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Chapter 21 – Short-term Investing

MNCs have many choices for investing

- Home $\Rightarrow$ return(USD) = deposit interest rate (US)
- Abroad Single country $\Rightarrow$ return(GBP) = deposit rate(UK)
  Portfolio of currencies $\Rightarrow$ return(portfolio)

When investing abroad, MNCs calculate an effective yield that incorporates e_f. Since we do not know e_f, we work with $E[e_{f,t}]$. That is, for a US MNC, the (expected) *effective yield/return* (in USD) is:

$$E[R^{USD}_{FC}] = (1+ R_{FC} \text{ x } T/360)\ (1 + E[e_{f,t}]) - 1 \qquad \text{(yield in DC=USD).}$$

MNCs: Evaluation of Investing Choices

Similar idea to Chapter 20: MNCs will maximize rates of return. Again, we will pay no attention to the variability of returns. This chapter ignores the risk/return relation.

Example: MSFT can invest at home, the U.K., and Mexico It has excess cash for 30 days
Data:
$R_{USD} = 6\%$
$R_{GBP} = 5\%$ $\quad E[e_{f,t}] = 0.7\%$
$R_{MXP} = 12\%$ $\quad E[e_{f,t}] = -1\%$
T = 1 month $\quad$ =>T/360=1/12.
MSFT will translate the foreign return into an effective USD return, R^{USD}_{FC}.

1. Home

$R_{USD} = .06 \text{ x } 30/360 = 0.005$ (or 0.50%)

2. Abroad

UK: $E[R_{GBP}^{USD}] = (1+.05/12)(1.007)-1 = .011196$ (or 1.12%)

Mexico: $E[R_{MXP}^{USD}] = (1+.12/12)*(1-.01) -1 = -.0001$ (or -0.01%)

In terms of expected returns, MSFT should invest in the U.K. ¶

• Using the distribution of e_f (realistic case)

We assume we know $E[e_f]$. The precision of $E[e_{f,t}]$ is given by the distribution of e_f. This distribution will tell us something about the risk.

Example: IBM has excess cash for T days (assume T= 1 year. Then, T/360=1).
Data:
$R_{USD} = 4\%$
$R_{GBP} = 5\%$

$R_{EUR} = 3\%$

$e_{f,t,}$ Distribution		Prob
GBP	-.04	.5
	0	.5
EUR	.01	.3
	.05	.7

1. Home

$R^{IBM}_{USD} = 4\%$

2. Abroad (GBP)

Distribution	Prob	R^{USD}_{GBP}
-.04	.5	(1+.05)*(1-.04) -1 = .008
0.00	.5	(1+.05)*(1+0) - 1 = 1.05

$E[R^{USD}_{GBP}] = .029$

3. Abroad (EUR)

Distribution	Prob	R^{USD}_{EUR}
.01	.3	(1+.03)*(1.01) - 1 = .0403
.05	.7	(1+.03)*(1.05) - 1 = .0815

$E[R^{USD}_{EUR}] = .043*(.30) + .0815*(.70) = 6.914\%$

4. Abroad (Portfolio: w_{GBP}=.4 w_{EUR}=.6) – Assume independence between GBP and EUR.

Distribution		Prob	R^{USD}_{Port}
GBP	EUR		
-.04	.01	.15	.4(.008)+.6(.0403) = .02738
-.04	.05	.35	.4(.008)+.6(.0815) = .05210
0.0	.01	.15	.4(.05)+.6(.0403) = .04410
0.0	.05	.35	.4(.05)+.6(.0815) = .06890

$E[R^{USD}_{POR}] = 0.053084$

The portfolio somewhat reduces the risk (a more compact distribution), relative to the two individual abroad choices. But, it still looks better to invest in EUR. ¶

BONUS COVERAGE: Eurocurrency Futures

● Eurocurrency time deposit
Euro-zzz: The currency of denomination of the zzz financial instrument is not the official currency of the country where the zzz instrument is traded.

Example: a Mexican firm deposits USD not in the U.S. but with a bank outside the U.S., for example in Mexico or in Switzerland. This deposit qualifies as a Eurodollar deposit. ¶

Rate paid on Eurocurrency deposits: London Interbank Offered Rate (LIBOR).

