th>
<th>Prime Lending Rate ($R_L$)</th>
<th>Offshore Borrowing Rate: LIBOR ($R^*_L$)</th>
<th>Offshore Deposit Rate: LIBID ($R^*_D$)</th>
<th>Onshore Deposit Rate ($R_D$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>7.50</td>
<td>5.9063</td>
<td>5.8125</td>
<td>3.70</td>
</tr>
<tr>
<td>Euro area</td>
<td>NA</td>
<td>4.5313</td>
<td>4.4375</td>
<td>3.04</td>
</tr>
<tr>
<td>Japan</td>
<td>1.375</td>
<td>0.1875</td>
<td>0.0938</td>
<td>0.03</td>
</tr>
<tr>
<td>Switzerland</td>
<td>4.75</td>
<td>3.4375</td>
<td>3.3125</td>
<td>3.29</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>7.00</td>
<td>6.1875</td>
<td>6.0313</td>
<td>6.00</td>
</tr>
<tr>
<td>United States</td>
<td>9.50</td>
<td>6.8125</td>
<td>6.6875</td>
<td>5.99</td>
</tr>
</tbody>
</table>

Note: Prime lending rates may not be comparable as lending practices may vary across countries. LIBID, LIBOR, and deposit rates are for three-month maturities.
Pricing in the Case of One Currency & Two Financial Centers

In recent times, the LIBOR-LIBID spread (for US$) has varied from about 0.125-0.25 % while the spread between the prime rate and the Federal Funds rate has varied from about 2-3 %.

<table>
<thead>
<tr>
<th>$R_D$</th>
<th>$R_D^*$</th>
<th>$R_L^*$</th>
<th>$R_L$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal Funds</td>
<td>LIBID Deposit</td>
<td>LIBOR Borrowing</td>
<td>Prime Lending</td>
</tr>
</tbody>
</table>
Suppose the Eurodollar deposit rate in London is 6.5 percent and the dollar deposit rate in New York is 6.0 percent.

A. What factors could explain the interest rate differential between the two locations?

B. Suppose the British Treasury imposes a 0.1 percent tax on deposits taken in London. What impact will this have on funds deposited in London?

C. Suppose that all offshore centers are subject to the same 0.1 percent tax on deposits. What impact will this have on offshore markets?

D. Returning to the original proposition, suppose the Fed increases short-term rates in the United States by 0.5 percent. What impact would you expect in the offshore rates?
A. Banks can pay greater interest offshore because they are subject to greater regulatory costs in the onshore market, such as reserve requirements held without interest, FDIC insurance fees, higher cost for compliance, taxes. Depositors usually demand higher interest on offshore deposits because of additional risks.

B. If a tax is imposed, other centers will probably gain market share over London. Funds would migrate to such location as Zurich, Paris, Singapore, Bermuda, or the US through IBFs. The supply curve to London shifts to the left and up by the amount of the tax.
C. A general tax on offshore deposits would lower the attractiveness of all offshore centers. There would be an incentive to develop new offshore centers not subject to this tax. However, because of the hysteresis phenomenon, centers may be slow to lose deposits.

D. Offshore rates are closely connected with onshore rates. So the Fed move to raise interest rates by 0.5% should result in a similar jump in offshore rates. The jump offshore could be greater than 0.5% because of the impact of reserve requirements; that is, the absolute value of the offshore/onshore spread increases with the absolute level of interest rates. The rise in offshore rates may have preceded the Fed move since offshore rates are more market-driven than onshore rates.
Atlantic Richfield, a big US oil and gas company, has a large amount of debt indexed to short-term Eurodollar rates. A $100 million facility at Bankers Trust is due in three months in mid-December 1993. Atlantic Richfield pays LIBOR + 1/4% and the Treasurer expects to “roll-over” the $100 million for another three months. The Treasurer is expecting interest rate to go up during the next three months.

