Overview

- Measuring Economic Exposure to FX Risk
  Regression Approach: Sensitivity of the firm’s MV to FX changes
  Scenario Approach: “What if?” analysis
  Value-at-Risk (VAR): With 95% probability, how much might our portfolio change in value in a day, a week, or a month?

- Limitations in estimating economic exposure
  What assumptions are we making?
  Can the approach be implemented? By whom?
The Concept of Economic Exposure (1 of 2)

- $\frac{\partial MV}{\partial S}$ reflects economic exposure of the firm.
  Because $MV=NPV$ of all future CF, if an FX change impacts any CF, this represents exposure.
- Economic exposure is a very broad concept involving
  - The firm: Including production and marketing operations
  - Its products: Whether the products are highly differentiated with low price elasticity of demand, or generic products with a high price elasticity
  - The industry: Whether it is highly competitive vs. oligopolistic, worldwide vs. local, with high or low barriers to entry.

The Concept of Economic Exposure (2 of 2)

- The channels of economic exposure include
  - The firm’s customers, suppliers and competitors
    There can be direct as well as indirect sources of exposure
- Economic exposure may be different in the short-run vs. the long-run
  - In the short-run, the firm has less flexibility to change its prices, production process, and products
  - In the long-run, the firm has more flexibility to change its prices, production process, and products. Plus, exchange rate changes are more likely to be offset by local price changes (Purchasing Power Parity)
The Regression Approach

- The regression approach directly measures the exposure of a firm to exchange rate changes by estimating the relationship between the firm’s market value at time $t$ ($MV_t$) and the spot rate ($S_t$) using the equation:

$$MV_t = a + b S_t + e_t$$

Units: $MV$ ($\), $a$ ($\), $b$ ($\), $S$ ($\$/£), $e$ ($\)

- The coefficient $b$ measures the sensitivity of the market value of the firm to the exchange rate.

Examples of the Regression Approach
Interpreting Regression Results

To interpret the regression analysis, three results need to be examined:

1. The magnitude of $b$.
   - $b > 0$ an asset exposure in the foreign currency
   - $b < 0$ a liability exposure
   - $b = 0$ no exposure to the exchange rate

2. The $t$-statistic of $b$.
   - Statistical significance is necessary for confidence in the results.

3. The $R^2$ of the regression.
   - $R^2$ measures the percentage of variation in the market value explained by the exchange rate.

A Numerical Regression Example

$MV_t = a + b S_t + e_t$

Partial Results

$b = 5.093 (1.464) t=3.5$

$R^2 = 0.416$
The Regression Approach - Extensions

- To measure the firm’s exposure to multiple exchange rates, a multiple regression can be estimated:
  \[ MV_t = a + b_1 S_{S/E},t + b_2 S_{S/£},t + b_3 S_{S/¥},t + e_t \]
- If the firm has data on cash flows at the level of a subsidiary or project, the exposure of these smaller units can also be measured:
  \[ CF_t = a + b S_t + e_t \]

The Scenario Approach

- Given a scenario, we can estimate the firm’s cash flows (and its market value) conditional on an exchange rate path.
- The scenario approach is well suited to a spreadsheet analysis where one is encouraged to ask a variety of “what-if” questions.
  Best case, worst case, most likely case, etc.
- “What if” regarding the time path of
  - Exchange rates
  - Sales volumes
  - Prices paid for inputs
  - Prices received for outputs
Consider the impact of a permanent 5% appreciation of the US$, holding all other factors constant.

The slope measures the exposure of the firm at the initial exchange rate.

Suppose the firm can pass along part of the exchange rate change to its Australian customers.

The slope of BOB* is flatter than AOA* since the firm has less exposure now.
The Value at Risk (VAR) Approach

- The “Wrong Question”: How much could I lose on a single day? (EVERYTHING!!)
- The “Right Question”: What is the most I could lose on a single day with 95% (or 90% or 99% or ...) confidence that I will not lose more than that amount?
- Assuming normal price distributions, calculate the loss in value of the portfolio if an unlikely (say, 5% chance) adverse price movement occurs.
- The result of this calculation is the value at risk (VAR)

What value could the future spot rate take with 5% probability?

![Graph showing the probability distribution of the $/£ spot rate with two different standard deviations](image)
Assumptions and Features of VAR

- VAR is a probability statement about the potential change in value of a portfolio resulting from changes in market factors over a specified period of time.
- VAR depends on the underlying probability distribution of market factors.
- VAR requires estimates of variance and correlation of underlying market price changes.
- VAR increases with the length of the time period (increases with the √time).
- Check VAR example in Box 16.5 + Discussion Board

Limitations in the Regression Approach

- Using market data presumes that financial markets are efficient, and that share prices respond quickly and appropriately to exchange rate changes.
- The regression approach produces estimates that are subject to estimation error.
- For the exposure coefficient to be useful, the relationship between spot rate changes and MV must remain stable in the future. Many things could change.
- The approach is unsuitable for newly organized or reorganized firms for which there is not a large sample of consistent observations.
Limitations in the Scenario Approach

- The number of scenarios is infinite
  Analyze likely, plausible scenarios
  Analyze unlikely, implausible scenarios (Stress testing)
  Analyze rudimentary or complex scenarios?
  How to aggregate information across scenarios?
- Draws on firm specific information
  Price elasticity of demand for outputs
  Price over cost mark-up
- Draws on industry specific information
  What will competing firms do?
  Exploit price advantages for market share, profit, R&D, etc.

Limitations in the VAR Approach

- Statistical parameters must be estimated
  (volatility of asset returns $\sigma$, correlation among asset returns $\rho$)
  Can use historical or implied methods to estimate these
- Assumption about normality of underlying distribution of price changes
  Market prices may experience abnormal jumps
- Market policies may be subject to abnormal shifts (new President, Congress, Fed chairman)
Empirical Evidence on Firm Profits, Share Prices, & Exchange Rates

- During the Bretton Woods pegged-rate period, the general stock market index tended to move up (down) immediately after a devaluation (revaluation) of the local currency.

- Studies also indicated that exposure coefficients vary from firm to firm within the same industry and over time, and that exchange rate changes can have a substantial impact on the overall economy.

Summary on Exposure Measurement

- Exposure seeks to estimate $\frac{\partial MV}{\partial S}$
- Task is complex and data intensive
  - Regression: Past equity market values and spot FX rates
  - Scenario: Prices and quantities determine cash flows
  - VAR: Mean, volatility and correlation of asset returns
- Each technique produces an estimate that depends on various assumptions
- Exposures are likely to be smaller in the long-run than in the short-run
  - Because of PPP, International Fisher Effect, and competitive forces across firms