• Eurodeposits tend to be short-term: 1 or 7 days; or 1, 3, or 6 months.
Typical Eurodeposit instruments:
Time deposit: non-negotiable, registered instrument, fixed maturity.
Certificate of deposit: negotiable and often bearer.

Note I: Eurocurrency deposits are direct obligations of the commercial banks accepting the deposits and are not guaranteed by any government. Although they represent low-risk investments, Eurodollar deposits are not risk-free

Note II: Eurodeposits serve as a benchmark interest rate for international corporate funding.

• Eurocurrency time deposits are the underlying asset in Eurodollar currency futures.

A. Eurocurrency futures contract
A Eurocurrency futures contract calls for the delivery of a 3-mo Eurocurrency time deposit at a given interest rate (LIBOR).

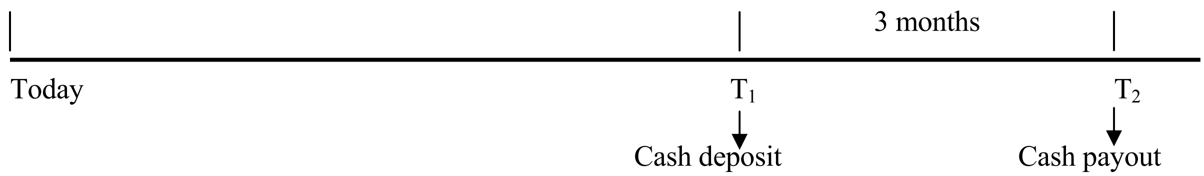
A trader can go long (a promise to make a future 3-mo deposit) securing a yield for a future 3-mo deposit. A trader can go short (a promise to take a future 3-mo. loan) securing a borrowing rate for a future 3-mo loan.

The *Eurodollar futures* contract should reflect the market expectation for the future value of LIBOR for a 3-mo deposit.

• Q: How does a Eurocurrency futures work?
A: Think of a futures contract on a time deposit (TD), where the expiration day, T_1, of the futures precedes the maturity date T_2 of the TD.

Typically, T_2-T_1: 3-months.

Such a futures contract locks you in a 3-mo. interest rate at time T_1.



Example: In June you agree to buy in mid-Sep a TD that expires in mid-Dec.
Value of the TD (you receive in mid-Dec) = USD 100.
Price you pay in mid-Sep = USD 99.

$\Rightarrow$ 3-mo return on mid-Dec (100-99)/99 = 1.01% (or 4.04% annually.)

• Eurocurrency futures work in the same way as the TD futures:
"A Eurocurrency futures represents a futures contract on a Eurocurrency TD having a principal value of USD 1,000,000 with a 3-mo maturity."

- Eurocurrency futures are traded at exchanges around the world.
  Each market has its own reset rate: LIBOR, PIBOR, FIBOR, etc.

- Eurodollar futures price is based on 3-mo. LIBOR.

- Eurodollar deposits have a face value of USD 1,000,000.

- Delivery dates: March, June, September and December.
  Delivery is only "in cash," -i.e., no physical delivery:

"Eurocurrency futures are cash settled on the last day of trading based to the British Banker's Association Interest Settlement Rate."

- The (forward) interest rate on a 3-mo. CD is quoted at an annual rate.
Eurocurrency futures price is quoted as:

100 - (the interest rate of a 3-mo. euro-USD deposit for forward delivery).

Example: if the interest rate on the forward 3-mo. deposit is 6.43%, the Eurocurrency futures price is 93.57. ¶

Note: If interest rates go up, the Eurocurrency futures price goes down, the short side gains.

• Minimum Tick: USD 25.

Since the face value of the Eurodollar contract is USD 1,000,000
$\Rightarrow$ one basis point has a value of USD 100 for a 360-day deposit.
For a three-month deposit, the value of one basis point is USD 25.

Example: Eurodollar futures$_{\text{Nov 20}}$: 93.57
Eurodollar futures$_{\text{Nov 21}}$: 93.55

$\Rightarrow$ Short side gains USD 50 = 2 x USD 25. ¶

• Q: How is the future 3-mo. LIBOR calculate?
A: Eurodollar futures reflect market expectations of forward 3-month rates. An implied forward rate indicates approximately where short-term rates may be expected to be sometime in the future.

