Measuring FX Exposure

Transaction Exposure 1

FX Risk Management

- **FX Exposure: Review**
- At the firm level, currency risk is called *exposure*.

- TE is simply to calculate: Value in DC of a specific transaction wit a certain date/maturity denominated in FC.

- We can measure TE, and analyze the sensitivity of TE to changes in S_t.
  - Use a statistical distribution or a simulation.
  The less sensitive TE is to S_t, the lower the need to pay attention to $e_{f,t}$.

- MNCs have measures for NTE for:
- a single transaction
- all transactions (Netting, where co-movements of S_t's are incorporated

• The last measure approaches TE with a portfolio approach, where currency correlations are taken into account.

• Correlations: Brief Review

Recall that the co-movement between two random variables can be measured by the correlation coefficient. The correlation between the random variables X and Y is given by:

$Corr(X,Y) = \rho_{XY} = \sigma_{XY}/(\sigma_Y\sigma_Y)$.

Interpretation of the correlation coefficient ($\rho_{xy} \in [-1, 1]$):

If $\rho_{xy} = 1$, X changes by 10%, Y also changes by 10%.

If $\rho_{xy} = 0$, X changes by 10%, Y is not affected –(linearly) independent.

If $\rho_{xy} = -1$, X changes by 10%, Y also changes by -10%.

Currencies from developed countries tend to move together... But, not always!

• **Netting**

MNC take into account the correlations among the major currencies to calculate Net TE ⇒ Portfolio Approach.

A U.S. MNC: Subsidiary A with CF(in EUR) > 0
Subsidiary B with CF(in GBP) < 0
$\rho_{GBP,EUR}$ is very high and positive.
Net TE might be very low for this MNC.

• Hedging decisions are usually not made transaction by transaction. Rather, they are made based on the exposure of the portfolio.

Example: Swiss Cruises.

Net TE (in USD): USD 1 million. Due: 30 days.

Loan repayment: CAD 1.50 million. Due: 30 days.

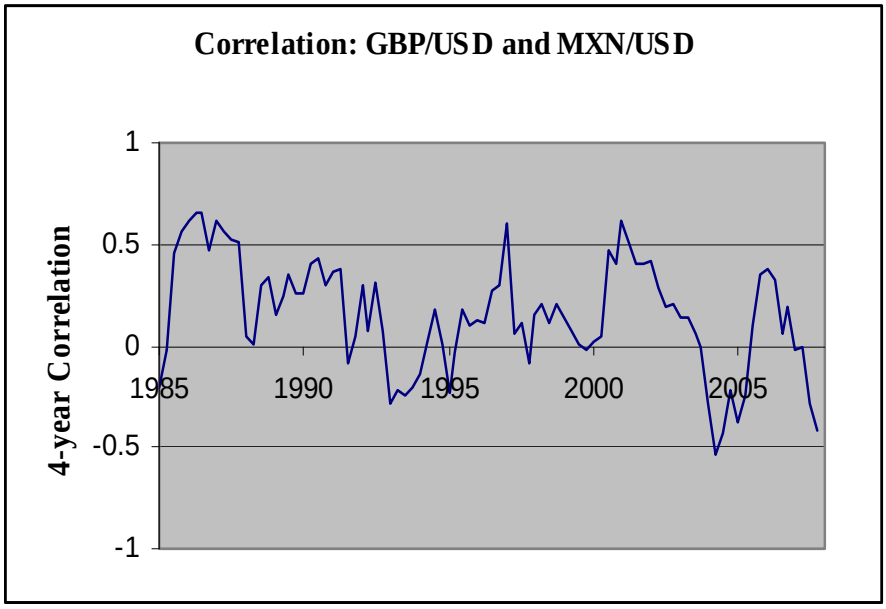
S_t = 1.47 CAD/USD.

$\rho_{CAD,USD}$ = .924 (from 1990 to 2001)

Swiss Cruises considers the Net TE (overall) to be close to zero. ¶

Note 1: Correlations vary a lot across currencies. In general, regional currencies are highly correlated. From 2000-2007, the GBP and EUR had an average correlation of .71, while the GBP and the MXN had an average correlation of -.01.