A. Assume that the December Eurodollar futures price is 96.40 (refer to Table 9.3 Prices of Eurodollar Interest Rate Futures). Illustrate how Atlantic Richfield could hedge its interest rate exposure using futures traded on the CME. Show all the steps, now and three months later. [For convenience, assume that CME maturity dates coincide with the firm’s roll-over dates.]

B. Suppose in three months that LIBOR is 4 percent. Will the firm have a gain or loss from its hedge? How large is the gain or loss in dollar terms? How much interest (in dollars) will the firm pay to Bankers Trust for the three-month period commencing in December?

C. What if LIBOR is 3.25 percent in mid-December? Will the firm have a gain or a loss from its hedge? How large is the gain or loss in dollar terms? How much interest (in dollars) will the firm pay to Bankers Trust for the three-month period commencing in December?
A. Assume that the December Eurodollar futures price is 96.40 (refer to Table 9.3 Prices of Eurodollar Interest Rate Futures). Illustrate how Atlantic Richfield could hedge its interest rate exposure using futures traded on the CME. Show all the steps, now and three months later. [For convenience, assume that CME maturity dates coincide with the firm’s roll-over dates.]

The firm hedges by selling $100 million worth of December Eurodollar futures at 96.40. This locks in a LIBOR rate of 3.6%. In three months, Atlantic will establish a LIBOR rate of 3.6% for the next three months, either by making delivery of the Eurodollar deposits or by buying back the futures at the current price. If rates go up, the firm will make a profit on its futures position that will compensate for the higher cost of funds. If rates go down, the firm will lose on its futures position. Loss on the futures will compensate gain from lower cost of funds.
B. Suppose in three months that LIBOR is 4 percent. Will the firm have a gain or loss from its hedge? How large is the gain or loss in dollar terms? How much interest (in dollars) will the firm pay to Bankers Trust for the three-month period commencing in December?

If LIBOR is 4% in three months, the futures will trade at 96.0, generating a profit of .40 for the firm. In dollar terms, the gain is $0.0040 \times 100,000,000/4 = $100,000$. This gain offsets the increase in rates and gives the firm an effective LIBOR of 3.6%. The firm’s interest payments to Bankers Trust are LIBOR+1/4% on $100$ million for three months or $0.0425 \times 100,000,000 / 4 = $1,062,500$. 
C. What if LIBOR is 3.25 percent in mid-December? Will the firm have a gain or a loss from its hedge? How large is the gain or loss in dollar terms? How much interest (in dollars) will the firm pay to Bankers Trust for the three-month period commencing in December?

If LIBOR is 3.25% in three months, the futures will trade at 96.75, generating a loss of .75 for the firm. In dollar terms, the loss is $0.0075 \times 100,000,000/4 = $187,500. This loss offsets the decline in rates and gives the firm an effective LIBOR of 4.0%. The firm’s interest payments to Bankers Trust are LIBOR+1/4% on $100 million for three months or $0.035 \times 100,000,000/4 = $875,000.
The ABC firm is considering borrowing $50 million for one year, either at a fixed rate of 6.50 percent in the U.S. domestic market or at a floating rate indexed to three-month LIBOR+1/4 in the Eurocurrency market. Currently, three-month LIBOR is 5.25 percent and it is expected to remain constant for the year.

A. How much would ABC save if it uses the Euromarkets and these expectations are met? (For convenience, assume that CME maturity dates coincide with the firm’s rollover dates.)

B. What are the risks in using a Euromarket loan?

C. Calculate the eventual saving for ABC if LIBOR increases by .50 percent every three months.
A. Savings are 1% of the outstanding amount for one year, or $500,000.

B. The risks are interest rate risk because the Euromarket loan is on floating rate terms, and roll-over risk if the bank has the option to refuse to renew or roll-over the loan. If ABC has a commitment for the year, then it has no roll-over risk as long as the bank remains in operation.