Example: 3-month LIBOR spot rate = 5.4400%
6-month LIBOR spot rate = 5.8763%
3-month forward rate = f = ?

$(1 + .058763 \times 182/360) = (1 + .0544 \times 91/360) \times (1 + f \times 91/360)$

$1.029708/ (1.013751) = 1.015740 = (1 + f \times 91/360)$ $\Rightarrow$ $f = 0.062270$ (6.227%)

Example: The WSJ on October 24, 1994 quotes the following Eurodollar contracts:

EURODOLLAR (CME) - $ 1 million; pts of 100%

						Yield		Open
	Open	High	Low	Settle	Chg	Settle	Chg	Interest
Dec	94.00	94.03	93.97	94.00	....	6.00	....	447,913
Mr95	93.56	93.60	93.53	93.57	+ .01	6.43	- .01	402,624
June	93.11	93.15	93.07	93.12	+ .01	6.88	- .01	302,119
Sept	92.77	92.80	92.73	92.77	....	7.23	....	243,103
Dec	92.45	92.49	92.42	92.46	....	7.54	....	176,045
Mr96	92.38	92.41	92.34	92.38	....	7.62	....	152,827
June	92.26	92.28	92.24	92.25	- .01	7.75	+ .01	124,984
Sept	92.16	92.18	92.12	92.15	- .01	7.85	+ .01	117,214
Dec	92.04	92.06	92.01	92.03	- .01	7.97	+ .01	95,555
Mr97	92.05	92.06	92.01	92.04	- .01	7.96	+ .01	83,127
June	91.98	92.01	91.95	91.97	- .01	8.03	+ .01	69.593
Sept	91.92	91.94	91.89	91.91	- .01	8.09	+ .01	55,103
Dec	91.81	91.82	91.77	91.79	- .01	8.21	+ .01	53,103
Mr98	91.83	91.84	91.79	91.81	- .01	8.19	+ .01	43,738
June	91.77	91.78	91.73	91.75	- .01	8.25	+ .01	37,785
Sept	91.71	91.73	91.67	91.69	- .01	8.31	+ .01	26,751
Dec	91.60	91.61	91.56	91.58	- .01	8.42	+ .01	24,137
Mr99	91.62	91.63	91.58	91.60	- .01	8.40	+ .01	21,890
June	91.56	91.57	91.52	91.54	- .01	8.46	+ .01	15,989
Sept	91.50	91.51	91.46	91.48	- .01	8.52	+ .01	10,263
Dec	91.40	91.41	91.36	91.37	- .01	8.63	+ .01	7,354
Mr00	91.44	91.44	91.40	91.41	- .01	8.59	+ .01	7,536
June	91.39	91.40	91.35	91.36	- .01	8.64	+ .01	4,971
Sept	91.34	91.35	91.30	91.31	- .01	8.69	+ .01	7,691
Dec	91.23	91.24	91.19	91.21	....	8.79	....	6,897
Mr01	91.28	91.28	91.24	91.26	....	8.74	....	7,312
June	91.24	91.24	91.20	91.22	....	8.78	....	5,582
Sept	91.21	91.20	91.17	91.19	....	8.81	....	5,040
Dec	....	....	....	91.09	....	8.91	....	3,845
Mr02	91.13	91.13	91.13	91.14	....	8.86	....	2,689
June	....	....	....	91.10	....	8.90	....	2,704
Sept	91.06	91.06	91.06	91.08	....	8.92	....	2,016
Dec	90.97	90.97	90.97	91.00	....	9.00	....	1,341
Mr03	91.01	91.03	91.01	91.04	....	8.96	....	1,589
June	90.97	90.97	90.97	91.00	....	9.00	....	1,367
Sept	90.85	90.98	90.95	90.98	....	9.02	....	1,354
Dec	90.85	90.88	90.85	90.89	- .01	9.11	+ .01	1,227

Est vol 437,328; vol Thur 615,913; open int 2,576,727. +17,451.

