AcF305:
International Financial and Risk Management
Week 7

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Outline of Lecture 7

- Essential reading: Chapters 12 & 13 of Sercu (2009).
- Topics:
  - Why hedging may have an effect on firm value?
  - How can adding a zero-value contract increase the value of the company?
  - What are the different forms of economic risk exposure? How are they defined?
  - Is exposure always linear? How do non-linear exposures arise? How can we hedge non-linear exposures? Are these hedges effective?

Why Hedging Might Have an Impact on Firm Value

- What we know from empirical research:

  1. Purchasing power parity does not hold in the real world:
     Example: A U.K. firm buys steel from a U.S. firm on a regular basis.
     What happens if USD appreciates and
     … PPP holds: no exposure to real exchange-rate risk.
     … PPP does not hold: exposure to real exchange-rate risk.
  2. Exchange rates are notoriously difficult to predict.

- The failure of the purchasing power parity creates exchange rate risk for companies, which can be hedged.

Why Hedging Might Have an Impact on Firm Value

- BUT: How can a zero-value contract (like a forward contract) increase shareholder value?
  - A company should only accept positive NPV projects.
  - A forward contract seems initially like a zero NPV project.

- It ignores the impact that hedging has on the other cash flows of the firm.

- We will now discuss how hedging may reduce:
  - the expected cost of financial distress
  - the firm's reliance on (costly) external financing
  - the expected compensation to corporate stakeholders
  - the expected tax liability

Bankruptcy and financial distress costs

- Hedging reduces the expected cost of financial distress
  - The expected cost of financial distress is
    the actual cost of financial distress × the probability of financial distress
  - Hedging lowers the probability of financial distress

- Example: UBISOFT needs to repay USD 140m in debt at time T.
  - At time T, the market value depends on 2 scenarios of S_T and equals:

$$\widetilde{MV}_T = \begin{cases} \text{USD 200m with prob = 0.50} \\ \text{USD 100m with prob = 0.50} \end{cases}$$

  - When bankrupt, the company pays USD 50m in fees → expected time-T market value equals 0.5 * 200 + 0.5 * (100 – 50) = USD 125m.
  - Assume now that UBISOFT hedges, so that market value at T = USD 150m (i.e. company never goes bankrupt).

A firm is distressed when income does not cover fixed expenses

(Costly) external financing

• Hedging makes a firm less reliant on costly external financing, which leads to a more efficient investment policy

- External financing can be costly

- Managers may skip value-enhancing investment opportunities if there are insufficient internal funds

- Hedging can ensure availability of internal funds

Compensation to corporate stakeholders

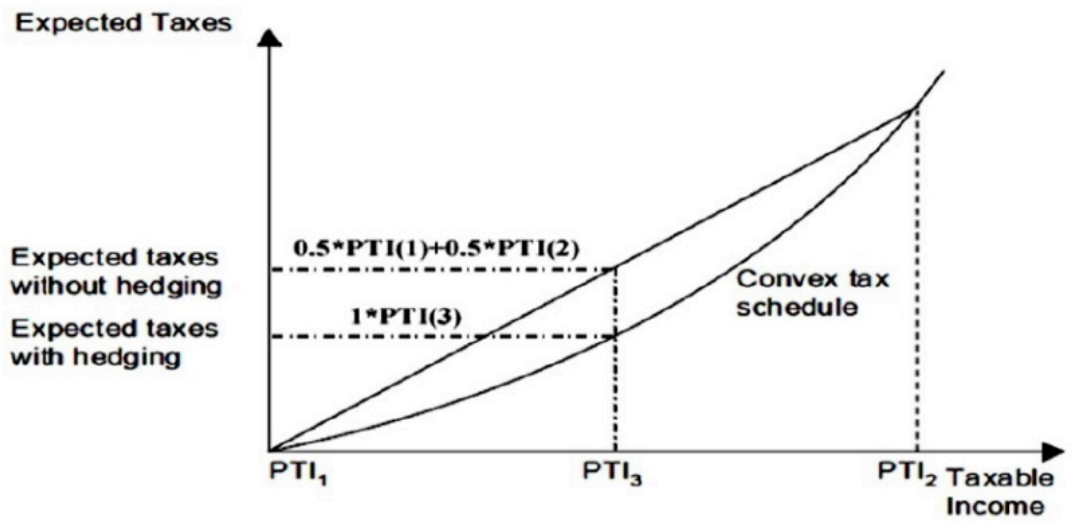
- Hedging reduces expected compensation to corporate stakeholders
  - Remember: Managers act as agents on behalf of the firm shareholders
  - There can be a conflict of interests: wages and bonus plans make managers wealth depend on firm performance
  - Managers can then…
    1. Reject risky, but potentially positive NPV projects
    2. Demand higher wages to compensate for risk
    3. Hedge away the excess risk of the firm