Note 2: Correlations also vary over time.



● **Sensitivity Analysis for portfolio approach**

Do a simulation: assume different scenarios -- attention to correlations!

Example: IBM has the following CFs in the next 90 days

FC	Outflows	Inflows	S_t	Net Inflows
GBP	100,000	25,000	1.60 USD/GBP	(75,000)
EUR	80,000	200,000	1.05 USD/EUR	120,000

NTE (USD)= EUR 120K*1.05 USD/EUR+(GBP 75K)*1.60 USD/GBP
= USD 6,000 (this is our baseline case)

Situation 1: Assume $\rho_{GBP,EUR} = 1$. (EUR and GBP correlation is high.)
Scenario (i): EUR appreciates by 10% against the USD ($e_{f,EUR,t} = .10$).
S_t = 1.05 USD/EUR * (1+.10) = 1.155 USD/EUR
Since $\rho_{GBP,EUR} = 1 \Rightarrow S_t$ = 1.60 USD/GBP * (1+.10) = 1.76 USD/GBP

NTE (USD) =EUR 120K*1.155 USD/EUR+(GBP 75K)*1.76 USD/GBP
= **USD 6,600** (10% change.)

Example (continuation):
Scenario (ii): EUR depreciates by 10% against the USD ($e_{f,EUR,t}$=-.10).
S_t = 1.05 USD/EUR * (1-.10) = 0.945 USD/EUR
Since $\rho_{GBP,EUR}$ = 1 $\Rightarrow$ S_t = 1.60 USD/GBP * (1-.10) = 1.44 USD/GBP

NTE (USD)=EUR 120K*0.945 USD/EUR+(GBP 75K)*1.44 USD/GBP
= **USD 5,400**. (-10% change)

Now, we can specify a range for NTE
$\Rightarrow$ NTE $\in$ **[USD 5,400, USD 6,600]**

Note: The NTE change is exactly the same as the change in S_t. If a firm has matching inflows and outflows in highly positively correlated currencies –i.e., the NTE is equal to zero-, then changes in S_t do not affect NTE. That's very good.

Example (continuation):
Situation 2: Suppose the $\rho_{GBP,EUR}$ = -1 (NOT a realistic assumption!)
Scenario (i): EUR appreciates by 10% against the USD ($e_{f,EUR,t}$= .10).
S_t = 1.05 USD/EUR * (1+.10) = 1.155 USD/EUR
Since $\rho_{GBP,EUR}$ = -1 $\Rightarrow$ S_t = 1.60 USD/GBP * (1 – .10) = 1.44 USD/GBP

NTE (USD)= EUR 120K*1.155 USD/EUR+(GBP 75K)*1.44 USD/GBP
= **USD 30,600**. (410% change)

Scenario (ii): EUR depreciates by 10% against the USD ($e_{f,EUR,t}$=-.10).
S_t = 1.05 USD/EUR * (1-.10) = 0.945 USD/EUR
Since $\rho_{GBP,EUR}$ = -1 $\Rightarrow$ S_t = 1.60 USD/GBP * (1+.10) = 1.76 USD/GBP

NTE (USD)=EUR 120K*0.945 USD/EUR+(GBP 75K)*1.76 USD/GBP
= **(USD 18,600).** (-410% change)

Now, we can specify a range for NTE
$\Rightarrow$ NTE $\in$ **[(USD 18,600), USD 30,600]**

Example (continuation):

Note: The NTE has ballooned. A 10% change in exchange rates produces a dramatic increase in the NTE range.

$\Rightarrow$ Having non-matching exposures in different currencies with negative correlation is very dangerous.

• Considerations for IBM

IBM can assume a distribution (say, bivariate normal) with a given correlation (estimated from the data) and, then, draw many scenarios for the S_t's to generate an empirical distribution for the NTE. From this simulated distribution, IBM will get a range –and a VAR- for the NTE.

IBM can assume a correlation from the ED and, then, jointly draw –i.e., draw together a pair, $e_{f,GBP,t}$ & $e_{f,EUR,t}$– many scenarios for S_t to generate an empirical distribution for the NTE.

From this ED, IBM will get a range –and a VaR- for the NTE. ¶