C. Fixed rate costs: 6.5% of $50,000,000 = $3,250,000
Floating rate costs:
\[(1+5.5%/4)\times(1+6.0%/4)\times(1+6.5%/4)\times(1+7.0%/4)=1.0625\]
or a cost of 6.25%. On $50,000,000 principal the interest bill will be $3,125,000; still better than a 6.5% fixed rate.
Consider the case of one currency (the US dollar) and several offshore centers (London, Frankfurt, Singapore, and Beijing).

In Figure 9.8, we continue to assume that the demand for dollars offshore is described by $D^*$, which reflects the underlying set of projects.

The supply of funds to each offshore center depends on depositors’ assessments of the costs of using the center – associated with known taxes and capital controls as well as the inconvenience of time zone differences – and the risks (of future taxes and capital controls).
Determination of Offshore Interest Rates and Market Shares

**Figure 9.8**

- Interest Rates
  - $R_L$
  - $X^*$
  - $8.25\%$
  - $8.00\%$
  - $R_D$

- Quantity of Funds
  - $Q_D$
  - $Q_C$
  - $Q_B$
  - $Q_A$
  - $D^*$
  - $S^*$ Beijing
  - $S^*$ Singapore
  - $S^*$ Frankfurt
  - $S^*$ London
The supply of funds to each offshore center depends on the assessed costs and risk of using the center.

Suppose each center incur cost $X^* = 0.25\%$.

Once the most efficient and least risky center has set the price, the others must follow suit.

Then for London, deposit rate = 8.00\%, lending rate = 8.25\%, market size = $Q_A$.

The demand for offshore dollars $D^*$.
Market Share and Pricing in Competing Offshore Centers

In principle, each center might have its own cost for collecting deposits and servicing loans. For simplicity, assume that these costs are identical across centers and equal to 0.25 percent. In Figure 9.8, this selection of $X^*$ results in a London deposit rate of 8.00 percent and lending rate of 8.25 percent and a London market size $Q_A$.

If a Frankfurt offshore center is to develop, it must offer loans at 8.25 percent to compete with the price charged in London. As a result, Frankfurt can pay no more than 8 percent on deposits, and it must be satisfied with a market size of $Q_B$. 
A similar story applies to Singapore with a resulting market size of $Q_C$ and Beijing with a market size of $Q_D$. In our example, once the most efficient and least risky financial center has set the price of loans, other centers must follow suit, leaving quantity as the only other variable left to adjust.

Question: If an offshore center adjust its deposit rates to higher than 8.00 percent in our example, what kind of signal might you be getting?
In reality, if Germany or Singapore were saddled with higher operating cost, they might be able to set a higher $R_L^*$ and still attract borrowers. But their loan portfolios would have higher credit risks than London.

Figure 9.8 also suggests that countries which depositors view as more risky will need more favorable regulations to lower their costs and reduce their lending rates.
The General Case with Many Currencies and Many Financial Centers

Arbitrage and Interest Rate Parity

We have analyzed the interest rate differential between an onshore market (New York dollars) and offshore market (London dollars), using a loanable funds approach.

We argue next that arbitrage and regulatory competition should keep the offshore interest rates for a single currency nearly equal.
The General Case with Many Currencies and Many Financial Centers

With pricing nearly equal, the market share of an offshore financial center depends on both the costs of using the center and the perceived risk of capital controls and new taxes.

Finally, the interest rate differential between offshore instruments should conform to the interest rate parity condition (5.1).

\[
\frac{F_{t,1} - S_t}{S_t} = \frac{i_\$ - i_\£}{1 + i_\£} \quad (5.1)
\]
The General Case with Many Currencies and Many Financial Centers

So, for example, the interest differential between Zurich dollars and Zurich sterling should equal the forward exchange premium between US dollars and UK pounds.

\[
\frac{F_{t,1} - S_t}{S_t} = \frac{i_{\$,Zurich} - i_{\£,Zurich}}{1 + i_{\£,Zurich}}
\]
Interest Rate Parity
in a Perfect Capital Market