Expected tax liability

- Hedging lowers the expected tax bill
  - In most cases, the amount of tax paid is a convex function of the profit (due to progressive tax regime)
  - Hedging lowers pre-tax income volatility
  - Therefore, risk management adds value by ensuring that taxable income falls within the optimal tax rate band
  - Furthermore, hedging increases debt capacity and allows for exploiting the tax shield more heavily

Expected tax liability

- Whenever tax schedules are convex, hedging reduces the tax burden:



Interaction between hedging and other cashflows

- Other (more minor) reasons:
  - Might enhance the quality of internal decision-making. Cashflows are less uncertain, and manager can make better decisions
  - By eliminating uncertainties, we can better see the quality of decisions made by the firm
    - *Underlying argument:* Non-core risks (e.g. exchange or interest rate risk) make it hard to assess how well the firm performs in its core business.

Currency risk: definitions

- Distinction between *exchange rate risk* and *exposure*:
  - **Exchange risk**: Uncertainty about future spot exchange rate.
  - **Exposure**: Change in HC value of asset or cash flow scaled by change in the exchange rate, i.e. $B_{t,T} = \Delta V_T / \Delta S_T$
    → By which percentage does V_T change for a change in S_T?

- What does V_T stand for? It is the home currency value of 3 types of exposure
  1. Net contractual cash flows in FC maturing at T (contractual exposure).
  2. Future (= not yet contracted) cash flows (operating exposure).
  3. Accounting exposure (translation exposure).

Currency risk: definitions

- **Economic exposure** = contractual + operating exposure
  - Economic exposure affect firm HC cashflows

- Each type of exposure can be hedged.

- How can we hedge economic exposure?

The Effectiveness of Hedging Contractual Exposures

• *Example:* An Italian firm, Viticola, which exports its fine wines to the U.S. Viticola extends 3 months credit to its U.S. customers. To reduce its exchange rate exposure, it can:

1. Sell in U.S. dollars and immediately hedge with a forward, which implies zero exposure to changes in *St* over *these* 3 months on *this* contract.

   BUT: Cash flows negotiated in 3-month time (i.e. next time) depend on changes in *S* over initial three months. Even perfect hedging of contractual exposure does not reduce the long-run variability of cash flows

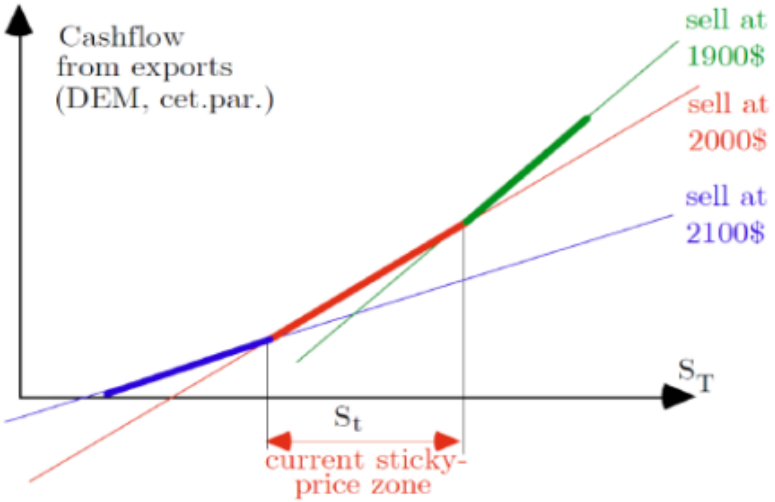
2. Invoice in EUR: Alleviates contractual exposure, but will lead to changes in demand

Hedging "Likely" Cash Flows

- An implication: Exposure is no longer linear in the exchange rate:

  $V_T = B_{t,T} S_T$ has to be replaced with $V_T = f_{t,T}(S_T)$

- *Example:* VW exports cars to the United States:
  1. At the prevailing exchange rate, VW asks USD 2,000 for each car.
  2. When exchange rate (DEM/USD) ↑, VW could decrease USD prices to steal business from U.S. competitors *if this is better than the status quo*.
  3. When exchange rate (DEM/USD) ↓, VW could increase USD prices to stabilize its DEM profit *if this is better than the status quo*.



