

Risk Management

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CHAPTER FIVE: Risk Handling Techniques: Diversification and Hedging

Textbooks:

Introduction to Risk Management and Insurance, by M. Dorfman and D. Cather, 10th edition, Prentice Hall.
Lecturer Handouts, Book Chapters

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Risk Bearing Institutions

- Bearing risk collectively
- Diversification
 - Diversify risk by combining a large number of exposure units in a risk group.
- Examples:
 - Pension Plans
 - Mutual Funds:

For a mutual fund, the exposure units are the various assets, mainly securities, purchased to meet the objectives of the fund

Insurance Companies



Additional Benefits

- Professional management
- Administrative Services
- Investment in Information
- Investment in Infrastructure



State of the Economy Table

- Shows returns in different situations with associated probability
- Can calculate E[R] and S again of investments given the different states of the economy
- Note that this is a discrete probability distribution



Creating a Portfolio

• What matters is interrelationship between investments across different states of the economy:

$$COV = P_{i} \sum_{i=1}^{n} (r_{A} - E[r_{A}]) * (r_{B} - E[r_{B}])$$



Correlation Coefficient - 1

• A number that tells us whether two investments are statistically dependent:





Correlation Coefficient - 2

- $-1 \leq \rho \leq +1$
- Implications:
 - Positive correlation
 - Negative correlation
 - Uncorrelated



Covariance & Correlation

Covariance

how random variables move in relation to each other

• Correlation coefficient

a numeric ratio of covariance compared to standard deviation

• Positive correlation,

greater than zero-variables move in the same direction

• Negative correlation

less than zero-variables move in opposite directions

• Zero correlation

statistical independence, e.g., the relationship between fires and traffic accidents



Diversification Again

A risk pool is a group of individuals or entities that come together to share and spread risk. The idea is to combine the risks of all members, reducing the financial impact of any one member experiencing a significant loss. This concept is commonly used in insurance, where policyholders pay premiums into a collective pool. If any policyholder experiences a covered loss, the pool provides compensation, thereby distributing the financial burden across all members.

TABLE 5-4 The Standard Deviation in Risk Pools with Independent and Positively Correlated Losses (in dollars)

Size of Pool	1	2	4	<u>1</u> 00	10,000	Infinite
Independent	<u>30,0</u> 00	<u>21,213.</u> 20	15,000	3,000	300	0
Correlation $= 0.1$	30,000	22,248.59	17,102.63	9,904.54	9,491.10	9,486.83

With a larger pool, individual risks are spread across more participants, reducing the impact of any single event on the total risk. This leads to a reduction in the overall standard deviation, making the outcomes more predictable and stable. This phenomenon is often referred to as the "law of large numbers.

Impact of 0.1 Correlation: The slight positive correlation means there is some shared risk among the events, slightly reducing the effectiveness of risk pooling in lowering the standard deviation. However, the overall risk reduction remains significant with a larger pool. In summary, even with a 0.1 correlation, increasing the pool size will help reduce the standard deviation, though not as effectively as with completely independent events.



In summary, with negatively correlated events, pooling leads to a more significant reduction in standard deviation and overall risk. This makes the risk management strategy of pooling even more effective, as the negative correlation helps to stabilize outcomes.

Risk Diversification

- 1. Risk diversification with negatively correlated groups, optimal condition
- 2. Risk diversification with positively correlated groups, no opportunity
- 3. Risk diversification with uncorrelated groups, e.g., insurance risk
- 4. Risk pools with two exposure units
- 5. Risk pools with more than two exposure units, opportunity to use the law of

large numbers The law of large numbers is a statistical principle stating that as the size of a sample increases, the sample mean will get closer to the expected value or population mean.

6. Correlated loss exposures and insurance complications; some perils and

exposures are not insurable, e.g., where there is no geographic dispersion of

exposure units

In risk management, "perils" refer to specific causes or events that can lead to a loss or damage. Perils are the events or hazards that insurance policies typically cover or exclude. They are the root causes of risk that need to be identified, assessed, and managed.



Lessons

- Perfect positive correlation among risk exposures is unlikely
- Natural diversification occurs across uncorrelated risks
- Bundling negatively correlated risk exposures dramatically reduce risk, see Hedging



Hedging

"hedging" refers to the practice of taking measures to offset or reduce the risk of adverse price movements or other financial uncertainties. This is typically achieved through financial instruments such as derivatives, including options, futures, and swaps. The main goal of hedging is to protect against potential losses rather than to make a profit.

- Taking two financial positions simultaneously whose gains will offset each other.
- Hence $\rho = -1$
- Examples:
 - Currency Risk
 - Interest Rate Risk
 - Commodity Price Risk

An example of hedging in risk management is an airline company hedging against the risk of rising fuel prices.

Scenario:

Airline Company: XYZ Airlines Risk: Volatile fuel prices that could increase operational costs and reduce profitability. Hedging Strategy: XYZ Airlines decides to use futures contracts to lock in current fuel prices for the next 12 months.



Derivatives

- A financial instrument whose value is based on the value of an underlying financial asset or commodity.
- Examples:
 - Futures Contract = Order to buy or sell an asset
 later at a specified price
 - Forward Contract = Same, but not traded on an organized exchange



Derivatives - 2

- Examples:
 - Swaps = Counterparties exchange cash flows of one party's financial instrument for those of the other party's financial instrument.
 - Call option = The right, but not the obligation, to buy the underlying asset
 - Put option = The right, but not the obligation, to sell the underlying asset



- A derivative is any asset whose payoff, price or value depends on the payoff, price or value of another asset
 - Futures Contract = Order to buy or sell an asset later at a specified price
 - Forward Contract = Same, but not traded on an organized exchange
 - Call Option = gives the holder the right to buy the underlying asset at a specified price at/until a specified data
 - Put Option = give the holder the right to sell the underlying asset at a specified price at/until a specified date
 - Swaps = Counterparties exchange cash flows of one party's financial instrument for those of the other party's financial instrument.



Finally

- Risk Management at the Boardroom Level increases Consistency and Negotiating Power
- Remember: ERM is a holistic approach to risk management: Pure Risks and Speculative Risks for the firm!



	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
State of Economy	Probability	$\frac{Stock \ A \ Returns}{R_A}$	Stock B Returns R _B	$R_A - E(R_A)$	$R_B - E(R_B)$	$ Col. 2 \times Col. 5 \\ \times Col. 6 $
Growth	0.5	22	14	6	6	18.00
Recession	0.5	10	2	-6	-6	18.00
TOTALS	1.0					$36.00 = \text{Cov}_{\text{AB}}$
	s Z	6 6	\$ & . 5 	6x6xQ.5 + 3G 5X [X-(= *-6] -6=	- <i>(-</i> [+-6×0.5] 18 (8	

TABLE 5-1 Calculating the Covariance Using Data from a Probability Distribution



TABLE 5-2 Negatively Correlated Stock Returns for Stocks C and D

	Column 2	Column 3	Column 4
State of Economy	Probability	Stock C Returns (R _C)	Stock D Returns (R _D)
Growth	0.5	<u>1</u> 0	40
Recession	0.5	30	Q
TOTAL	1.0		

TABLE 5-3 Uncorrelated Stock Returns for Stocks E and F

State of Economy	Probability	Stock E Returns (R _E)	Stock F Returns (R_F)
Growth	0.33	15	9
Status quo	0.33	11	3
Recession	0.33	10	12
TOTAL	1.00		