_Equating the two:_

\[
1 \times \frac{1.0}{S_t} \times (1 + i_{\text{\£,Zurich}}) \times F_{t,1} = 1 \times (1 + i_{\text{\$\text{,Zurich}}})
\]

_Rearranging terms:_

\[
\frac{F_{t,1}}{S_t} = \frac{1 + i_{\text{\$\text{,Zurich}}}}{1 + i_{\text{\£\text{,Zurich}}}}
\]

_Subtracting 1 from each side:_

\[
\frac{F_{t,1} - S_t}{S_t} = \frac{i_{\text{\$\text{,Zurich}}}}{1 + i_{\text{\£\text{,Zurich}}}} - \frac{i_{\text{\£\text{,Zurich}}}}{1 + i_{\text{\£\text{,Zurich}}}}
\]
The General Case with Many Currencies and Many Financial Centers

Figure 9.9 helps to underscore why tests of interest rate parity may fail when the arbitrage is between traditional, onshore securities.

In arbitrage between US Treasury bills and UK treasury bills (examples of New York $ and London £ securities, respectively), two dimensions of risk are changed: exchange risk and political risk.

The forward exchange contract hedges only the exchange risk portion of the interest differential, not the political risk portion.
The Structure of International Financial Markets: Many Currencies, Many Markets

regulatory costs and political risk vary

<table>
<thead>
<tr>
<th></th>
<th>United States</th>
<th>United Kingdom</th>
<th>Germany</th>
<th>Switzerland</th>
<th>Singapore</th>
<th>Brazil</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NY IBF US$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK£</td>
<td>NY IBF £</td>
<td>London £</td>
<td>Frankfurt £</td>
<td>Zurich £</td>
<td>Singapore £</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NY IBF £</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM</td>
<td>NY IBF DM</td>
<td>London DM</td>
<td>Frankfurt DM</td>
<td>Zurich DM</td>
<td>Singapore DM</td>
<td>exchange risk vary</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SFr</td>
<td>NY IBF SFr</td>
<td>London SFr</td>
<td>Frankfurt SFr</td>
<td>Zurich SFr</td>
<td>Singapore SFr</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S$</td>
<td></td>
<td>London S$</td>
<td>Zurich S$</td>
<td>Singapore S$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rio Real</td>
<td></td>
</tr>
</tbody>
</table>

Figure 9.9

<table>
<thead>
<tr>
<th>Onshore market</th>
<th>Offshore market</th>
</tr>
</thead>
</table>

9-76
Risk in Cross-Border Transactions:  
The Wells Fargo - Citibank Case

In June 1983, Wells Fargo Asia Limited (WFAL), a Singapore-chartered, wholly owned subsidiary of Wells Fargo Bank, made two six-month deposits of $1 million each with Citibank’s Manila branch.  

On October 15, 1983, the Philippine government imposed exchange controls requiring prior approval by the central bank for repayments of principal on foreign obligations to foreign banks. Citibank did not repay the deposits when they matured in December 1983 and Wells Fargo took legal action in February 1984.
Under the principle of corporate responsibility, one could argue that the parent retained responsibility for deposits at the Philippine branch.

Clearly Citibank had the ability (that is, the financial capacity) to repay the deposits; as an operational matter, payment would have been effected electronically through facilities in New York. However, the separate entity principle recognizes that the WFAL deposits were booked in the Philippines and thus subject to the sovereign risk of the Philippines.

For Citibank (Manila or New York) to have repaid the deposits at maturity without government approval would have flouted the spirit and possibly the letter of Philippine law.
The Wells Fargo - Citibank Case

Throughout the lengthy legal debate, the case seemed to resolve around several points:

(1) Was the matter a question for Philippine or New York law?

(2) Would the deposits be repaid through New York or Manila?

(3) Could Citibank draw on its Philippine or worldwide assets to repay the WFAL deposits?