A.1 Terminology

Amount: A Eurodollar futures contract involves a face amount of USD 1 million. To hedge USD 10 million, we need 10 futures contracts.

Duration: Duration measures the time at which cash flows take place.
• For money market instruments, CFs generally take place at the maturity of the instrument.

A 6-mo. deposit has approximately twice the duration of a 3-mo. deposit.
$\Rightarrow$Value of 1 bp for 6-mo. is approximately USD 50.

Hedge a USD 1 million six-month deposit beginning in March with:
(1) 2 March Eurodollar futures (*stack hedge*).
(2) 1 March Eurodollar futures and 1 June Eurodollar futures (*strip hedge*).

Slope: Eurodollar contracts may be used to hedge other interest rate assets and liabilities. The rates on these instruments are not expected to change 1-for-1 with Eurodollar interest rates.

• Let f be the interest rate in an Eurodollar futures contract, then

slope = Δ underlying interest rate / Δ f. (think of *delta* = change)

• If the rate of change of T-bill rates with respect to Eurodollar rates is .9 (slope = .9), then we only need nine Eurodollar futures to hedge USD 10 million of three-month T-bill.

• F_A: face amount of the underlying asset to be hedged
D_A: duration of the underlying asset to be hedged.
n: number n of Eurodollar futures needed to hedge underlying position

$$n = (F_A/1{,}000{,}000) \times (D_A/90) \times \text{slope}.$$

Example: To hedge USD 10 million of 270-day commercial paper with a slope of .935 would require approximately twenty-eight contracts.

Margin: Eurodollar futures require an initial margin. In September, this was typically USD 800 per contract; maintenance margin was USD 600.

● Q: Who uses Eurocurrency futures?
A: Speculators and Hedgers.

• Hedging
Short-term interest rates futures can be used to hedge interest rate risk:

- You can lock future investment yields (Long Hedge).
- You can lock future borrowing costs (Short Hedge)

A.2 Eurodollar Strip Yield Curve and the IMM Swap

• Successive Eurodollar futures give rise to a strip yield curve.

March future involves a 3-mo. rate: begins in March and ends in June.

June future involves a 3-mo. rate: begins in June and ends in September.

→ This strip yield curve is called *Eurostrip*.

Note: If we compound the interest rates for four successive Eurodollar futures contracts, we define a one-year rate implied from four 3-mo. rates.

• A *CME swap* involves a trade whereby one party receives one-year fixed interest and makes floating payments of the three-months LIBOR.

CME swap payments dates: same as Eurodollar futures expiration dates.

Example: On August 15, a trader does a Sep-Sep swap.
Floating-rate payer makes payments on the third Wed. in Dec, and on the third Wed. of the following Mar, June, and Sep.

Fixed-rate payer makes a single payment on the third Wed. in Sep.¶

Note: Arbitrage ensures that the one-year fixed rate of interest in the CME swap is similar to the one-year rate constructed from the Eurostrip.

Application: Pricing Short-Dated Swaps

• Swap coupons are routinely priced off the Eurostrip.

Key to pricing swaps: The swap coupon is set to equate the present values of the fixed-rate side and the floating-rate side of the swap. Eurodollar futures contracts allow you to do that.

• The estimation of the fair mid-rate is complicated a bit by:
(a) the convention is to quote swap coupons for generic swaps on a semiannual bond basis, and
(b) the floating side, if pegged to LIBOR, is usually quoted money market basis (for consistency, we will assume that the swap coupon is quoted bond basis).

Notation: If the swap is to have a tenor of m months (m/12 years) and is to be priced off 3-mo Eurodollar futures, then pricing will require n sequential futures series, where n=m/3 or equivalently, m=3n.

Example: If the swap is a six-month swap (m=6), then we will need two future Eurodollar contracts.

• Procedure to price a swap coupon involves three steps:

i. Calculate the implied effective annual LIBOR for the full duration (full-tenor) of the swap from the Eurodollar strip.

$$r_{0,3n} = \prod_{t=1}^{n} [1 + r_{3(t-1),3t} \frac{A(t)}{360}]^{\tau} - 1, \qquad \tau = 360/\Sigma A(t)$$

ii. Convert the full-tenor LIBOR, which is quoted on money market basis, to its fixed-rate equivalent $FRE_{0,3n}$, which is stated as an annual effective annual rate (annual bond basis).