Operating Exposure Comes in All Forms

- Operating exposure arises from the effect of exchange rate changes on future cash flows which are not yet contracted.

- Contrary to intuition, operating exposure also impacts:

  - Companies which invoice only in their HC (through quantity demanded).

  - Companies without any foreign business (through other firms); these other firms could be foreign exporters (see DanskWool from Week 6)

Technical Details

- Let asset value ($V_{T,s}$) depends on (a) the exchange rate and (b) other factors (e.g. business conditions):

$$\begin{aligned}\tilde{V}_{T,s} &= A_{t,T} + B_{t,T}\tilde{S}_{T,s} + \tilde{\varepsilon}_{t,T,s} \\ &= \underbrace{A_{t,T} + \tilde{\varepsilon}_{t,T,s}}_{\text{uncorrelated with } \tilde{S}} + \underbrace{B_{t,T}\tilde{S}_{T,s}}_{\text{linear in } \tilde{S}}\end{aligned}$$

- Hedging exchange rate risk eliminates $B_{t,T}S_{T,s}$, but it cannot eliminate $A_{t,T} + \varepsilon_{t,T,s}$: it's hard to hedge against broad economic conditions.

- We will learn how to hedge exchange rate risk but no economic conditions

Simple Case

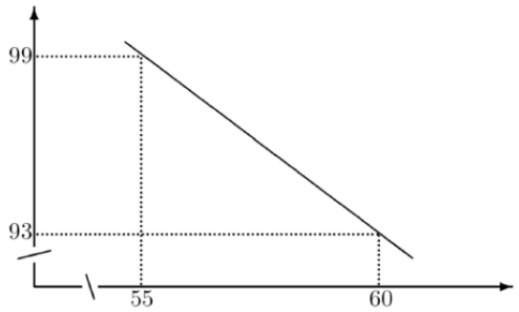
- *Example* without noise:
  - In 1992, a Belgian firm had a subsidiary in the United Kingdom.

$$\tilde{S}_T * \text{cash flow}_{\text{UK subsidiary}} = \begin{cases} 60 * 1.55\text{m} & \text{if deflationary U.K. policy} \\ 55 * 1.8\text{m} & \text{if expansionary U.K. policy} \end{cases}$$

  → Profits are thus either BEF 93m or BEF 99m.
  - In terms of the above formula:

$$93 = A_{t,T} + B_{t,T}\,60 \text{ and } 99 = A_{t,T} + B_{t,T}\,55,$$

  which means that $B_{t,T} = -1.2$.
- The firm's exposure is **NEGATIVE**.



Simple Case

- The Belgian firm now wants to hedge with a forward contract:

$$\tilde{V}_T^{Hedged} = A_{t,T} + B_{t,T}\tilde{S}_T + \tilde{\varepsilon}_{t,T} + \delta[\tilde{S}_T - F_{t,T}]$$
$$= 165 - 1.2\tilde{S}_T + \delta[\tilde{S}_T - F_{t,T}]$$

  where δ is the number (positive) or sells (negative) and [$S_T - F_{t,T}$] is the expiration value of a long forward.

- **Question**: How many forwards should the firm buy or sell?

- Assume the company would buy 1.2 forwards:

$$V_T^{Hedged} = 165 - 1.2\,S_T + 1.2[S_T - F_{t,T}] = 165 - 1.2F_{t,T}$$

  → V_T^{Hedged} does now no longer vary at time *T*: the company is perfectly hedged against exchange rate risk.

- **General rule**: Set δ to $-B_{t,T}$ to eliminate linear FC risk.

More Complicated Case with Noise

- Operating exposure is less certain than contractual exposure, as future cash flows are random (2 sources of uncertainty).