(4) If Citibank repaid the deposits from New York using its worldwide assets, would this contravene the Philippine exchange control law?
In an unusual twist to the case – as part of an appeal to the US Supreme Court in 1989 – the Department of State, the US Treasury, the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation, the Office of the Comptroller of the Currency, and the Solicitor General filed a friend-of-the-court brief supporting Citibank.

In part, the brief claimed that allowing the deposit to be cleared and settled through New York would give WFAL “something it did not bargain for and had no right to receive – dollar-denominated deposits that are exempt from federal reserve requirements and insurance assessments but legally payable in the United States.”
The Wells Fargo - Citibank Case

Despite the impressive support for Citibank, the US circuit court finally ruled in favor of Wells Fargo on June 26, 1991.

In deciding this case, the court focused on the distinction between the physical location of “repayment” (where the liability will be discharged, New York in the case of Eurodollars) and the location of the assets (that is, the assets of Citibank Manila or the assets of Citibank worldwide) that may be used for “collection” to satisfy the liability.

WFAL could have stipulated that collection on its Manila deposits be made at Citibank (New York), in effect demanding a parental guarantee on repayment of the deposits.
The Wells Fargo - Citibank Case

If this had been done, presumably the rate of interest on Citibank (Manila) deposits would have been identical with the interest on similar deposits placed with Citibank (New York). In fact, the rate of interest paid by Citibank (Manila) was higher than the rate available at Citibank (New York) as our analytic model predicts.

However, the court ruled that under New York law, unless there were an agreement to the contrary, a creditor may collect a debt at any place that the parties have agreed it is repayable. Because there were no agreement forbidding the collection in New York, and repayment of dollar deposits through New York is a normal business practice, the court sided with WFAL.
The Wells Fargo - Citibank Case

Moreover, the court found that Citibank had not satisfied its good faith obligation to seek the Philippine government’s approval to repay the WFAL deposits.

WFAL had recovered $934,000 of its $2 million deposit in 1985 after Citibank petitioned the Philippine central bank for permission to use its worldwide assets for this purpose. In 1987, a US district court allowed Wells Fargo to recover the remainder of its deposit in New York. At that time, the court concluded that because the Citibank branch in Manila was not a separate legal entity, Philippine law would not be violated by a repayment from Citibank’s worldwide assets.
The Wells Fargo - Citibank Case

In our theoretical analysis (in Figure 9.5), the higher rate of interest paid on Eurodeposits represents compensation for the greater sovereign risk to which these deposits are exposed compared with onshore deposits. If depositors desire protection against these sovereign risks, it seems reasonable that the cost of this guarantee would be equal to the offshore-onshore deposit rate differential. The situation is analogous to a US bank loan to a foreign subsidiary of a US industrial firm. If the parent is required to guarantee the loan against the risk of exchange controls that might block repayment by the foreign subsidiary, then the interest rate on the loan should be lower, reflecting the reduction in sovereign risk and the credit risk of the parent.
The Wells Fargo - Citibank Case

The *WFAL v. Citibank* case may have important implications for the practice of deposit taking in offshore markets. As the court upheld WFAL, offshore banks may respond by having depositors expressly acknowledge that offshore deposits are subject to particular sovereign risks. Without this, offshore depositors in a branch of a US bank would seem to be exempt from certain exchange control risks, although they remain exposed to the risk that their assets could be confiscated through an act of state.
What did the Wells Fargo Asia vs. Citibank case demonstrate as far as legal issues of Eurocurrency markets are concerned?

The Wells Fargo vs. Citibank case demonstrated that parties are subject to risk in the offshore market when an exchange control or capital control program is suddenly imposed. In this specific case, Citibank’s behavior was judged improper since the normal mode of repayment of an offshore deposit was via a transfer from the bank’s New York account. Citibank had claimed that because the deposit was a contract entered into the Philippines, that Citibank must adhere to the Philippine exchange control law where it was in place.
Describe the relationship between the onshore deposit rate, the offshore deposit rate, the onshore lending rate and the offshore lending rate. Look in today’s newspaper (Wall Street Journal or Financial Times) and see if this relationship holds for the US$ rates. What about for DM or UK rates?