$FRE_{0,3n} = r_{0,3n}$ x (365/360).

iii. Restate the fixed-rate equivalent on the same payment frequency as the floating side of the swap. The result is the swap coupon SC. This adjustment is given by

$SC = [(1 + FRE_{0,3n})^{1/k} - 1] \times k$, k=frequency of payments.

Example: It's October 24, 1994. Housemann Bank wants to price a one-year fixed-for-floating interest rate swap against 3-mo LIBOR starting on December 94.

Fixed rate will be paid quarterly (quoted quarterly bond basis).

TABLE 21.A

Eurodollar Futures, Settlement Prices (October 24, 1994)

	Price	Implied 3-mo. LIBOR	Notation	Number of Days Covered
Dec 94	94.00	6.00	0 x 3	90
Mar 95	93.57	6.43	3 x 6	92
Jun 95	93.12	6.88	6 x 9	92
Sep 95	92.77	7.23	9 x 12	91
Dec 95	92.46	7.56	12 x 15	91

Housemann Bank wants to find the fixed rate that has the same present value as four successive 3-mo. LIBOR payments.

(1) Calculate implied LIBOR rate using (i).
Swap is for twelve months, n=4.

$f_{0,12} = [(1+.06x(90/360)) \times (1+.0643x(92/360)) \times (1+.0688x(92/360))x(1+.0723x(91/360))]^{360/365} - 1 = =$ .06760814 (money market basis).

(2) Convert this money market rate to its effective equivalent stated on an annual bond basis.

$FRE_{0,12}$ = .06760814 x (365/360) = .068547144.

(3) Coupon payments are quarterly, k=4. Restate this effective annual rate on an equivalent quarterly bond basis.

$SC = [(1.068547144)^{1/4} - 1] \times 4 = .0668524$ (quarterly bond basis)

→ The swap coupon mid-rate is 6.68524%. ¶

Example: Go back to the previous Example. .
Now, Housemann Bank wants to price a one-year swap with semiannual fixed-rate payments against 6-month LIBOR.

The swap coupon mid-rate is calculated to be:

$SC = [(1.068547144)^{1/2} - 1] \times 2 = .06741108$ (semiannual bond basis). ¶

Note: A dealer can quote swaps having tenors out to the limit of the liquidity of Eurodollar futures on any payment frequency desired.

CHAPTERS 20 & 21 – BRIEF ASSESMENT

1. Cammy Co., a U.S. firm, needs funding for the next 90 days. It's planning to borrow 80% from a Swiss bank and the remaining 20% from a Brazilian bank. The forecasts of the appreciation (against the USD) of the Swiss franc (CHF) and the Brazilian real (BRL) for the next three months are as follows:

Currency	Possible e_f	Probability
CHF	0%	.50
CHF	2%	.50
BRL	4%	.80
BRL	8%	.20

The three-month borrowing rates are: 2% in CHF, 6% in BRL, and 2% in USD. Calculate the effective cost of funds of the overall portfolio. Would you advise Cammy Corp. to borrow abroad or at home? (Justify your answer, considering borrowing in CHF deposit only, BRL only, in the above mentioned 80-20 portfolio of currencies, and in USD only.)

2. Baggy Co., a U.S. firm, has excess cash for the next 30 days. It can invest 60% from a Swedish bank and the remaining 40% from a Dominican Republic bank. The forecasts of the appreciation (against the USD) of the Swedish kroner (SEK) and the Dominican peso (DOP) for the next month are as follows:

Currency	Possible e_f	Probability
SEK	-1%	.30
SEK	0%	.70
DOP	1%	.60
DOP	2%	.40

The 1-mo deposit rates are:1% in SEK, 7% in DOP, and 2% in USD. Calculate the effective yield of the overall portfolio. Would you advise Baggy Corp. to deposit abroad or at home? (Justify your answer, considering placing the excess funds in SEK deposit only, DOP only, in the above mentioned 60-40 portfolio, and in USD only.)