- *Example:* A U.K. firm has set up a subsidiary in a foreign country, Freedonia. When it comes to collecting cash:
  - The exchange rate is either 1.20 or 0.80 GBP/FC.
  - The Freedonian economy is either in an expansion or recession.

	boom: $CF^* = 150$	bust : $CF^* = 100$	$E(\tilde{V}_T \mid S_T)$
$S_T = 1.2$	$150 \times 1.2 = 180$	$100 \times 1.2 = 120$	$\frac{180 \times 0.15 + 120 \times 0.35}{0.15 + 0.35} = \text{GBP } 138$
probability →	$p = 0.15$	$p = 0.35$	$p = 0.50$
$S_T = 0.8$	$150 \times 0.8 = 120$	$100 \times 0.8 = 80$	$\frac{120 \times 0.35 + 80 \times 0.15}{0.35 + 0.15} = \text{GBP } 108$
	$p = 0.35$	$p = 0.15$	$p = 0.50$
	$p = 0.50$	$p = 0.50$	

More Complicated Case with Noise

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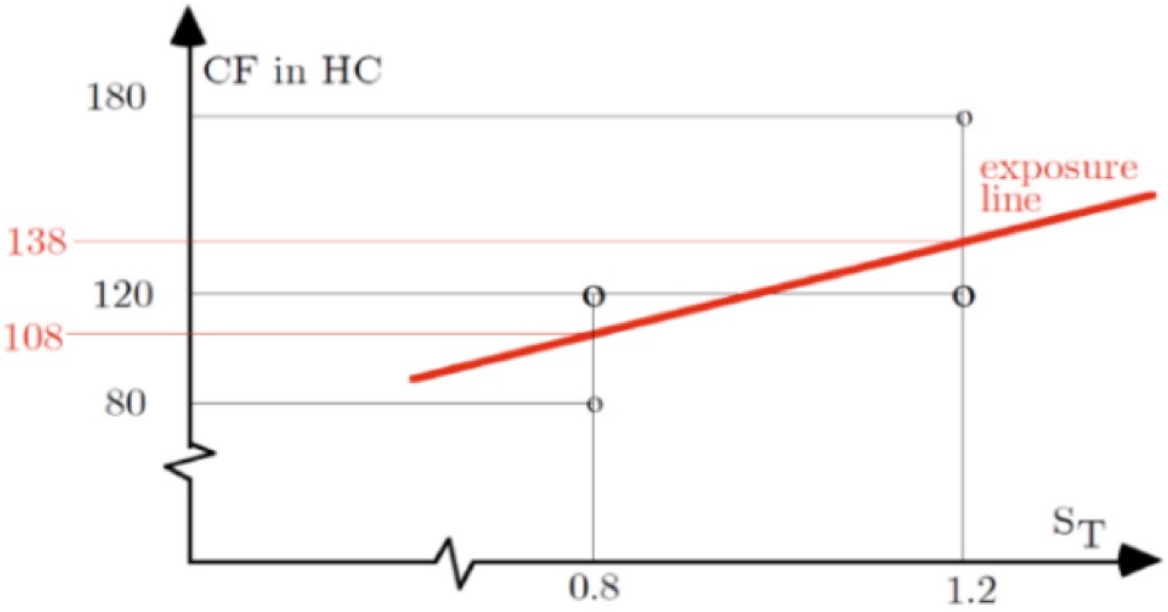
More Complicated Case with Noise



More Complicated Cases with Noise

- The expectation can be hedged in the same way as before:

$$\begin{aligned}\tilde{V}_T^{Hedged} &= E[\tilde{V}_T \mid S_T] + \tilde{\varepsilon}_{t,T} + \delta[\tilde{S}_T - F_{t,T}] \\ &= A_{t,T} + B_{t,T}\tilde{S}_T + \tilde{\varepsilon}_{t,T} + \delta[\tilde{S}_T - F_{t,T}]\end{aligned}$$

- Find $B_{t,T}$ from: 138 = $A_{t,T}$ + $B_{t,T}$ 1.2 and 108 = $A_{t,T}$ + $B_{t,T}$ 0.8, which implies that $B_{t,T}$ must be 75, and set δ to $-B_{t,T}$.