Theory suggests that the onshore lending rate ($R_L$, NY Prime) exceeds the offshore lending rate ($R_L'$, LIBOR), which exceeds the offshore deposit rate ($R_D'$, LIBID), which exceeds the onshore deposit rate ($R_D$, Fed Funds or NY deposit rate).
“The United States could have an offshore market for US$ in the United States.” True or false. Explain.

True. The U.S. offshore market for US$ in the United States is known as an *International Banking Facility*. An IBF operates at a lower level of regulation than the normal U.S. banking system. The IBF allows transactions only for non-residents, and funds cannot be used for transactions within the United States.
The Costs of Taxation

It does not matter whether a tax on a good is levied on buyers or sellers of the good...the price paid by buyers rises, and the price received by sellers falls.
The Effects of a Tax...

<table>
<thead>
<tr>
<th>Price buyers pay</th>
<th>Price without tax</th>
<th>Price sellers receive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity with tax</td>
<td>Quantity without tax</td>
<td>Quantity</td>
</tr>
</tbody>
</table>

Size of tax
The Effects of a Tax

◆ A tax places a wedge between the price buyers pay and the price sellers receive.
◆ Because of this tax wedge, the quantity sold falls below the level that would be sold without a tax.
◆ The size of the market for that good shrinks.
Repo, Repurchase Agreement

A repurchase agreement (or repo) is an agreement between two parties whereby one party sells the other a security at a specified price with a commitment to buy the security back at a later date for another specified price.

Most repos are overnight transactions, with the sale taking place one day and being reversed the next day.

Q: Doesn’t Repo sound like a time deposit? How does Repo actually differ from time deposit? A: While a repo is legally the sale and subsequent repurchase of a security, its economic effect is that of a secured loan.

http://www.riskglossary.com/link/repo.htm
Reverse Repo, Reverse Repurchase Agreement

Reverse repo is a term used to describe the opposite side of a repo transaction. The party who sells and later repurchases a security is said to perform a repo. The other party—who purchases and later resells the security—is said to perform a reverse repo.

The repo party borrows money. The reverse repo party borrows security. Economically, the reverse repo party purchasing the security makes funds available to the seller and holds the security as collateral. If the repoed security pays a dividend, coupon or partial redemptions during the repo, this is returned to the original owner. The difference between the sale and repurchase prices paid for the security represent interest on the loan. Indeed, repos are quoted as interest rates.

http://www.riskglossary.com/link/repo.htm
Assignment from Chapter 9

Exercises 3, 4, 5.
This inequality states that for US$, the New York lending rate ("Prime") $R_L$ exceeds the London Interbank Offered rate (LIBOR) $R_L^*$, which exceeds the London Interbank Bid Rate (LIBID) $R_D^*$, which in turn exceeds the marginal cost of funds $R_D$ (either a certificate of deposit rate or the Federal Funds rate) of a New York bank.
a. GM could sell 250 Eurodollar futures for every maturity where its interest payments are set initially or re-set; that is, September and December 2001 and March and June 2002.
b. For the next year, GM can lock in LIBOR rates of 7.15% (Sep 01 at 92.85); 7.18% (Dec 01 at 92.82); 7.12% (Mr02 at 92.88), 7.11% (June 02 at 92.89). The annual LIBOR rate is just the sum of the four quarterly rates.
Chapter 9, Exercise 4

Refer to lecture slides 9-56 & 9-57.

b. The risks are interest rate risk because the Euromarket loan is on floating rate terms, and roll-over risk if the bank has the option to refuse to renew or roll-over the loan. If ABC has a commitment for the year, then it has no roll-over risk as long as the bank remains in operation.
Chapter 9, Exercise 5

b. $312.50

c. The trader carries the political risk of deposits in Singapore. If funds were blocked in Singapore, he might not be able to pay back his London loan. Time differences between London and Singapore may also increase the difficulty of this transaction.