- In this case, not all risk has been eliminated (note $F_{t,T}$ = 0.96):

$S_T = 1.2$	$180 - 18 = 162$	$120 - 18 = 102$	$\frac{162\times 0.15 + 102\times 0.35}{0.15+0.35} = \text{GBP}120$
$S_T = 0.8$	$120 + 12 = 132$	$80 + 12 = 92$	$\frac{132\times 0.35 + 92\times 0.15}{0.35+0.15} = \text{GBP}120$

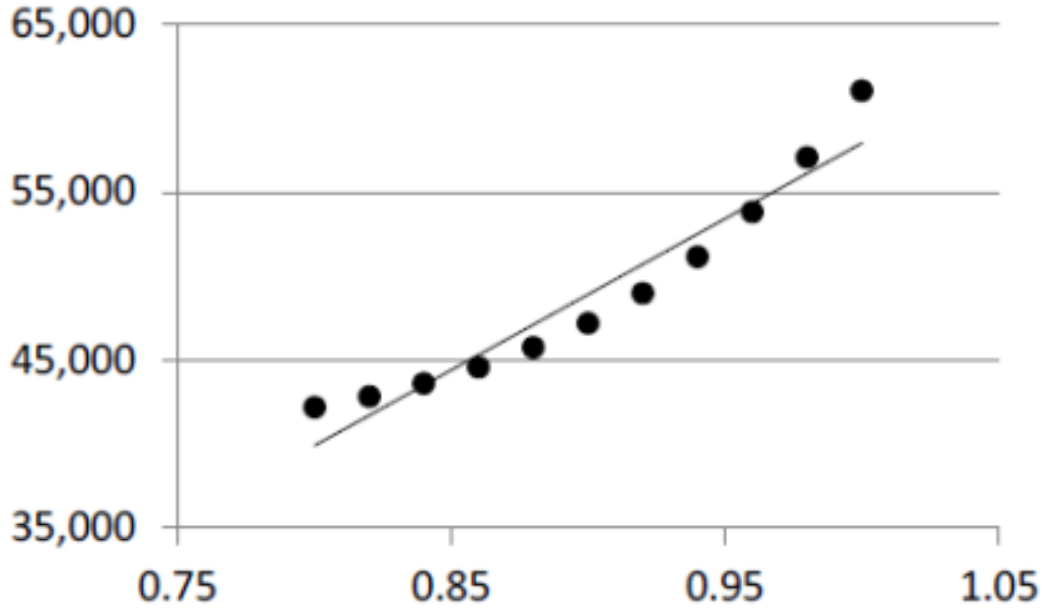
Minimum Variance Hedging in General

- In practice, there are often more than 2 or 4 scenarios, but still same problem remains: find the $B_{t,T}$ coefficient. How?
  - **Solution**: Use regression analysis, i.e. regress $V_{T,s}$ on S_T.
- In practice: EXCEL offers an easy way to implement regression analysis:

1. Decide on one column which contains all V_T values and on one which contains all S_T values.
2. Choose tools → data analysis → regression.
3. Indicate in which column the $V_{T,s}$ values are and in which column the S_T values are.
4. Click on OK and EXCEL will find $B_{t,T}$ for you.

Minimum Variance Hedging in General

- An example of a linear regression line with hypothetical data



Practical Problems of this Approach

- Implementation of regression analysis is easy; the complicated part is to collect the values for $V_{T,S}$ and for S_T:

  1. Simply download past data.

     - **Several problems**: (1) assumption that past is like future, (2) statistical estimation error, (3) problem of unit roots (you must run regression on returns).

  2. Alternative scenarios for future cash flows.

     - In principle, this makes more sense, **BUT** estimate only as good as numbers you obtain from Marketing & Operations.

Practical Problems of this Approach

- Other considerations:
  - If you use scenarios, you need to know the probability of each pair of $V_{T,s}$ and S_T combinations showing up.
  - Also consider R^2: check how much of the variability in $V_{T,s}$ is captured by your hedge
    → use non-linear hedge?
  - Hedge against other risks (oil price risk), too?

    → If yes, then use a multiple regression equation:

$$\tilde{V}_{T,s} = A_{t,T} + B_{t,T}\tilde{S}_{T,s} + C_{t,T}\tilde{oil}_{T,s} + \tilde{\varepsilon}_{t,T,s}$$

Summary, Homework and Additional Reading

- **In this lecture**, we dealt with:

  – Different forms of exposure: contractual exposure, operating exposure and translation exposure.

  – Non-linear exposures arising from cash flow uncertainty and behaving optimal. We argued that these non-linear exposures are hard to hedge in the real world.

- **At home**, you will need to cover:

  – Tutorials: solve exercises